ON MONSTERS OF THE SYMELIAN TYPE

BEING A THESIS FOR THE DEGREE OF M.D.,

by

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The specimens and dissections on which the description of the symelus is founded are in the Anatomical Museum of the University of Glasgow.

I N D E X.

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For many reasons the study of that form of monstrosity in which the inferior extremities are more or less fused has long engaged the interest and attention of teratologists. It is a comparatively rare type of monstrosity; from the earliest times up till the present less than one hundred and twenty have been recorded. This is all the more noteworthy when it is remembered that such a striking abnormality must always have excited much curiosity, and that in all probability nearly every case which has occurred has been recorded in some form or other. Taruffi states that in the course of sixty-eight years only two were sent to the University of Bologna, although the doctors of the surrounding district were in the habit of sending all the specimens of abnormalities occurring in their practice. The remarkable regularity which these monsters shew in their irregularity, as one may put it, is one of their most noteworthy features. They form a class strictly delimited from all other types of monstrosity and yet shewing amongst themselves a remarkable variety of form. The twisting or torsion which the fused limb seems to have undergone, the absence in almost every instance of external genital organs and anus, and the fact that many of these monsters have been born alive and lived

movements which occurred early in the fifth month and were felt up to the date of the confinement. As this confinement was unduly prolonged the midwife sent for Dr.Webster. On examination the presenting hydrocephalic head was found filling up the whole pelvis. The child was delivered with forceps without much difficulty; the cord was pulsating and the child made a few abortive attempts to breathe and moved a little, but soon the heart stopped. A serious haemorrhage caused all attention to be directed to the mother for some time, so that no attempt was made to carry on artificial respiration to resuscitate the child. The mother assigned no cause for the occurrence of the monster's birth, no history of maternal impression being elicted in this case as in so many similar cases. No history of monstrous births on the paternal side could be discovered, but the patient's mother was reported to have had a "cat-faced" baby, probably an anencephalic monster.

General. The monster was hydrocephalic but seemed well nourished, with, as was afterwards found on dissection, plenty of subcutaneous fat. With the exception of the hydrocephalus the whole of the upper part of the monster to the level of the fold of the groin was normal. The external characteristics are well shown in the photographs, for which I am much indebted to Dr.Manson. The two lower limbs were fused along their whole length

length, and projected forwards with a slight convexity backwards. (Photo.Fig. II). The posterior aspect of the fused limbs was convex from side to side, the anterior aspect was flattened with a slight groove running down the middle indicating the line of fusion. The patellae could be seen and felt on the outer aspects of the fused limbs, and the lower leg portion of the limb could be flexed forwards on to the upper thigh portion. The feet projected forwards almost at right angles to the conjoined limbs.. They were fused along their outer border, and the soles were turned forwards, so that in each foot the big toe was most external (Photo.Fig. I + II).

Each foot carried five distinct toes, the little toes in each foot being adjacent to one another, but not fused with one another, there being a distinct notch between them. All the toes carried well developed nails. There were no signs of external generative organs or anus. Posteriorly in the gluteal region there was a small dimple with some furrows radiating from it as if indicating an attempt at the formation of an anus. Above this was a small button-like projection about 2 c.m.long, soft and moveable, and evidently overlying a projection backwards of the spinal column in this region. The total length from vertex to heel was about 90 c.m.; the length of the fused limbs from the anterior fold of the groin to the tip of the foot was about 35 c.m. The weight was about 5 lbs. The umbilical cord shewed

Vid. Fig. III

shewed one artery and two veins. The placenta was not available for examination.

OSSEOUS SYSTEM.

Vertebral Column. Cervical Region. In the cervical region seven vertebrae were present. The second and third were partially fused with one another, all the others were free.

Thoracic. In the thoracic region twelve vertebrae were present. The first vertebra was free, the second was partially fused with the third, the third and fourth were almost completely fused, the fourth, fifth and sixth were completely fused with one another as were also the seventh, eighth and ninth, while the tenth, eleventh and twelfth were all free.

Lumbar. Five complete free lumbar vertebrae were found.

Sacrum. The right half of the first sacral vertebra was absent. Four foramina presented in the left side, the first being between the first half vertebra and the second vertebra, the corresponding foramen was absent in the right side, there being only three foramina on this side. The fourth left sacral foramen

foramen was exceedingly small with a very tiny nerve issuing from it, whilst the third foramen in the right side was large and the nerve issuing from it was grooved, giving evidence of being formed by the fusion of two nerves. The second and third pieces of the sacrum were complete and distinct. The remaining parts could not be distinguished and simply consisted of a triangular piece of cartilage representing the last two pieces of the sacrum, and the coccyx. This latter part was curved back considerably so that its anterior surface looked almost directly backward. To this backward projection the button like process on the dorsum was chiefly due.

Pelvis. The changes in the pelvis were profound. The ilia were flattened and projected almost transversely outwards. The true pelvis appeared as if it had been compressed laterally. There was no subpubic angle and the ischio-pubic rami of each side were compressed together forming a keel as it were in the under aspect of the pelvis, running from the symphysis anteriorly to the conjoined ischial tuberosities posteriorly; the latter formed a massive projection in the under and posterior aspect of the pelvis. The ischial spines were absent. The thyroid foramina were present and closed by membrane, but owing to the squeezing together of the ischio-pubic bones they did not

Figs. IV + V

not lead into the pelvis anteriorly, but were so approximated, one to the other, that a probe passed into the one came out at the other; posteriorly they led at their upper part into the pelvic cavity. At the upper and inner extremity of each foramen a small canal led, on each side, into the cavity of the pelvis and conducted the obturator nerve and vessels. The floor of the pelvis was formed of a stout membrane passing across between the two iliac bones and between the fused ischii posteriorly and the symphysis pubis anteriorly, and slightly hollowed for the reception of the genital organs. The acetabular cavities were present, but instead of showing one smooth articular surface the surfaces were facetted for the pyramidal head of the femur. The fossa acetabuli was absent.

Owing to the fusion of the ischio-pubic rami and ischial tuberosities with one another there was no true exit from the pelvis, the spaces between the bones being filled up with fibrous tissue. A large opening posteriorly led out of the pelvis. This opening, homologous with the great sacro-sciatic foramina, was bounded by the fused ischial tuberosities in front, the ilia at the sides and posteriorly by the turned back end of the vertebral column. The opening was transversely oval in shape, measuring in its transverse diameter 2.5 c.m. and its antero-posterior diameter 1.75 c.m., and through it the branches

branches of the sacral plexus and the branches of the internal iliac arteries passed out of the pelvis. Through the small obturator canal mentioned above the obturator nerve passed. This canal was bounded at the outer side by a free edge of the membrane described above.. The junction of the pubis and ischium of each side with those of the opposite side obliterated the [illegible] cavity of the true pelvis, and the latter was represented solely by a small hollow or dimple in the membrane passing across between the iliac bones and filling up the interstices between the bones. In this hollow the genital organs and the termination of the large intestine lay.

Ribs. On the left side twelve ribs were present of which eight reached the sternum. The ninth costal cartilage was attached to the eighth cartilage; the last three were floating ribs, the tenth having a very long costal cartilage reaching in the abdominal wall almost to the middle line.

On the right side twelve ribs were present. The first and second were fused for the anterior half of their length and united by one costal cartilage to the sternum. The third and fourth were similarly disposed, whilst the fifth and sixth were only separate as far as their angles. The ninth costal cartilage reached the sternum, the tenth was attached to the

to the lower border of the ninth, whilst the eleventh and twelfth were floating ribs.

ernum. The sternum was found to be normal.

mora. Both femora were well developed. The head was pyramidal in shape and facetted with a deep depression at its summit for the strong ligamentum teres. There was practically no neck, the head being set almost directly on the shaft internal to the great trochanter. Owing to the rotation which had taken place in the limbs the great trochanter looked backwards as well as outwards and the small trochanter forwards and inwards.

g IV

The internal condyles were directed forwards owing to the rotation of the limbs and the tibial articular surfaces of both internal and external condyles were somewhat flattened from before backwards. Both patellae normally developed, were situated, each in the outer aspects of the conjoint limbs.

ibiae & ibulae In the leg both tibiae and fibulae were well developed, but their relative positions were considerably modified. The fibulae were most internal, being connected with one another by a thin interosseous membrane, whilst the tibiae were placed on

g. VI

on the outer side of the leg, each tibia being connected with the corresponding fibula by a strong interosseous membrane. The tibial malleolus on each side descended to a lower level than the fibular malleolus and took the form of a rounded lip articulating with that part of the tibial facet on the astragalus continued on to the neck of the latter. The fibulae articulated in a normal way with the tibiaand at the lower end the fibular malleoli almost touched the summit of the conjoint ossa calcis.

Tarsus. Owing to the rotation and fusion which had taken place in the parts of the conjoint limb the plantar aspects Fig. VI of the feet were directed forwards and the outer borders of the feet were most internal and fused with one another as far as the base of the little toe. The tarsal bones, although somewhat distorted and considerably altered in their relations, showed in the individual bones little change. The normal number of bones was present in each foot, the only fusion being that between the ossa calcis. The latter were fused along their contiguous surfaces except for a small interval on each side Ossa Calcis. distally, the free part having a groove which indicated the double nature of the bone. The conjoint bone was pyramidal Fig VI in shape with a round blunt apex projecting between the lower ends of the fibulae. The outer surfaces, which also looked somewhat

somewhat forwards bore two cartilage covered facets which articulated with the astragalus, two distinct synovial cavities being present and separated from one another by a strong interosseous ligament. Distally the bone had two distinct facets, separated by the groove mentioned above, for articulating with the cuboid bones.

Astragalus Fig VI

The astragalus lay in the outer part of each foot and was somewhat distorted. Its fibular articular surface was situated on the inner and proximal end of the bone, its tibial facet on the outer surface, whilst on the inner surface it articulated with the os calcis by two distinct facets. Distally it articulated with the scaphoid, the articulation possessing a distinct synovial cavity.

Scaphoid Cuneiform

The form and relations of the scaphoid and cuneiform bones were practically normal.

Cuboid. Fig. VI

The cuboids came very near each other in the middle line. Internally each presented a smooth groove entering into the formation of the foramen for the tendon of the peronei longi muscles.

Metatarsus. Fig. VI

The metatarsal bones were normal in number and arrangement with the exception that the bones of the fifth metatarsals

metatarsals were fused together in the middle line.

Phalanges

The usual number of phalanges was present, the terminal ones carrying well developed nails.

Fig VI

The changes in the bones of the conjoint limb are not extreme. Apart from the alteration in the pelvis and the fusion of the ossa calcis and the bases of the fifth metatarsals, the bones were nearly normal in their main anatomical features. The rotation outwards that each half of the conjoint limb seems to have undergone is well seen in the position of the patellae, fibulae, tarsal, and metatarsal bones.

MUSCULAR SYSTEM.

Gluteus Maximus.

The Gluteus Maximus was present. The origin was normal, but the insertion of the muscle was entirely on to the femur. There was no Fascia Lata on the limb. The muscle was

Fig. VII C

supplied by a small nerve entering its deep surface and running from the superficial aspect of the great sciatic nerve almost immediately after its exit from the pelvis.

Gluteus Medius.

Fig VII G.M.

The Gluteus Medius was present, a Arising and being inserted normally, with the exception that, owing to the rotation of the limbs, it passed to the posterior aspect of the great trochanter.

Gluteus

luteus inimus. The Gluteus Minimus was present. Arising normally it passed to be inserted into the great trochanter in its postero-internal aspect. Between medius and minimus were the superior gluteal vessels and nerve, the latter supplying the muscles as normally.

ensor Vag. Femoris. This muscle was completely absent.

yriformis Fig. VII P. This muscle arose fleshily from the ilium, above the fused ischia, internal and superior to the acetabular cavity. It was continued into the interior of the pelvis by a fibrous band attached to the side of the sacrum. The muscles of each side were connected with each other by a fibrous band passing across the conjoined ischia close to the bone. The Pyriformis had the usual insertion into the great trochanter of the femur. The muscle on the right side was divided into two parts by the external popliteal division of the great sciatic nerve which pierced it.

emelli & bturator nternus. Below the level of the Pyriformis muscle was a fleshy mass marked D. Fig. VII This mass on dissection resolved itselt into a small superior slip arising from the back of the fused ischia near the middle line and connected with the corresponding slip of the other side, and an inferior mass continuous

continuous across the middle line, arising from the fused ischia posteriorly and divided indistinctly into two tendons at its insertion into the inner aspect of the great trochanter of the femur. The superior slip, also inserted with the other two into the great trochanter, probably represented a Superior Gemellus muscle, whilst the lower portions probably represented the Obturator Internus and Inferior Gemellus muscles.

Gemelli & Obturator Internus.

Quadratus Femoris.

Running between the two great trochanters posteriorly was a small rectangular slip of muscle which was quite free except at its attachment to the trochanters. This muscular slip is marked F. Fig. VII . Deeper on each side was a fleshy mass arising from the back of the fused ischia and passing to be attached to the posterior intertrochanteric line at the lower part. This muscular mass is marked E.E' Fig. VII .

A small nerve arose from the deep aspect of the great sciatic and passed down to end in the inferior gemellus muscle and also sent twigs both to the transversely running slip of muscle and the deeper quadrangular mass. The slip of muscle running transversely between the two trochanters is to be regarded as a part of each quadratus muscle which has become detached at its origin and fused with ~~each other~~ its fellow of the opposite side.

MUSCLES OF THE THIGH.

Gracilis
Fig. VIII G

The gracilis arose by a slender tendon from the front of the pubis and expanded into a fusiform muscle. It was inserted by a flattened aponeurosis into the mesial aspect of the tibia immediately below the inner head. This flattened aponeurotic insertion covered over the insertion of the sartorius muscle and was continued down into the deep fascia of the leg. It was supplied as usual by a twig from the obturator nerve.

Sartorius
Fig. VIII S

The sartorius had a normal origin. In shape it was markedly fusiform and the flattened tendinous insertion was inserted deep to that of the gracilis. From the mesial border of the tendon a fibrous expansion was given off, passing inwards over the adductor muscle and femoral vessels, and forming a kind of Hunter's canal. This aponeurotic expansion was pierced by a vein and a nerve; the latter, in all likelihood the internal saphenous, was traced in the subcutaneous tissue to the mesial aspect of the foot.

the internal Saphenous vein.

Semitendinosis.
Fig. VIII S.T.
Fig. VII S.T.

Only one semitendinosus muscle was present. It arose posteriorly by a long slender tendon from the fused ischial tuberosities

tuberosities between and in front of the tendons of the semimembranosus muscles. The tendon expanded into a fleshy belly which appeared in the front of the conjoint limb between the gracilis muscles. The fleshy belly ended in a rounded tendon which in turn expanded into a small triangular fleshy muscle. At the inferior angles of this triangular muscle two little flattened tendons passed out to be inserted into the mesial aspect of the upper parts of the shafts of both tibiae below the insertions of the gracilis muscles. The single semitendinosus muscle thus obtained an insertion into both tibiae.

Semimembranosus

Fig. VII S.B. " VIII S.B.

The semimembranosus muscles arose posteriorly by long slender tendons from the fused ischial tuberosities. The tendons expanded into fusiform muscles which were inserted into the inner aspect of the head of the tibia. These muscles were supplied by the great sciatic nerve as usual.

Biceps.

Fig. VII B.

The long head was absent. The short head arose as usual from the back of the shaft of the femur for about the lower two thirds, and the muscle was inserted by a short tendon into the head of the fibula.

Adductors.

A.Longus & A.Brevis. Fig. VIII A.L.

The adductors longus and brevis were present, the origin and insertion of these muscles being quite normal as also

also were their relations to the obturator nerve. The adductor magnus was also present; that part of the muscle arising

Magnus. from the ischial tuberosity, owing to the rotation and fusion of the two tuberosities, formed a distinct layer on the posterior aspect of the muscle. The muscle was attached to the whole inner aspect of the shaft of the femur, extending as far down as the internal condyles, where the fibres became tendinous and where the femoral vessels passed back to gain the posterior aspect of the conjoint limbs.

VII A.
VIII A.M.

Pectineus

Fig. VIII P. The pectineus muscle was present and normally disposed, and supplied by the obturator nerve.

Iliopsoas

Fig. VIII I The Iliopsoas was a strong well developed normally disposed muscle having the usual bursa between itself and the hip joint.

Obturator Externus. This muscle was present well developed and normally disposed.

Popliteus

XIII P. The two popliteal muscles were found forming a composite muscle which shewed a division into two distinct parts. Anteriorly a band of muscle passed between the two tibiae, being attached to the bones on the back of the shafts immediately below the condyles. Deeply this band of muscle sent fibres on

on each side to join a quadrangular mass of muscle, now to be described. This quadrangular muscle was situated somewhat higher and deeper in the limbs than the above mentioned band. It united the heads and upper ends of the shafts of the fibulae together. In the depth of the muscle a short, stout, shining, white fibrous cord was dissected out passing between the summits of the heads of the fibulae. Fibres of this cord were traced into similar cords which passed between the heads of the fibulae and the internal condyles of the femora of each side.

Rectus Femoris. Fig. VII R.F.

The Rectus Femoris was present. The origin from the anterior inferior spine was absent, whilst the reflected tendon was very well developed. This muscle, owing to the rotation of the limbs, was situated in the lateral aspect of the thigh.

Crureus

The Crureus was present and disposed normally except that it lay on the lateral aspect of the thigh.

Vasti. VII & VIII

The Vasti muscles were present and well developed. Owing to the rotation of the limbs the vastus externus lay behind, and the internus to the front of the limbs on either side.

MUSCLES OF LOWER ~~POSTERIOR~~ ANTERIOR ASPECT OF CONJOINT LIMBS.

Stretching across between the tibiae in this region was a strong deep fascia covering in the muscles, bloodvessels and nerves and giving origin in part to some of these muscles. Fig. XI 1. At the ankle this fascia was thickened into a strong transverse ligament, beneath which the ~~muscle~~ tendons, bloodvessels and nerves passed into the sole. The muscles lying beneath are the flexores longi digitorum, the flexores longi hallucis, and the tibiales postici.

Flexor Longus Digitorum

The flexor longus digitorum arose from the postero-mesial aspect of almost the whole of the shaft of the tibia. Fig. XI F.L.D. The tendon began in the inner aspect of the muscle and passed below the transverse ligament. In the sole it expanded into a flattened aponeurosis from which five slender tendons passed to the toes. The two inner tendons were connected by a transverse band. The two long flexors of the toes almost completely overlapped the remaining muscles, and between them the posterior tibial nerves and vessels ran on the interosseous membrane connecting the limbs together. The individual tendons to the toes could be distinguished in the flattened aponeurosis as thickenings of that structure.

Flexor

Flexor longus hallucis

Fig. XIII F.L.H

The flexor longus hallucis arose from the upper two thirds of the shaft of the fibula, and the interosseous membrane between it and the tibia, and from the outer part of the interosseous membrane between the two fibulae. Its tendon passed beneath the transverse tendinous arch formed from the tendons of the tibiales postici, to join, partly the deep aspect of the flattened tendon of the flexor longus digitorum, and partly the tendon of the latter going to the big toe, of which it formed the greater part.

Tibialis Posticus

q XI T.P.
q XIII T.P.

This muscle arose from the inner aspect of the shaft of the tibia in its upper third and also from the shaft of the fibula in its upper third. The tendon began on the outer aspect of the muscle and passed downwards over the lower end of the tibia where it was tightly bound down by a layer of fascia. At this point the tendon divided into two parts, the mesial part passing directly inwards to join with a similar one from the corresponding muscle of the other side, to form a transverse tendinous cord.

The cord thus formed was attached on its deep aspect to the membrane connecting the bones of the limbs together, except where the attachment was interrupted at three places to form three compartments. Through the mesial compartment the posterior

posterior tibial vessels and nerves passed, through the lateral ones the tendons of the flexor longus hallucis muscles. The lateral flattened part of the tendon passed over the lower

Tibialis Posticus.

end of the tibia, closely attached to the capsule of the ankle-joint, and ended by being attached to the tarsal bones and bones of the metatarsals.

Peroneus Longus

Vide Fig. IX E.P.L.

This muscle arose from the posterior aspect of the shaft of the fibula in its upper two-thirds and from the corresponding part of the interosseous membrane between the two fibulae. The tendon of the muscle at the level of the lower end of the bone divided into two parts, superficial and deep. The superficial portion became flattened and united with the corresponding part of the tendon of the other peroneus longus muscle to form one fascial expansion beneath the flattened expansion formed by the tendons of the peroneus brevis and extensor longus digitorum muscles. This flattened dorsal expansion of the peroneus longus muscle was attached to the bases of the second, third, fourth and fifth metatarsal bones. The deep part of the tendon of the muscle united with the corresponding portion of the tendon of the other side to form a rounded cord which shewed by a groove its compound character. The conjoined tendon passed through a foramen and appeared in

in the sole of the foot. Here it divided into two parts ~~and~~ which passed outwards to ~~its~~ their insertions into the bases of the first metatarsal bones. The foramen through which the conjoined tendon passed was bounded behind by the anterior end of the fused ossa calcis, in front by the fused bases of the fifth metatarsals, and at the sides by the cuboid bones which were grooved for the passage of the tendon.

eroneus revis

Fig IX H. P.B.

This muscle arose from the lower part of the posterior aspect of the shaft of the fibula and the fibrous septum between it and the extensor longus digitorum muscle. Its tendon became flattened; externally it joined the expansion of the extensor longus digitorum muscle, whilst internally it passed to the base of the fifth metatarsal, being united in the middle line with the corresponding tendon of the other side.

eroneus Tertius. This muscle was absent.

xtensor ongus igitorum

ig IX H. .D.B.

This muscle arose from the outer aspect of the shaft of the fibula, slightly also from the tuberosity of the tibia, and also from the septum between itself and the contiguous muscles. The tendon became flattened over the dorsum of the foot into a triangular expansion joined internally by the peroneus brevis. The individual tendons appeared as thickenings in the expansion, became free from it, and passed to the terminal

terminal phalanges of the four inner toes.

Tibialis Anticus

Fig. IX T.A. R.

This muscle arose from the posterior aspect of the upper two-thirds of the shaft of the tibia, the interosseous membrane between the tibia and the fibula, and the fibrous septa intervening between itself and the extensor longus digitorum and extensor longus hallucis muscles. The tendon wound round the lower end of the tibia and split into two distinct pieces to be attached to the internal cuneiform bone and the base of the first metatarsal.

Extensor Brevis Digitorum

Fig IX E.B.D. P.

This muscle was very small and possessed three tendons inserted into the phalanges of the first, second and third toes.

Lumbricales.

Fig. X L
Fig XI L

Two lumbrical muscles were distinguished, arising in each foot from the outer side of the tendon to the second toe, and passing to the outer side of the dorsum of the first phalanx of the same toe.

Gastrocnemius.

Fig. IX + XI G

Fig XIII G.

Two gastrocnemii seemed to be present as will be seen from inspection of Figs. IX + XI G. Each muscle arose by a somewhat fascial origin from both femora. The muscle on the anterior aspect of the conjoined limbs (Fig. XI G) arose in this fashion Fig. XIII G

fashion from the two inner condyles. The fascial origin soon gave place to two small muscular bellies which joined and ended in a long slender tendon running superficially down the middle of the anterior aspect of the conjoint limbs. This tendon passed beneath the tendon of the tibialis posticus and became lost in the deep fascia. It could not be traced to the tarsus. On the posterior aspect of the limbs a similar but more slender muscle appeared. This muscle (Fig. XI Q) arose in a similar fashion to the preceding one from each femur above the external condyle. The muscular belly ended in a long slender tendon passing down the posterior aspect of the conjoined limb to end in the summit of the fused os calcis bones.

In all probability each of these muscles is a conjoint one; the anterior muscle consisting of the right half of the left gastrocnemius and the left half of the right gastrocnemius, the posterior muscle being constituted by the left half of the left gastrocnemius and the right half of the right gastrocnemius. The two muscles in the rotation and fusion of the limbs have undergone first a splitting into two halves with subsequent fusion of opposite halves.

Soleus. No trace of this muscle could be found.

Flexor Accessorius. From the tendon running transversely between the tendons

tendons of the tibialis posticus muscle in front of the ankle joint some muscular fibres arose. These, with some arising deeply from the conjoined ossa calcis, formed a small accessorius muscle passing to be attached to the posterior border of the flattened conjoined tendon of the flexor longus digitorum muscles.

Fig XIII A.

Adductor Hallucis & Flexor Brevis Hallucis.

From the tendinous expansion formed behind the ankle joint by the tibialis posticus and gastrocnemius muscles the adductor and flexor brevis hallucis muscles arose, the latter also arising from the bases of the first metarsal bone and from the tarsus. Both muscles had the usual insertion. The adductor obliquus arose from the bases of the metatarsals and tendon of the peroneus longus and passed to be inserted on the big toe in the usual manner.

Fig XIII A. + F.B.H.

Adductor Obliquus Hallucis

Adductor Transversus Hallucis.

This muscle was absent.

The adductor and flexor brevis minimi digiti were absent; their places being taken by a small quantity of fibrous tissue.

Interossei.

Four dorsal normal interossei were present. Three planter interossei were also present; the latter in addition to

to the normal origin from their respective metatarsal bones arose largely from the tendon of the peroneus longus in the sole.

NERVOUS SYSTEM.

Lumbar Nerves

The lumbar plexus was of the postfixed type. The four lumbar nerves and the greater portion of the fifth took part in it, only a very small twig descending to join the first sacral nerve.

The ilio-hypogastric and inguinal nerves arose from the first lumbar and had a normal course and distribution. The genito-crural arose from the first and second nerves and was traced to the front of the thigh; no genital branch was found. The external cutaneous arose from the second and third nerves and pursued its usual course to the front and postero-outer part of the thigh. The anterior crural and obturator nerves arose from the second, third, fourth and fifth lumbar nerves. The anterior crural pursued its usual course to the thigh, where it had its usual muscular and cutaneous distribution. The obturator ran round the brim of the pelvis and passed out through a small obturator foramen to the thigh to be

be distributed normally.

Sacral Plexus.

On the left side there were four sacral foramina, with four nerve trunks issuing from them; on the right side there were only three foramina with three nerve trunks. The first of these sacral nerve trunks was joined on each side by a small twig from the fifth lumbar nerve.

The great sciatic nerve arose on the left side by from the four ~~trunks~~ nerves and on the right side by from the three nerves issuing from the anterior sacral foramina. Each nerve issued from the pelvis through a foramen bounded by the ilium, sacrum, and fused ischia, the nerve on the right side being divided into two parts for a short distance by some fibres of the pyriformis muscle which pierced it. A short distance after their exit from the pelvis the two nerves joined to form one large median cord, which at the junction of the lower and middle thirds of the thigh divided into four branches.

Fig. VII SN

The conjoined nerve in the thigh gave off numerous branches to the hamstring muscles.

The two largest branches of the four, into which the conjoined nerve divided, passed anterior to the popliteus muscle and ran down in the interval between the conjoined limbs, lying in the membrane stretching between the fibulae and accompanying the

the posterior tibial vessels. They passed through the middle of the three foramina described in connection with the tendon of the tibialis posticus muscle, and ended by dividing into internal and external planter nerves. The terminal distribution of the posterior tibial nerves is shewn diagrammatically in Fig. XVII. In this course the posterior tibial nerve supplied the muscles in this region of the conjoined limbs.

The two smallest divisions of the conjoined sciatic nerve passed down dorsal to the popliteus muscle and entered the muscles on the dorso-external aspect of the lower part of the composite limb. In the substance of the muscle each divided into two branches. One branch, the anterior tibial nerve, passed down in the interosseous membrane between tibia and fibula and finally divided into two slender branches ending in the dorsum of the foot in the extensor brevis digitorum muscles and the joints. The other branch, the musculo-cutaneous nerve, issued from between the peronei muscles in two divisions, became subcutaneous, and was distributed as figured diagrammatically in Fig. XXIV.

Small Sciatic Nerves

The small sciatic nerves arose from the back of the great sciatic nerves as the latter emerged from the pelvis. The two nerves half way down the thigh fused to form a slender median

median trunk which was traced in the subcutaneous tissue to the dorsum of the foot.

nferior luteal erve. The inferior gluteal nerve came from the back of the great sciatic nerve and was distributed as usual to the gluteus maximus muscle.

Superior luteal erve. The superior arose from the first sacral nerve, passed out with the great sciatic nerve and accompanied the gluteal artery between the gluteus medius and minimus muscles which it supplied. From the same trunk arose the small twigs to the quadratus femoris, gemelli, and obturator internus muscles.

CIRCULATORY SYSTEM.

In the thorax the disposition of the vessels was normal. In the abdomen the aorta gave off no renal or inferior mesenteric branches. It bifurcated normally at the lower border of the fourth lumbar vertebra. Opposite the sacro-iliac joint the common iliac arteries divided into a large hypogastric and smaller internal and external iliac arteries. The two hypogastric arteries ran round the brim of the true pelvis to reach the anterior abdominal wall, where they fused to form a single median hypogastric artery running in the anterior abdominal

abdominal wall to the umbilicus.

The internal iliac vessels passed down into the pelvis and divided into ilio-lumbar and gluteal arteries and one or two other very small twigs which could not be followed or identified.

The external iliac arteries ran external and parallel at first to the hypogastric arteries along the brim of the pelvis to Poupart's ligament, beneath which they passed to become the femoral trunks.

The femoral vessels passed down the front of the thigh at the lower part of which they passed beneath the tendinous expansion from the sartorius muscle and then below the tendon of the adductor magnus to the back of the knee joint. Here each vessel divided into two trunks, the anterior and posterior tibial arteries.

The anterior tibial branches pierced the muscles, and, running somewhat laterally, ran down between the tibia and the fibula on the interosseous membrane to the dorsum of the foot where, as the dorsalis pedis arteries, they finally terminated.

The posterior tibial branches, accompanied by veins and the posterior tibial nerves, passed directly downwards lying

lying on the membrane connecting the two fibulae, and after passing through the foramen described in connection with the tibialis posticus muscles, ended by dividing into internal and external planter arteries. A planter arch was present but details could not be made out.

VISCERA

Thorax. On examination nothing abnormal was detected in the thorax. The heart and lungs were normal as were also the number and origin of the great vessels. A well developed thymus gland was present.

Abdomen. The abdominal viscera shewed numerous deviations from the normal. When the abdominal cavity was opened, the whole alimentary canal was seen to be attached to the posterior abdominal wall by a single simple mesentery or mesogaster. This mesentery was attached in the middle line to the vertebral column from the level of the lower end of the eleventh thoracic vertebra to the lower border of the fourth lumbar vertebra. The digestive organs from the stomach to the end of the large intestine were attached along the ventral border of this mesentery. The spleen lay behind the stomach between the

the two layers, and the pancreas extended backwards and to the left, also lying between the two layers. From the small curvature of the stomach which was directed somewhat upwards and to the left, a fold of peritoneum, the gastro-hepatic omentum, passed upwards and to the right to the transverse fissure of the liver. There was no great omentum.

On a general survey of the abdominal contents being taken the liver was seen lying at the upper part and extending almost the whole breadth of the cavity. Coils of small intestine filled up the greater part of the space, and in the middle line, at the lower part, a blind dilated piece of large intestine appeared, attached at the place where the simple mesentery terminated. From this sacular termination of the large intestine a small cord-like structure passed down into the pelvis, terminating in a matted mass in the pelvis behind the structures which proved to be the generative organs. These latter appeared as shewn in Fig. XIV , and will be described in detail later.

tomach. The stomach measured 5 c.m. along its greater curvature and seemed normal except in its peritoneal relations and in its position. The normal rotation had failed to take place and the largest axis of the viscus was directed from above downwards

downwards, forward, and to the left, so that the small curvature looked somewhat forwards and the great curvature backwards. From the small curvature the gastro-hepatic omentum extended upwards, somewhat forwards and to the right to the liver. The peritoneum from the great curvature passed backwards to the posterior abdominal wall.

Spleen. The spleen was present lying in the fold of peritoneum passing from the great curvature of the stomach to the posterior abdominal wall and measuring in its longest axis 5 c.m.

Intestine. The first 5 c.m. of the small intestine were thicker than the rest of that tube and formed a somewhat U shaped loop, with the convexity directed forwards and to the right, in which the head of the pancreas lay. The total length of the small intestine was 250 c.m., its average diameter about 75 c.m., and it was supplied with blood from the superior mesenteric artery.

Large Intestine. There was present the fœtal type of conical caecum continued into the vermiform appendix. Above the ilio-caecal junction the length of the large intestine was 48 c.m. and its diameter 1.5 c.m. The last 7 or 8 c.m. of this part of the bowel

bowel became dilated, ending in a blind saccular extremity measuring 5 c.m. in diameter, and lying in the middle line nearly at the pelvic brim where the attachment of the dorsal mesentery ended. The whole of the large intestine was slung like the small intestine to the posterior abdominal wall by the common simple mesentery, and it received its blood supply from the superior mesenteric artery, the inferior mesenteric vessels being absent. Reasoning from this, one would suppose that this part of the large intestine represented the ascending and transverse colon only.

From the end of the dilated extremity of the large intestine a small fibrous cord stretched into the pelvis where it ended in a somewhat indefinite mass lying behind the genital organs. Under water this was dissected out into the sacculated structure shewn in Fig. . The cord led down into four small globular structures closely attached to one another and about the size of a large pea. Between the second and third of these round structures a small somewhat leaf-shaped one led off laterally. These four globular masses were succeeded by a slender cord passing to a somewhat oval structure which in turn was attached to an elongated cord ending blindly and attached at its extremity to the fibrous tissue of the pelvis. The measurements of the structures are given in Fig. .

The

The first of these structures 1. Fig. XV was a thin walled sac from which on incision a white flocculent material emerged, which on microscopic examination was found to consist of lymphocytes; 2 Fig. XV had thicker walls, 3 was apparently solid, 4 had a very small lumen, and 5, 6, 7 were, when examined by the naked eye and small hand lens, to all appearance solid.

Pancreas. This viscus was well developed. Its head lay in the duodenal loop and it stretched back and to the left in the dorsal mesentery till its tail touched the spleen. It measured from head to tail about 4 c.m.

Liver. The liver filled about the whole of the upper part of the abdominal cavity, measuring transversely 10 c.m. The gall bladder was somewhat smaller than usual and contained bile. The cystic, hepatic and common bile ducts were disposed as normally. The umbilical vein gave off branches to the liver, and turned to the right to join the portal vein, whilst the ductus, venosus continued straight back from it to join the inferior vena cava. The portal veins were present and normally disposed.

Supra-renals. Two well developed suprarenals were present lying behind

behind the peritoneum in the lumbar region and supplied each by a suprarenal artery from the aorta.

Kidneys
Ureters
Bladder
Urethra
Urachus

No trace of kidneys, ureters, bladder, urethra or urachus could be found. The whole urinary apparatus was absent.

Genital Organs.

As noted above no trace of external genitals could be found, but the internal organs were fairly well developed and shewed the sex to be female. A general view of the genital organs as they lay in the shallow cavity of the pelvis is given in Fig. XIV The uterus was almost completely divided into two parts, of which the left half was much the larger and was connected with the small right half by a slender cord. Both ovaries and Fallopian tubes were present although only those on the right side are shewn in Fig. XIV, the left half of the uterus being pulled over to the left and concealing the corresponding tube and ovary. From the summit of each half of the uterus a fibrous cord, the round ligament of the uterus, passed out and was lost in the anterior abdominal wall. A complete view of the genital structures is shewn in Fig. XII, a view taken of them when removed complete and dissected out under water. The larger left half of the uterus is seen to be conical with

with the Fallopian tube and round ligament coming off near its summit. The smaller half was rounded, was connected with the larger half by means of a very small cord, and had attached to its right side the corresponding ligament and tube. Both halves contained a cavity, and a microscopic section gave the usual histological structure of the uterus. The cord connecting the two halves was hollow. No os uteri could be seen on section, both halves being completely closed and shewing no external opening. No trace of a vagina was discovered. As will be seen from Fig. XIII and Fig. XIV the ovaries were elongated glands, retaining the primitive shape, and microscopic examination proved their structure to be truly ovarian.

Nomenclature. Many and varying have been the names applied to this type of monster. Dieckerhoff in 1819 proposed the term "Monopodia" and this was adopted by Meckel and Cruveilhier, but both the latter used as a synonym the name "sirenomelia". Isidore Geoffrey St.Hilaire pointed out the inappropriateness of the term Monopodia, because in the Monopodia or Sirenomelia there is present not one limb only, but a fusion of the two lower limbs. He also objected to the term "sirenomelia" on classical grounds, as the sirens of Mythology were not credited with feet, and certain types of sirenomelic monsters possess one, or in some cases, two almost complete feet. He therefore proposed the term "symelien" for this class of monstrosity and divided them into three sub-divisions or genera. Symelien simply denotes fusion of limbs and might apply equally well to fusion of the superior as well as of the inferior extremities. But St.Hilaire foresaw this objection quite well, and met it by pointing out that in simple monsters fusion of the superior extremities is unknown although of common enough occurrence in double terata. Levy in 1833 proposed the name "sympodia" and this term was adopted by Förster, the latter, like St.Hilaire, dividing the family into three genera. Förster's three sub-divisions were (1) "sympus dipus" corresponding to the "symelus"

"symelus" of St.Hilaire. (2) "Sympus monopus", the "uromelus" of St.Hilaire. (3) "Sympus apus", the "sirenomelus" of St. Hilaire. Taruffi impressed with the profound alterations in the pelvis uses the name "lecano-teras" (pelvic deformity) for this type of monster. Other names which have been employed are "foetus cuspidatus" (Rodati), "monopedia", "Sirenia", "sireniform foetus", "mermaid foetus", and "foetus with a tailed appendage". The term "sympodia" strictly means fusion of the feet; but fusion of the feet alone is not the essential characteristic of this class of monster, but fusion of the whole limb, with sometimes complete absence of the feet. "Forster adopted in 1861 the term from Levy, and it has been used by the majority of teratologists since, both Taruffi and Ballantyne preferring "Forster's nomenclature. But I am of the opinion that Isidore G.St.Hilaire's terminology has not been materially improved upon, the only valid objection to it being that "symelien" might be applied to fusion of the superior limbs as well as of the inferior. But this objection vanishes if we restrict the term to simple monsters, fusion of the superior extremities never being found except in double monsters. Such double monsters belong to quite a different category, although it is true that in some few cases the symelien type

type has been described in double terata. Moreover some respect and consideration is due to the man who first gave a systematic description and classification of monsters and raised Teratology to the dignity of a science. I have accordingly used the nomenclature and followed the classification of I.Geoffrey St.Hilaire in this paper.

Definition Symeliens may be defined as that form of monster in which the lower limbs are inverted with a greater or lesser degree of fusion of the lower limbs, together with an imperfect development of the lower limbs, pelvis, genito-urinary organs and pelvic portion of the alimentary canal. The three subdivisions or genera into which Symeliens are divided are:-

(1) Symelus. In this genus the two lower extremities are completely united, but there is a double foot, with the soles directed anteriorly.

(2) Uromelus. In this genus the fused lower extremities terminate in a single foot with the sole directed anteriorly

(3) Sirenomelus. In this genus the fused lower extremity terminates in a conical or pointed stump, there being no evidence of a foot.

To

To these three genera of St.Hilaire it is necessary to add a fourth. This genus departs least from the normal and on that account ought perhaps to be placed first in the family. The lower limbs are rotated and simply united by a membrane as in Ballantyne's case, and they may be rotated and united as far as the knee below which the limbs are free and separate from one another, as in the cases recorded by Maier, Naudin, Labougle and Regnier. For this genus Taruffi, following the classification of Förster, has proposed the name "epi-sympus dipus".

Historical.

This type of monster was known to the ancients as it is referred to in various classical authors. No explicit mention of actual cases is made but cases must have occurred which stimulated the imagination to create weird monsters.

Aristotle alludes to it in his book on the generation of animals Bk.IV. Cap.iii.

Pliny described a race of one legged men; "Item hominum genus qui Monocoli vocarentur, singulis cruribus mirae pernicitatis ad saltum; eosdemque Sciapodes vocari quod in maiori aestu humi iacentes usupini umbra se pedum protegant; non longe eos a Troylodytes abesse".

This highly imaginative description doubtless had its

its origin in the birth of a symelic foetus and in the wonderful tales which at that time would arise out of such a portentous event. Perhaps the earliest direct reference is that of Julius Obsequens. In the copy of his book "De Prodigiis" in the Glasgow University library printed at Basle in 1552, on page 50 there is a figure of a sirenomelic foetus without arms and on page 51 the sentence, "in Picino infans absque manibus ac pedibus natus". Obsequens flourished about the 4th century. The figure of the foetus is obviously an addition of the German printer.

In 1542 Nicholas Rocheus in his book, "De morbis mulierum curandis", described a symelic foetus born in the land of the Bourbons in the preceding year and which lived one hour. Christian baptism was accorded it because of this fact. Schenkius described the same case in 1609 as "monstrum superna parte hominis effigie ad umbilicum resque inferna syrenum caudem, pedum loco referns". Another case was reported by Fincelius in 1556. Lycosthenes in his Chronicon refers to Symeliens. In the copy in the Glasgow University library page 10 the following passage occurs:- "Scipodes ac Monomeri, gentes qui unum tatum pede habentes non flectentes poplitem, mirabilis celeritatis. Hi plinis teste per aestium tempus in terra suspini iacentes pedum se umbra protegunt". This description is obviously

obviously borrowed from Pliny quoted above, and on the same page is a somewhat fantastic picture of a man lying on his back with a single limb carrying a huge foot raised at right angles to his body and acting the part of a sunshade.

Taruffi considers that Lycosthenes, for some occult reason, did not wish to refer to the cases published by Rochens and Fincelius and says that he simply borrowed a tale from Livy about an amelic foetus, and that he was ignorant of the true nature of symelic monsters, and in order to fit his figure to the story he drew it without arms and gave it a penis and a scrotum. But on page 623 of the University library copy the following passage occurs; "Anno Domini 1552 Vidensbachi quod distat miliare unu a Schlosingii, monstrum natum est ex muliere imagine infantus absque pedibus, quorum loco habiut cuspidem demissam a foemoribus etia cuspides prominentes habiut. Cuius meminit lobus Fincelius de miraculis post senatum Evangelium". Not only is the case noted and attributed to Fincelius but on the same page is a figure of a symelus with arms and legs and what looks more like a vulva than a penis and scrotum. Taruffi has perhaps consulted an imperfect copy of the Chronicon, thus accounting maybe for his somewhat harsh judgment of the chronicler.

Aldrovandi described a case he had seen in 1556 of a foetus

The case number is in Aldrovandi's work p. 519 & figured at p. 521

Ambrosinus published in 1642 Aldrovandi's "Monstrorum Historia" which is no doubt the work here referred to.

The passage should then read [illegible]

Ambrosini published the work of Aldrovandi ~~[illegible]~~ "Bononiae typis Nicolai Tebaldini 1642."

Ambrosinus added the "Paralipomena Historiae Omnium Animalium" in the same volume -

foetus which was of a pyramidal shape below the umbilicus, the apex resembling a folded tail and having no trace of external genitals. This case was first published in 1642 in the work of Ambrosinus. The surgeon Scultetus in 1656 reported a case of a still-born foetus having the legs fused, with no external genitals or anus but otherwise well formed.

In the book of Licetus published in 1668, on page 56 the following sentence occurs, "In villa Nepritz non procul ab oppido Wurtenzensi, ad Moldam sito, natus est infans sine pedibus. Foki etiam Fincelii testimonio". On page 57 is a figure of a symelic foetus without feet, wanting arms but with a penis and a scrotum. This figure is repeated on pages 63, 70 and 142. On page 58 a symelian similar to that of Aldrovandi is figured with two small triangular folds projecting on each side in the lumbar region and with a small opening which might represent a vagina.

Near the end of the seventeenth century Hartmann gave the first description of a dissection of a symelus and Du Cauroi in a letter in the Journal des Sçavans related how he had been informed by a midwife of very high character whose statements could be trusted, about the birth of a child with no sexual organs and having a single leg projecting from the middle

middle of the hypogastrium. During the eighteenth century nearly a dozen cases were put on record. The majority of these, such as those of De Superville and Baster, were very imperfectly described; in fact they may be described as only very imperfectly noticed. A noteworthy exception to this imperfection is found in the writings of the St.Petersburg professor, A.Kaaw Boerhaave, whose description of two cases extends to over a hundred pages with twenty four plates illustrating very fully the dissectional appearances.

The contributions of the nineteenth century have been very numerous, and the names of Cruveilhier, St.Hilaire, Otto, Vrolik, Taruffi, andBallantyne may be singled out as meriting special mention. The bibliography appended at the end of this paper may be consulted for fuller details.

I have appended what may be regarded as a representative list of cases taken from Italian, French, German and British sources, from the very early notices of Superville and Baster down to the most recent ones of Bennington and Moorhead.

Frequency. With regard to the frequency with which symeliens occur it has already been noted that they are to be regarded as comparatively rare. Ballantyne puts their percentage frequency to other terata in teratological collections as being about three

three per cent. What their frequency is compared with normal births, or in clinical practice, with monstrous births, is unknown. The largest teratological collections, namely those of the Royal College of Surgeons, London, and the museum of Breslau, have only six examples apiece.

Sex. With regard to sex, Meckel stated that symeliens were most frequently female. St.Hilaire was in doubt as to which sex predominated, and later, Förster affirmed, without giving any definite grounds for his belief, that up till the year 1865 neither sex was in the majority. Taruffi is of the same opinion. I have made an analysis of sixty cases (Table IV.) which I have divided into four groups, male, female, undetermined or not notified, and doubtful. Of the sixty cases twenty six were males, seventeen were females, seven were of doubtful sex and in ten the sex was undetermined. This gives 43.3% of males, 28.3% of females, 11.6% of doubtful sex and 16.6% not notified, a considerable preponderance of the male sex. In all probability however the number of cases investigated is too small to permit of any definite statement in the matter.

Complications. Symeliens occur with other deformities which are to be regarded as accidental complications not essential to the symelic condition. Rarely there is an increase in the number of

of vertebrae and ribs; absence of the thumbs, duplication of the thumb, absence of the radius, spina bifida, defects of the diaphragm, defects of the abdominal parietes and exomphalos, hare lip and cleft palate have all been described, but none of these can be regarded as an integral part of symelians.

Cruveilhier considered that hydrocephalus was a common complication of symelians and that it was an essential feature of the condition. I have been able to collect only five instances of this complication (Table V.) and I shall return to its consideration in discussing the etiology of symelians. In one case hydramnios was present.

The majority of symelians have been born prematurely, some have been born dead at or near full time, whilst a few have been born alive, to die soon after birth, living at the utmost for twenty four hours. Hartmann's case lived for this period, made feeble cries and movements and swallowed fluids. The mortality of symelians may depend on the defective condition of the urinary organs; the kidneys are absent in the majority of cases, so that the toxins which normally are excreted into the bladder are permitted to circulate in the blood, and thus bring about death from toxaemia. This factor, of course, would only come into play in the later periods of pregnancy when the kidneys begin to function, the placenta hitherto serving as the organ

organ of excretion as well as of nutrition. But I have not been able to correlate the presence or the absence of kidneys with viability or non-viability. In my own case the child was born alive and lived for a short time, yet no trace of kidneys was found. The cause of the mortality is therefore uncertain. The condition of the alimentary tube, the absence of anus, the defects in the genito-urinary system render post-natal life an impossibility. In the ante-natal period there is not much of importance to record. The majority of the pregnancies were quite uneventful; foetal movements were often felt up till or shortly before birth, and in a few instances is there a history of a maternal impression ~~such~~ as in Dunn's case, where the monstrous birth is attributed to the mother's constantly hearing one of her children talk about a man without legs who had been seen in the street drawing himself about by a mechanical contrivance. The labours were usually normal except where some complication, e.g. hydrocephalus, caused difficulty, or where the fused limbs presented, and caused difficulty in diagnosis.

GENERAL DESCRIPTION

Symeliens occur as a rule in simple foetuses and though it is not proposed to discuss double terata in this paper, still before

before proceeding to a general description of simple symelians it will be of interest to briefly notice such examples as have been described. Santi-Sirena has described a monster which had two heads, a single trunk diminishing in size, and the inferior extremities fused. This probably unique specimen is not fully enough described to enable any very definite conception to be formed of the parts entering into the fused limbs; whether it consisted only of the fused lower limbs of one foetus, the two of the other foetus being wholly suppressed, or whether parts of more than two limbs entered into the composite limbs it is impossible to state. Taruffi (vol.VI. p.527 ob.3) has described a sirenomelus which had two distinct and symmetrical inferior mandibles, this representing an extreme degree of fusion of two foetuses from below upwards. Symeliens in double asymmetrical monsters have also been described, notably by Behn, and Boerhaave also noted its occurrence in fowls. The observations of Boerhaave derive additional interest from the comparatively rare occurrence of symeliens in animals.

Simple Foetuses.

External Characters. An outstanding feature of the external anatomy of all genera of symeliens is the absence of external genitals and anus. I have only been able to collect five cases in which external

Table I P 143

external genitals were present. Teacher and Coats described a rudimentary penis in their specimen, Juillard described a vulvar aperture without nymphae opening into a blind vagina, Vrolik found one testicle in a scrotal fold, Cruveilhier described what he thought to be the vestige of a clitoris, and Behn described a case with a normal penis, urethra, two scrotal folds but no testicles. McLaren's case is doubtful, as the "well formed penis" was attached dorsally one and a half inches below the coccyx, and no dissection was made to discover its deeper connections, so I am inclined to regard it as being more probably of the nature of one of those caudal appendages to which I shall refer later. In this case McLaren noted in the median line anteriorly, two inches below the umbilicus, a small papule which may well have been a rudimentary penis. In several instances a slight depression or scar, the genital scar, has been noted in the situation where the external genitalia ought to be.

The anus is, in the great majority of cases, totally absent. Sometimes a scar, anal scar, or a slight dimpling or depression indicates the site of the anus, and a fibrous continuation from the blind end of the large intestine may be traced to this situation. Sometimes there is a small anus present

present leading into a short blind anal canal lined with a mucosa as in a case of Cruveilhier's, or there may be an actual communication with the large intestine as in the cases of Teacher and Coats, and Abramoff and Riezanoff, Juillard and Sachse have also recorded the presence of an anus; in the latter's case a probe could be passed in for a distance of two inches, and the canal seemed to lead into the rectum. I have tabulated these cases in Table II. P 143

An external opening simulating an anus occurs sometimes in connection with the caudal appendages which are present in some symelians. Windle who examined the caudal appendage in Bennington's case says that the occurrence of such tails is rare, he having been able to find reference in the literature to only one other case, and Taruffi is also of the same opinion, as he has only been able to find three instances. Gebhard considers that they are not uncommon and I have been able to find fifteen instances, so that I am inclined to share Gebhard's opinion as to their relative frequency. The fifteen cases are tabulated in Table III. P144 These tails vary considerably in their appearance. In some cases, as in my own, they simply consist of a round button-like elevation of the epidermis, covering a mass of fat, or elevated upon the turned back extremity of

of the sacrum or coccyx. Occasionally they are of some length, as in Superville's case, which he described as pig-like, and as in Bennington's, which was 2.5 c.m. long. In other cases the tail is described as penis-like with a small central canal, as in McLaren's case, and in one of Cruveilhier's. The tail is described as soft, spongy, and vascular in some cases, or it may be bifurcated or lobulated. In Bennington's case which was examined microscopically by Windle, muscular fibres were found, continued evidently from the gluteus maximus muscle, as also a central artery of some size, the termination of the middle sacral, and a longitudinally running tube which was considered to be a vein. Windle considered this appendage to be an example of a true caudal appendage or skin tail. andthat the muscular fibres represented the curvator caudis or curvator coccygis muscle of lower animals. Abramoff and Riezanoff describe the appendage in their specimen as resembling the tail of a young pig; it was 6 c.m. long, and had in the middle of its back a small opening leading into a narrow channel which extended the whole length of the appendage and communicated with the blind end of the rectum. Muscle fibres were continued into this appendage from the somewhat anomalous latissimus dorsi muscle. Microscopically the central canal was found to be lined

lined with a mucous membrane, and muscle fibres, nerves and blood vessels were present. In my own case the caudal appendage seemed to be partly due to the backward projection of the coccyx over which it lay, and to a mass of fibro-fatty tissue containing bloodvessels and nerves, but no central canal or external opening was present. The four genera of symelia are sharply marked off from each other as far as their external appearance goes, but it is otherwise with their internal structure. It will be most convenient to describe first the external appearance commonly found in the different genera and then to give a general description of the internal anatomy of the whole family, indicating, where necessary, the characters peculiar to each genus.

Symelps. In this genus there are usually no deviations from the normal as far as the fold of the groin. Below the fold of the groin there is one conical inferior limb usually giving external indications of its composite nature. The limb is usually curved gently with the convexity directed backwards, or the whole limb may project forwards or backwards or laterally at an angle with the trunk; the anterior flexure may be so extreme that the limb lies against the anterior abdominal wall. There are three distinct segments in the conjoint limb. The

The crural portion of the limb is rounded posteriorly and flattened anteriorly, sometimes a slight hollowing or concavity being present in front. This portion of the limb is broader than a normal thigh, but its length corresponds to the normal length of thigh. At the knee it is evident that some external rotation of the limb has taken place, as the patellae, instead of being placed anteriorly, are situated externally or even directed somewhat backwards. Flexion can take place at the knee joint, but in this movement the leg is flexed anteriorly on to the thigh instead of posteriorly as normally. The leg portion of the limb is of the usual length, but broader than normal; flattened in front and rounded behind, there is nothing in this segment to indicate its dual nature.

The fused feet are the most remarkable of the external characteristics of this genus. There are in all cases two feet or parts of feet. The number of toes varies from ten to six; in a few instances supernumerary toes, e.g. eleven, have been described. The feet are fused along their outer borders and rotated in such a manner that the plantar aspect looks forward, the dorsal aspect looks backwards, the big toes are most external, and the little toes most internal. The fused feet may simply continue the line of direction of the limb, or make an angle

angle, generally an obtuse one with it; very occasionally are they at right angles to it, as normally. The degree of fusion varies considerably; very rarely are the feet fused only at the posterior part of their outer borders, the rest of the foot being quite free; more frequently are they united for the whole length of their outer border, the little toes being fused into one median toe, where only nine toes are present, or where there are less than nine toes there are varying degrees of fusion and disappearance of the outer toes. My own case is a very typical one of a symelus and I have figured the external appearance of [redacted] similar ones taken from the literature. Figs. XVIII + XIX

Uromelus. This genus is characterised by having apparently only one foot; the signs of duplicity of the compound lower limb are less marked than in the first genus, but there are always three distinct segments. This genus is usually normal in appearance above the fold of the groin, though in some cases narrowing of the abdomen takes place below the umbilicus. The thigh and leg segments are narrower than they are in symelus and they may be somewhat shorter than normal. The foot may be larger than normal and may carry as many as five toes; in the majority of cases the foot is much smaller than normal and bears

bears few toes, one, two or three; in some cases the foot is very much reduced and may be represented by a single toe attached directly to the leg . (This genus deviates much more from the normal than the symelus and the rotation , fusion, and suppression are much more profound). The foot always presents a rotation similar to that seen in symelus, that is, the plantar aspect is directed forwards and the dorsal aspect backwards. St.Hilaire's term uromelus is not quite appropriate for those forms which only display a single toe, cutaneous appendage, or irregular swelling instead of a foot, but I am of opinion that all cases which show any indication of a foot or toe are better classified under this heading rather than one should attempt to make species of them. Species-making in Teratology could only lead to confusion as no two specimens are ever exactly alike and the number of species would coincide with the number of specimens. Figures of this genus taken from the literature are given in Figs. XXD + XXA

Sirenomelus. It is to this genus that the term sirenomelus or sireniform foetus properly belongs, it having an obvious likeness to the fabled sirens of ancient mythology, and to it the line from Horace quoted by Cruveilhier and St.Hilaire applies;

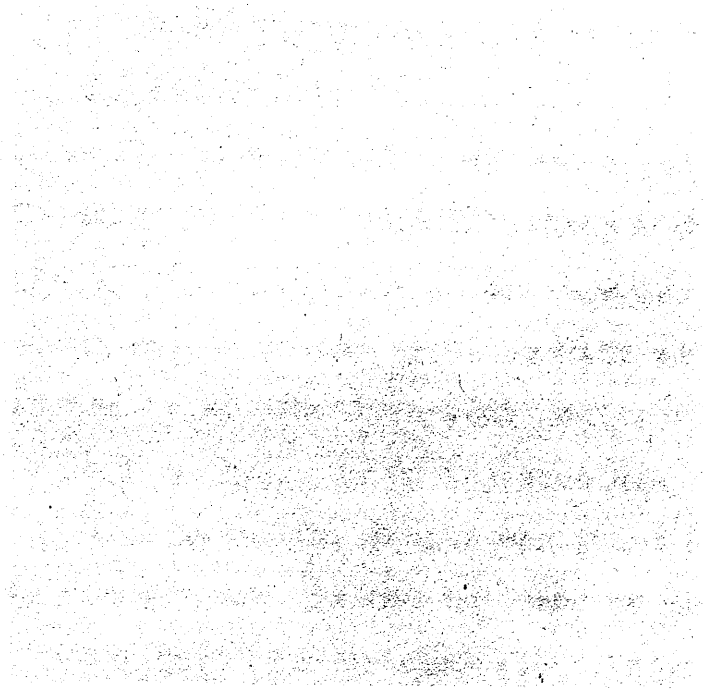
"Desinit in piscem mulier formosa superne".

This

This genus departs still more from the normal than the two foregoing. The abdomen begins to narrow below the umbilicus and the succeeding part of the body appears like a tail. The division into three segments is indistinct, there is no foot present, the conjoint limb ending either in a somewhat sharp point or in a rounded end not unlike a surgical stump. Figs XXI XXI

For the fourth genus of symelians Taruffi has proposed the name of epi-sympus-dipus. I have only been able to collect four instances of this genus and the descriptions are so meagre that it is impossible to generalise about them. In Ballantyne's case, details of which I have been unable to obtain, the limbs were rotated out as in the symelians but they were united along their inner borders by a membrane. Maier described a monster which had the lower limbs fused only as far as the knee, the legs and feet being quite free, and Naudin described a foetus which terminated inferiorly in a tumour from which the very imperfectly developed lower limbs projected. Whether this case was really one of symelès is impossible to determine. The case of Labougle and Regnier ought perhaps to be included in this genus. It will be seen from the foregoing that this genus deviates least from the normal, the symelès come next, then the uromelès, whilst the sirenomelès are the most abnormal of

of the whole class. Curiously enough the relative frequency of these four classes is in exactly the opposite order; sirenomelès are by far the most frequently occurring, the epi-sympus-dipus the least frequent, symelès are comparatively rare, whilst uromelès occupy an intermediate position between the sirenomelès and symelès.



I N T E R N A L A N A T O M Y

keleton. Changes in the cervical vertebrae are of comparatively rare occurrence. In some few cases fusion, either partial, as in my own case, or complete, has been described. A similar statement applies equally well to the thoracic vertebrae, but increase in the number of vertebrae has been described (Smith). In the lumbar region changes are more frequent. The number of the lumbar vertebrae is sometimes diminished, sometimes increased. When the sacrum is absent, as it frequently is, then the last lumbar vertebra articulates with the pelvis and such an articulation, which is simply composed of fibrous tissue, allows of great mobility at this ilio-lumbar joint. The above statements as to the variations in the cervical, thoracic, and lumbar portions of the column apply equally well to all classes of s[illegible]meliens. The most important modifications are found in the sacrum and coccyx. In no instance are those bones complete. In several cases the sacrum was found complete and normal in every respect, but in the majority of instances the number of the sacral vertebrae is diminished, rarely is it increased, and in some cases the sacral vertebrae are only partially

partially deficient and fused with one another. The sacrum is usually projected backwards at a considerable angle to the vertebral column, so that its anterior surface may look almost directly backwards; instead of being directed backwards it may deviate laterally, but in no case is it ever directed forwards.

The coccyx is never complete. In some cases the coccyx is represented by a small triangular undifferentiated mass of cartilage; it may have one or two vertebrae complete, or it may fail altogether. In some instances the sacrum and coccyx are represented by undifferentiated cartilage, or the upper part of this cartilage may be differentiated into one or more vertebrae. The coccyx, or the representative of it, is turned backwards, sometimes to such an extent as almost to touch the lumbar spines, and it frequently forms the base of the caudal appendage not uncommon in this monstrosity. Thus it will be seen that all types of sacrum and coccyx may be found, from nearly normal to complete absence. Symeles have usually a nearly complete sacrum and coccyx, sirenomeles often have this part of the vertebral column completely awanting, whilst in the uromeles the intermediate forms are found. The column as a whole may shew anomalous curves, scoliosis in the thoracic region with compensatory curving in the lumbar having been noted in several instances.

Pelvis

Pelvis. The changes in the pelvis are so constant and profound that, many anatomists have regarded them as the primary changes in this form of monster. In addition to the changes in the sacrum and coccyx described above, all the other bones of the pelvis undergo more or less marked changes. The changes will be best understood if one imagines an external force acting on the pelvis from before backwards and also laterally on each side.

Ilia, The ilia are usually flattened out so that their superficial aspects look backwards, their abdominal surfaces forwards, and the anterior superior spines are directed outwards and downwards. The ilia may be otherwise not much altered in shape, but very often in addition the concave abdominal surface has become convex and the convex superficial surface correspondingly concave. When the sacrum is absent then the ilia approach each other closely and articulate by ligaments with the last lumbar vertebra. The ilia may become fused with each other posteriorly and this fusion may be so extreme as to form one iliac plate or shield carrying a cotyloid cavity for the head of the femur. In a few cases the ilium has been found wanting on one side.

Ischia

Ischia. The ischial tuberosities always approach and fuse with one another in the middle line. The ischial rami are generally united with one another, as also are the descending pubic rami, so that the conjoined ischio-pubic rami form a keel extending from the pubis anteriorly back to the ischial tuberosities posteriorly and completely obliterating the exit of the true pelvis. In this fusion the ischia coalesce from the ischial spine downwards, so that in the complete skeleton the small sacro-sciatic foramina are non existent. When the ilia are present the large sacro-sciatic foramina exist as one large oval foramen partially subdivided into two by the projecting lower end of the vertebral column. (Vid. Fig. IV+V). Two acetabular cavities may be present, but owing to the fusion of the ischial bones they approach one another and generally look considerably backwards. Two complete acetabular cavities are found in the symeles and sometimes in the uromeles. In the latter the cavities may have partially coalesced, there may be one cavity with a slight median ridge to indicate its double character, orthere may be one single simple depression for the head of the single femur; the ~~latter~~ last condition is constant for the sirenomeles. Acetabula have been described on the sides of the sacrum (Rossi) or on the sides of the pubis (Hofer). When the cavity of the true pelvis is occupied by an osseous mass, as

as it is sometimes in the cases where the pubes and ischia are fused into one bone, then the acetabulum may be placed on the under surface of this bone midway between the pubis and the sacrum.

Pubis. The pubic bones may be so fused with one another as to form a ridge of bone projecting forwards anteriorly in the middle line, and the fusion between the pubic bones and the ischial bones may be of such a degree as to partially or completely obliterate the obturator foramen, but even when the foramen is completely obliterated the obturator canal, conducting the obturator vessels and nerves, remains. In some instances the bones have become laterally pressed together at a point some distance behind the symphysis pubis, so that the outline of the pelvis regarded from above is a figure of eight. No actual symphysis pubis is present, but the pubic bones may become widely separated and united by fibrous tissue. The difference in the pelves of the genera of symeliens is simply one of degree. In the symeles the least amount of fusion and suppression has taken place; in the sirenomeles the fusion and suppression may be extreme; the pelvis in the latter may be represented by an iliac shield with a mass of bone in front representing the pubes

pubes and ischia, whilst the pelvis of the uromeles is intermediate between those two. An idea of the varying forms of pelvis is given in Figs. IV, V, XXIII – XXVII.

Femora. Two distinct and almost normally developed femora may be present, as is the case in symeles. But even in the most perfect specimens variations from the normal are seen; the necks are short or absent, the heads being set directly on the shafts of the bone, and in all cases a certain amount of rotation outwards is evident. The amount of rotation may be slight or it may be considerable, the small trochanters may be directed forwards, and the great trochanter considerably backward; the shaft shows a similar rotation, whilst the internal condyle is rotated forwards and the external condyle backwards. The amount of rotation may vary from 90°, in which the patellae are situated externally, to 180°, in which they are situated posteriorly. Occasionally the amount of rotation of the two femora is unequal, one femur having rotated through a much greater angle than the other, but in the great majority of instances ~~however~~ the amount of rotation is equal, so as to preserve the symmetry of the composite limb. All degrees of fusion of the two femora may be found. The bones may be found distinct throughout their whole extent except at their inferior extremities which are fused

fused, or they may be fused at the upper extremities of the shafts but with distinct heads, whilst the remainders of the two bones ~~is~~ are perfectly distinct from each other, or the amount of fusion may be more extreme, resulting in one composite bone with two inferior extremities. One composite bone may be present, the shaft of which is much thicker than normal, and such a bone may have at its upper extremity two distinct heads articulating separately with the pelvis, and three trochanters, one representing fusion usually of the two large trochanters, the two smaller trochanters being distinct; the fused trochanters may shew their dual nature in two eminences projecting above the level of the common mass. Similarly at the inferior extremity there may be only two condyles present, resulting from the complete suppression of the two external ones, or a third eminence may be present posteriorly resulting from their fusion (Vid. Figs. xxiii-xxiii)

In the symeles two distinct femora may be found, or they may be fused to a greater or lesser extent at their upper parts whilst their lower extremities are always distinct and articulate with two tibiae (Vid. Figs. xxv-xxvii). In the uromeles the fusion of the femora is much more marked; there may be only one bone but plainly shewing evidence of its composite nature, and at the lower extremity it usually articulates with a composite

composite tibia or with the separate upper extremities of the parts of two tibiae (Vid. Figs XXVII).

In the sirenomeles one bone represents the two fused femora, giving usually, in the expanded nature of its lower extremity, evidence of its dual nature (Vid. Figs. XXIII XXIV XXVI).

Patellae. When two patellae are present they are directed to the exterior, to the posterior aspect of the limbs, or to some position between those two. The patellae may approach each other in the middle line posteriorly and fuse; the fusion may be so great that the bone shews no evidence of duplicity, or it may be so slight as simply to consist of union by their external borders. All degrees of fusion between those two may be found. In symeles two patellae are found, their relative positions in the limb depending on the amount of rotation each half of the latter has undergone. There may be two patellae, separate or fused, in the uromeles, one composite bone may be found in the sirenomeles, but even in the latter two separate bones have been described. Occasionally the patellae are absent.

Tibiae. The tibiae present a much greater degree of rotation than the femora. The bones or their representative are rotated through

through an angle of 180° so that the anterior surfaces are directed posteriorly and the posterior surfaces anteriorly. Hence it is that the flexion at the knee is anterior. There may be two distinct tibiae or they may be fused towards their lower extremities; these conditions obtain in the symeles and also in the uromeles. The fusion may become more extreme, giving rise to an imperfect tibia ending in a point inferiorly, as in the sirenomeles. The tibiae may be very rudimentary, being represented by a very small mass of bone. (Fig. xxvi-xxvii).

Fibulae. The peroneal bones when present are always placed in the middle line between the tibiae. Occasionally there are two complete bones, more frequently there is one composite bone, stouter than the normal fibula. This condition of the fibula is confined to the class symeles. In the uromeles and sirenomeles the bone is wanting altogether. The fibula when present articulates with the os calcis as well as the astragalus in the foot.

Tarsus. The variations in the tarsal bones are very great. In some symeles all the tarsal bones are present and the only fusion is a partial one between the os calcis bones on what ought normally to be their outer sides. It has been noted above

above, in the general description of the external appearances of symeliens, that the feet when present are united along their outer borders, the heels are internal and anterior, the soles directed forwards, the dorsal surface backwards, the little toes are internal and the large toes external. Hence it arrives that the os calcis bones lying in the median line are fused along their outer surfaces. All the other bones may be complete and separate, the only difference being that of position, the cuboid being placed internally and the cuneiform externally. Various degrees of fusion take place, the varieties being so great as scarcely to permit of a general description, nearly every single specimen differing from every other one in this region. The tarsus may be represented by a cartilaginous mass, or it may be absent altogether.

Metatarsus and Phalanges. The full number of metatarsals is rarely present; usually more or less fusion of the bones takes place in the middle line, the fifth metatarsals being most internal and oftenest fused. Occasionally two toes are present in the middle line resulting from one overlapping or being placed on the top of the other. The number of phalanges present depends on the number of toes; sometimes more than three phalanges are present

present in one toe. Very occasionally, when the tarsus is absent, the phalanges may articulate directly with the tibia. In the symeles and uromeles the tarsus, metatarsus, and phalanges are present to a varying extent, in the former very complete, in the latter very incomplete; in the sirenomeles these bony parts of the leg are entirely awanting.

With regard to the remainder of the skeleton, absence of some of the bones of the upper limb, e.g. radius, and the bones of the thumb, has been noted, but these defects do not seem to be important ones in symeliens, but rather are to be regarded simply as accidental complications. Meckel, as will be shewn later, laid great stress on these minor defects.

Increase in the number of ribs, even as many as sixteen, (Otto) or diminution as low as six, (ibid) and also fusion of adjacent ribs, may occur. Fusion of the sternum with ectopia cordis has been described.

Muscular System. It is only in the comparatively recently published cases of symeliens that one finds details with regard to the muscular system and these are too few to allow of anything but the broadest generalizations being made. As a general rule in all classes of symeliens the gluteal muscles are present; they may vary somewhat in origin and insertion, sometimes in the case

case of the gluteus medius and minimus, receiving fibres from within the pelvis, and sometimes one or other muscle is represented by fat or fibrous tissue or may even be absent altogether. The muscles which have an intrapelvic origin, e.g. the pyriformis and obturator internus, are defective or absent altogether. I have not been able to find any reference anywhere to the levator ani and coccygeus muscles; their absence may therefore be considered the rule. The obturator externus is very generally present and normally disposed. The gemelli muscles are variable. They may be, especially in the case of the superior gemellus, completely absent, or they may be fused with those of the opposite side into a transversely running strip. The quadratus femoris is frequently fused with its neighbour of the opposite side into a transverse muscle or it may fail completely. In the thigh the hamstring muscles are generally absent or deficient; when the biceps is present the long head is generally awanting. Fusion of the hamstrings may take place as in the semitendinosus muscles of my specimen. I have not been able to find a single instance in which the hamstring muscles were complete. The adductor muscles with the pectineus and iliopsoas are generally completely and normally developed in symeles. Varying amounts of fusion and suppression of these muscles take place, so that in the sirenomeles an

an indefinite muscular mass only may be present. The ~~origin~~ insertion of the sartorius, when that muscle is present, owing to the rotation of the limb, is covered by that of the gracilis; the other muscles on the front of the thigh, when present, are directed outwards owing to the rotation of the limb also. The same remark applies to the vastus externus which is directed somewhat backwards on account of the same reason. This rotation outwards in the case of the uromelus and sirenomeles may be so great that the two vasti-externi muscles may be fused together in the middle line posteriorly.

In the sirenomeles the muscles of the leg and foot are completely absent or represented at most by a few fibres. In the symeles the muscles may be practically normal so far as origin and insertion are concerned, but owing to the rotation which the limb has undergone, the muscles which normally are on the anterior surface of the leg, have become posterior, and those which normally are posterior, are anterior, and the muscles arising from the fibula are most internal, whilst the tibial muscles are external. This alteration of the normal relationship is well illustrated in my own case. In the great majority of cases the calf muscles, the gastrocnemius and soleus, are absent or represented only by rudiments, and the popliteus

popliteus in all cases is a composite or rudimentary muscle. In the foot all the muscles may be present except those of the little toe which are absent, or represented at most by a few fibres. In the uromeles the same altered position of the muscles is found, but here the fusion and suppressions are so great that almost every specimen described differs from all others. Very often there is one fused muscle on the back and one on the front of the leg from which tendons representing different muscles may be traced to the foot or toes.

Nerve Plexuses. Details of the various nerve plexuses are not abundant. This is partly due to the fact that the plexus which undergoes the greatest change may be very rudimentary indeed, and difficult of dissection, and partly to the fact that anatomists have hitherto concentrated most of their attention on the skeletal and visceral changes, and have paid scant attention to muscles and nerves. The lumbar plexus shews trifling changes; the obturator nerve may vary somewhat in its origin, arising somewhat higher from the cord on one or both sides. Owing to the constant and profound changes in the sacral and coccygeal vertebrae marked changes are found in the sacral plexus. The arrangement of the plexus corresponds to the modifications in the sacrum. The number of nerves entering into

into the plexus may differ on the two sides, and in all the cases in which I have been able to find reference to this plexus, the lower portion of the plexus and the coccygeal nerves were absent, a correlation with the absence of the external genitalia, anus, and lower end of the alimentary canal. Generally all the nerves entering into the plexus unite into one large sciatic nerve, from which the other branches, e.g. gluteal, obturator and quadratus femoris branches, arise. The sciatic nerves on emerging from the pelvis unite with one another and run down the composite limb to end in various ways, by dividing into two, three or four branches. Sometimes the sciatic nerves are absent and the gluteal nerves only present, or they may be represented by thin strands coming off a single stem in the pelvis, or the plexus may be reduced to a flattened fibrous mass from which no branches make their way to the exterior of the pelvis, or lastly, the plexus may be completely awanting, as in those cases in which the sacrum is absent.

Circulatory System. Like the viscera the circulatory system is generally normal above the diaphragm; very few unimportant modifications having been described. In the abdomen absence of the renal, inferior mesenteric, and lumbar arteries has been very frequently

frequently observed. Renal arteries have been noted in some cases in which kidneys have been present. The middle sacral artery has been traced in a few cases into the caudal appendage when the latter was present. The chief interest lies in the umbilical arteries. Bocrhaave and Behn were the first to draw attention to the fact that in symeliens only one artery was present in the cord and that it arises in an anomalous manner. Meckel stated that the presence of only one umbilical artery was a constant fact in the anatomy of symeliens, and as far as I have been able to discover from the literature, this may be regarded as being practically the case. Absence of one umbilical artery is not confined solely to symeliens, it may be found in normal foetuses and in other teratológical conditions, notably incases of absence of the ilium (Taruffi), but it is a constant feature of symeliens. Not only is there only one artery present, but in the great bulk of cases it arises from the aorta in an anomalous manner. Very rarely does it arise from the external iliac arteries, and in general it arises from the aorta itself; it may arise from the bifurcation of the aorta or from any point between this and the origin of the superior mesenteric artery. Sometimes the umbilical artery, arising from the aortic bifurcation, has such calibre as to

to seem more like the continuation of the aorta than its branch, and when it arises above the bifurcation its calibre is often much greater than that of the aorta below its origin. Rarely do two arteries arise, as in my own case, from the external iliacs and course round the brim of the pelvis to the anterior abdominal wall to fuse there into a single vessel. Sometimes the artery runs in a fold of peritoneum to the umbilicus, being in such cases often accompanied by the terminal portion of the intestine.

The branches of the internal iliac may be fairly well developed with the exception of the pudic branches which are generally absent, as is also the corresponding nerve. The internal iliac branches are usually only found well developed in the symeles, but in the uromeles, and even in some sirenomeles, the obturator artery may be well developed and run through the obturator canal with its corresponding vein and nerve, to end in the muscles of the conjoint limb. The internal iliac branches may be vestigial and the artery itself may be absent. In the femoral trunks one finds all variations from practically normal arteries in the symeles, pursuing a normal course and giving off normally disposed branches, to mere vestiges, in the sirenomeles, ending a short distance below the fold of the groin

groin in the muscular mass of the limb. The femoral trunks may fuse with each other to form a single median trunk running down to terminate in or near the end of the fused limb, or they may unite with each other to form an arch from which numerous small branches run to terminate in the muscles of the limb.

Viscera. As a general rule all the viscera above the diaphragm are normal; such abnormalities as do occur are infrequent and unimportant and are to be regarded as accidental complications. Ectopia cordis and supernumerary lobes of the lung have been observed, abnormalities which are found in widely varying conditions and have no connection, other than accidental, with symeliens. The diaphragm has been seen once to be completely absent (Paganisi) and in several other instances it has been found partially deficient, giving rise to diaphragmatic hernia. The liver has, on one occasion, been found completely absent, as were also the pancreas and spleen (Switzer), but in the majority of cases no variations of importance have been noted. Absence of the gall bladder, or its place taken by a dilatation of the hepatic duct, or the liver subdivided into supernumerary lobes, have been reported. Stomach, pancreas and spleen are generally normally developed and situated. It is in the intestine, however, and in the intra-pelvic portion of it usually, that the most important and constant modifications are found. In

In the vast majority of cases the large intestine ends in a blind, dilated, bulbous or conical extremity, often filled with meconium. The intestine ends, according to most authors, at the sigmoid flexure. In my own case, owing to the whole of the intestine being supplied with branches from the superior mesenteric artery, the inferior mesenteric being absent, I have regarded the gut as ending at the end of the transverse colon, the descending colon and rectum being present in a very rudimentary form. Sometimes a tube or cord continued from the blind saccular extremity of the large intestine passes with the umbilical artery to the umbilicus. Sometimes the cord-like continuation of the intestine ends in the fibrous tissue over the sacrum, and in some instances the narrow canal found in a certain number of caudal appendages has been traced into the dilated extremity of the intestine. Rarely does the intestine open inferiorly, and then, as in Julliard's[54] case, it does so in an anomalous manner.

Urinary Organs. Kidneys. The kidneys in a great many cases are completely absent. I have tabulated (Table VI. P. 146) the cases in which I have been able to find mention of them. In some cases one kidney may be present, whilst the other is completely absent; in a few

few cases both kidneys are present but rarely normal; in the majority of cases, when the kidneys are present, they are cystic, often being represented by very thin walled sacs in which renal tissue is found with difficulty. The kidneys are more often present in a more or less imperfect condition in the symeles than in the uromeles and sirenomeles; indeed it is the rule in the latter to find the urinary organs completely absent, but Dunn[31] and Smith[121] have described cases in which both kidneys were present but cystic.

Suprarenals. The suprarenal capsules on the contrary are almost always present, and may be larger than normal, even in the cases where there is complete aplasia of the kidneys. Presence or absence of the kidneys seems to bear no relation to the presence or absence of the suprarenals, and there is on record a case (Otto[80]) where one kidney was present but the corresponding suprarenal absent, whilst the suprarenal of the opposite side was present.

Ureters. Even when the kidneys are present the ureters are nearly always absent, the pelves of the kidneys being closed. In those cases where they have been described, they ended blindly, or joined with one another to end blindly; only in very rare instances

instances do they join the bladder or its rudiment.

Bladder. The bladder, like the kidneys, is gearally awanting in all symeliens; when it does exist, it is usually very rudimentary, sometimes being represented by a small tube about the thickness of a quill; into this rudiment the ureters and deferent ducts open very rarely. The urachus is also generally absent, although its presence has been noted where no trace of bladder could be found. The urethra naturally is also almost always awanting; in a few cases a very short canal running a short distance from the rudimentary bladder has been described, and in only one instance (Behn[9]) have I been able to find a record of urethra leading from a rudimentary bladder to a well formed penis; in this case both kidneys and ureters were absent.

Generative Organs. Although in the majority of cases all trace of external genitalia is absent, yet on the contrary the internal generative organs are more or less developed. In the males one or two testicles may be found in varying situations in the abdomen, generally at or near the site of the deep abdominal ring. Vasa deferentia may be absent; when present rarely do they open into a rudimentary bladder; more often they open into the rectum. In the female one or both ovaries with corresponding tubes

tubes may be found. The condition of the uterus varies; it may be of a bi-cornate form, or almost completely divided into two parts, as in my own case. It may fail altogether or be represented by small hard solid nodules, or a cord-like structure. The above statements with regard to the generative organs apply equally well to all three classes of symeliens, with the proviso that defect and absence are more common in the sirenomeles than in the uromeles and more common in the latter than in the symeles.

SUMMARY OF GENERAL ANATOMY OF SYMELIENS

The essentials of symelian anatomy may be summarised as follows:-

(1) The posterior limbs are rotated in such a manner that the soles, when feet are present, look forward, and fusion takes place along the outer surfaces of the limbs.

(2) External genitals and anus are absent.

(3) Only two blood-vessels are found in the cord, one artery and one vein.

(4) Varying amounts of deficiency of the structures of the fused limbs.

(5) Varying amounts of fusion of the structures in the fused limbs.

(6) Abnormalities in the spinal column; deficiency, rarely excess of vertebrae.

(7) Varying defects and fusions in the pelvis.

(8) Defects of the viscera, chiefly absence of the uropoietic organs and defects in the termination of the large intestine.

ETIOLOGY.

The teratogenesis of symeliens is one of the most interesting and perhaps one of the most difficult of all teratological problems. At the outset one is met with the difficulty that embryology is not yet perfectly clear and definite in the normal development of limbs, and until the normal development is properly worked out it will be difficult to satisfactorily explain all the phenomena of symelic monstrosities. It is scarcely necessary to review the earlier theories with regard to this form of monster; ,in common with other teratological phenomena, and following the teaching of Swammerdam it was believed to be due to an original malformation or monstrosity of thegerm. The theory of the original monstrosity of the germ, an inevitable corollary to the preformation theory of the early anatomists, received its death blow from the embryological studies of Wolff. This great embryologist shewed that the preformation theory was absolutely untenable, and that the embryo grew from a simple germ utterly unlike the mature animal, by a complicated evolution, and that the process was not one of simple enlargement of a very minute animal to the size of the mature

mature specimen. This doctrine of epigenesis, as it was called, rendered at once the theory of the original monstrosity of the germ impossible, as it was evident that if animals were developed from simple cells or germs, if there were no pre-existing organisation in such germs, then no original monstrosity could exist. The anomalies of organisation must appear at certain periods of development following upon modifications in the evolution of certain organs or groups of organs.

The theory which followed that of the original monstrosity of the germ and which continued to be accepted by most teratologists until a few decades ago was that of maternal impression. In common with other teratological phenomena this theory was applied to account for the birth of symeliens. I have referred in a preceding part of this paper to the case reported by Dunn[31] (Vide p. 48), and Geoffroy St.Hilaire, although not giving credence to the theory, relates that the father of one of his cases was a soldier who had lost one leg in battle, but in the majority of cases of symelic births no reason in the way of maternal impression is assigned for the phenomenon. To-day, maternal impression is given a very subsidiary position indeed in the etiology of monsters and one must look elsewhere for an explanation of their occurrence.

Meckel

Meckel,[40] the great German anatomist, in despair of finding a satisfactory explanation of this extraordinary abnormality, reverted to the idea of the original monstrosity of the germ, and in support of this theory he shewed that Symeliens were frequently abnormal in other respects, e.g. absence of thumbs, or bones of arm &c. He was led thus to give importance to very subsidiary facts in symelian anatomy, but as shewn above, the progress of embryology had shewn the theory of original monstrosity of the germ to be untenable. Meckel's hypothesis was enunciated in 1825, but as late as 1859 Calori, finding himself unable to explain the defects in the lower end of the spinal column, and in the viscera, reverted to Meckel's hypothesis of the original monstrosity of the germ.

A year prior to Meckel's work on symeliens, Cruveilhier[23] had enunciated the theory of external pressure. Looking at the fusion of the limbs and their peculiar rotation, the contraction of the pelvis and the imperfect condition of the pelvic viscera, this eminent French anatomist came to the conclusion that this form of monstrosity could be explained if one imagined two external forces acting on the embryo, the one force causing rotation of the limbs from within outwards and backwards, and the other acting laterally, pressing the limbs together

together, and thus causing their fusion. But Cruveilhier did not find it an easy matter to explain what these forces might be which would act in this manner. He imagined that intra-uterine pressure might be increased in some manner, as forex-ample by the occurrence of hydrocephalus, which he stated to occur frequently in symeliens. A careful search through the literature has only revealed its occurrence in four other cases in addition to my own (Vide Table V. P. 146), so that hydrocephalus can, by no means, be said to be of common occurrence. Cruveil-hier also suggested that uterine contraction might contribute in producing symeliens, though, as he points out in one of his cases, the mother of which wore no corsets, no evidence of ex-ternal pressure could be always adduced. But there is no his-tory of uterine contractions obtainable in any of the cases, as there would almost surely have been did they occur, and even granting that they do occur it is almost certain that uterine contraction potent enough to cause such a deformity would almost inevitably produce abortion. Moreover the physical condition of the embryo, surrounded as it is on all sides by the fluid of the amniotic sac, is such as to guard it most ef-fectually from the effects of such external pressure, even though it did exist. Several facts, any one of which is almost necessarily

necessarily fatal to Cruveilhier's hypothesis, at once emerge, even if one were disposed to grant any or all of the factors suggested by him as giving rise to this pressure. It is impossible that any pressure strong enough and constant enough to cause the complete fusion of the lower limbs of a foetus could act and yet leave no trace externally, no mark or record of any sort of its existence, even presupposing that this pressure only took place after the bones were sufficiently ossified, as they are not, to resist any marking. External pressure will not account for the visceral defects, defects not confined entirely to the pelvic viscera, nor is it easy to conceive how external pressure could be so regulated and nicely applied as to produce structures of such symmetry; indeed the almost perfect symmetry of symeliens cries out against the theory of external pressure and demands some deeper, more fundamental, reason.

Prior to the publication of Cruveilhier's descriptions the great work of Isidore Geoffroy St.Hilaire[99] appeared, in which, for the first time, the facts of teratology were systematised scientifically and a classification of monsters made, so complete, that up to the present time it has not been superseded nor even altered except in minor details. In this work

work St.Hilaire gave a description and a classification of symeliens and attempted a partial explanation of the phenomena they present. He pointed out that in development there are organs, which, originally paired and lateral, later become, in the natural course of development, united in the middle line. Other paired and laterally situated organs remain throughout life paired and lateral, but occasionally as a variation from the normal they meet and fuse with one another in the middle line; such organs are not situated far from each other, nor are they separated by many or important structures. On the other hand, certain paired and laterally situated organs are separated from each other by a fair distance, or by many and important organs, and such paired structures are never found united with each other unless as a sequel to very grave defects of the intervening organs., defects so grave and serious as to constitute not an abnormality only but a veritable monstrosity. In the thoracic region the superior limbs are far apart, and separated by such important organs as the heart and lungs, which even in the most defective condition are never wholly awanting; hence fusion of the upper limbs in simple monsters is unknown. But with regard to the inferior limbs, they are not so widely separated, nor do such important organs intervene; hence in the occasional absence of these intervening structures there is nothing

nothing to hinder the meeting and fusion of the developing hinder limbs, with the formation of the symelian monster. St. Hilaire formulated, to explain the fusion of bone with bone, blood-vessel with blood-vessel, and nerve with nerve, the law of the affinity of like structures for like (Loi de l'affinité de soi pour soi); that is to say, that given the proper conditions, the fusion was as natural as the fusion of other parts, which, at first paired and lateral, become normally united at a later period of development. He also stated that far from being surprised at the fusion of the lower extremities we ought rather to be astonished at its rarity. When paired and lateral organs such as the kidney and testes become median and fused, a certain amount of atrophy of each organ is found, and in the same way we should expect, says St.Hilaire, a certain amount of suppression of parts in the composite limbs. St. Hilaire confessed that certain constant features of symelic anatomy he was at an utter loss to explain; the constant rotation of the limbs with their consequent fusion along their outer surfaces instead of their inner, absence of the kidneys and bladder, the constant abbreviation of the intestine, the absence of external genitalia and anus, and the presence of only one artery in the cord were all phenomena of which the state

state of the science then afforded no explanation, but he appealed hopefully to the progress of science to solve these knotty problems, just as other facts which had been looked upon as quite inexplicable had been satisfactorily explained by the progress of science.

Defects of Nutrition. Later writers, Orsolato[98], Calori[15], Weigert[117], Serres[120], laid stress on the imperfect development of the arterial system, the absence of an umbilical artery, the poor development of the iliac and femoral trunks, and sought to attribute to the consequent lack of nutrition the imperfect development of the pelvis with a resulting fusion of the limbs. This was a most inadequate explanation as it not only failed to make good any of the defects in the hypothesis of St.Hilaire, but it was quite at a loss to explain almost any of the constant features of symelic anatomy. The symmetry, the gradual transition of one genus into the other, from the epi-sympus dipus to the sirenomelus, are facts alone sufficient to negative arterial defect as the etiological factor in this monstrosity, and rather must we consider such circulatory defects as resultants of the deformity, and not as its causative agents.

Vrolik[115] after rejecting the theories of external pressure and arterial defect came to the conclusion that the cause

cause must be sought for in some primary defect in the pelvis which brings about the deformity of the pelvis and its contained viscera, and that the fusion of the limbs is secondary to this pelvic defect. He could, however, give no idea as to the nature of this primary defect of the pelvis and its viscera. This hypothesis is open to the grave objection that it makes no attempt to explain the rotation of the limbs which is a constant and integral part of symelian anatomy.

Successive teratologists have given various mechanical explanations, e.g. Julliard[54] thought that unequal muscular development on the two sides would serve to explain the rotation and fusion of the limbs. But the muscular development of the halves of the conjoint limbs is often markedly symmetrical, and the position of the muscles in the limbs ought rather to be considered as the result of the rotation, and not its cause. Labougle and Regnier,[58] following Cruveilhier, attributed the pelvic defects and fusion of the limbs to an external compressing force acting laterally on each side, and also from before backwards. What the nature of this mechanical force was they could not determine. The objections offered to the hypothesis of Cruveilhier apply equally well to that of Labougle and Regnier, and it need not be further discussed.

uniotic

Amniotic Pressure. Of all mechanical explanations that enunciated first by Camille Dareste[25] in 1868 is most worthy of consideration. Symeliens don't occur often in the lower animals, but Dareste has seen two cases in birds, and several other cases in which it would have occurred if development had been allowed to proceed. His observations have led him to believe that symeliens result from arrested development of the posterior part of the amnion, the part he calls the "capuchon caudal". "Lorsque ce capuchon s'est arrêté dans son developpement, qu'il ne s'est pas replié au dessous de l'extrémité posterieure, et qu'il reste appliqué sur elle au lieu de s'en écarter, comme il le fait dans l'evolution normale, les bourgeons qui sont le point de départ des membres posterieurs, au lieu de descendre des deux côtés du corps, se renversent en arrière, et viennent se placer au dessus de l'embryon. Ils se rapprochent alors l'un de l'autre par leurs bords extérieurs devenus internes. Puis, si la pression continue à s'exercer, ils se soudent entre eux et donnent naissance à un membre unique contenant, en plus ou moins grande quantité, les elements de deux membres, et qui tantôt se développe complètement et tantôt se reduit à un simple morgnon, comme dans l'hémimélie". (Production des Monstruosités 1891, p.420). This pressure, due to the lack of development

development of the tail fold of the embryo takes place at a very early stage (Vide Figs ~~xxiii xxiv~~) when the embryo is composed of practically homogenous cells, and the definitive organs, muscles, bones, nerves &c., develop in the homogenous mass of the fused limb buds. This mechanical explanation has this great value that it is the result of direct observations, but there are certain points in symelian anatomy which Dareste himself confesses he cannot explain by this means, viz, the absence of kidneys and bladder, the defects in the intestine and generative organs, and he asks the obstetricians who may assist at such monstrous births to take note of the condition of the placenta in order to get, if possible, a clue to these defects. This request seems to me to conceal a suspicion that his explanation is not quite adequate, and that some more profound internal factor must in addition be sought for. For my own part I confess I cannot quite understand the process by which the limbs are turned back and fuse with one another in such a way that their internal borders become external and their external internal, nor is it quite easy to conceive how narrowing or non-development of the posterior end of the amnion could, even at a very early stage of embryonic life, lead to the symmetrical development characteristic of symeliens; such pressure would

would require to be very evenly and regularly applied indeed to get such constant results.

Gebhard[34] has adopted the theory of Dareste, modifying it in order to bring it into line with modern embryological research. He points out that at first the limb develops in such a way that the tibial side of the limb is proserial, the fibular side retroserial, the flexor surface directed inferiorly, and the extensor surface superiorly, and as development proceeds the limb undergoes a rotation inwards, that the right limb rotates from right to left and the left from left to right. If by amniotic pressure the limbs are brought close together at an early stage, and fusion takes place, then this normal rotation is prevented from taking place, so that in symeliens it is not correct to say that rotation from within outwards in each half of the composite limb has taken place, but rather that the normal rotation from without inwards has been prevented from taking place. This explanation of Gebhard is a distinct advance on that of Dareste, as the apparent rotation of the limbs is accounted for, but the theory fails completely to account for the intestinal and uropoietic defects.

Of all the theories which have been advanced to account for the occurrence of symeliens the only one which I regard as being satisfactory is that of St.Hilaire. Briefly put it

it states that owing to the failure of development in the posterior part of the embryo, the limb rudiments are brought into contact, and following a natural law fuse with one another and produce the symelic form. The development of science has cleared up, as St.Hilaire predicted it would do, the difficulties in the way of accepting this hypothesis, and I propose to show how it is possible with the aid of the later developments of anatomy and embryology to shew how all the phenomena of symeliens can be explained on the hypothesis of St.Hilaire, without having recourse to any mechanical explanation whatever. In this elaboration of the hypothesis of St.Hilaire I have found the most suggestion and help in the writings of Louis Bolk[13] to whose papers I have given a full reference.

There is no doubt but that the human body is made up of a series of what were originally homologous segments. This original segmentation, evident in the early embryo, is almost completely lost in the adult, only certain structures, e.g. the spinal column, the cord, ribs and certain blood vessels retaining the segmental condition. But still even in the body of the adult it is possible to trace to a certain extent the boundaries of the segments of which it is composed, and this has been done in this manner. It has been shewn that each developing

developing nerve supplies the developing skin or dermatome, the developing muscles or myotome, the developing skeleton or sklerotome and the developing alimentary canal or enterotome of its own segment and of its own segment only. No matter what subsequent change takes place in the elements of the segment or how far they may apparently wander from their original position, the segmental nerve keeps pace with and attached to them and binds them all together as it were with one nervous cord, the neurotome. Hence if one can trace out a single spinal nerve through all its ramifications and into its ultimate terminations, then the skin, muscles, bone and viscera supplied by that nerve developed from, and belong to one original segment.

The segmentation of the embryo is a phenomenon which is accomplished according to very definite and fixed rules and it begins at a very early age in the anterior part of the embryo. Here at a certain definite point, as Cleland[19] pointed out, there is a growing area from which growth and segmentation proceeds forwards and backwards. The segmentation proceeds till a certain number of segments, characteristic of each species, is produced, and in man, if the head segments are left out of consideration, the number is thirty three. If the number of segments is deficient, then the embryo will be deficient, and if the posterior segments fail to develop to a certain extent then the

the symelian type of monster is produced. To understand how this is brought about one must examine the segmental development of the posterior end of the trunk and inferior limbs. Bolk has shewn how it is possible to reconstruct the segmentation of the limb bones. In Fig. XXIX is a sketch of the inominate bone with the muscular attachments marked on its outer surface, and the spinal segments which supply each muscle, that is to say the segments which have contributed to the formation of each individual muscle. The muscles attached to the inominate bone are developed from the twentieth to the twenty seventh segment, and it will be evident from the figure that the muscles developed from the more posterior segments are attached more towards the dorsal surface of the bone. The segments or myotomes are not attached haphazard on the pelvis but in a regular succession from the ventral to the dorsal borders. In Fig. XXX the red lines indicate the limits of the zones of insertion of the twentieth to the twenty seventh myotome. The zone of insertion of one myotome Bolk designates as the "sklerozone" and the sum total of these "sklerozones" in a bone as the "sklerozonie" of that bone. A connection between the primitive segmentation of the muscular system and the skeleton is to be recognised, and it follows from this that in the early embryo where there are no muscles but only the primitive myotomes

myotomes the latter are attached to the skeleton in a simple state before differentiation has begun. In this simple myotome septa appear and divide it into individual muscles, so that in the evolution of an embryo the limb muscles do not undergo a change of insertion; their insertions are fixed as a result of this division in the metameric muscular mass. Again, there can be little doubt but that the myotome is isomeric with the part of the skeleton to which it is attached, so that, for example, the part of the iliac bone covered by the twenty third sklerozone is derived from the mesenchyme of the twenty third segment. Thus when the sklerozonie of a bone has been determined one can state what segments enter into its composition, e.g. the inominate bone is derived from the skeletogenous tissue of the twentieth to the twenty seventh segments.

Goodsir was the first to entertain on theoretical grounds the principle of the segmentation of the limbs, and it is now possible by the aid of the above principles to state, more definitely than he was able to do, the segments that enter into the construction of the inferior limb. In Fig. XXXI is a somewhat diagrammatic sketch constructed on the above principles after Bolk and shewing the segmental nature of the skeleton of the entire inferior extremity. The limb is drawn as seen

seen from above, so that only the ilium which develops in the dorsal parts of the segments is seen, and as if it (the limb) were inplanted at right angles to the trunk. The parallel lines indicate the limits of the segments. Suppose that the development of segments fail posteriorly at any one point, for example after the twenty third segment as figured schematically in Fig. XXXIII, then all parts behind this segment will fail; this applies equally well to the right limb as well as the left, and to the parts which ought to develop normally in the middle line from the missing segments. It is easy to conceive with the aid of the diagram how the parts of the posterior limbs, since there is nothing to prevent their fusion, will grow out together from the very commencement and form a fused limb, such as one gets in the uromeles. If more segments should fail,e.g. beyond the twenty-second, then the result would be a sirenomelus (Vide Fig. XXXI line 22), whilst if only the most posterior segments should fail, say beyond the twenty sixth, then a symelus would be the result, with all the bones of the limbs present and only having fusion in the tarsal region (Fig. XXXI line 26). With varying defects in the formation of the segments all varieties of symeliens will be produced; a comparison of Figs. XXXI & XXXII will render this fact easy of comprehension. The

The hind gut and its derivatives, and the external genitals as their innervation shews, are all derived from the most posterior segments of the embryo which are always wanting in symeliens, so that these structures must necessarily fail. This hypothesis of defect in segmental formation also serves to explain the muscular anomalies of symelian anatomy. In those cases in which the muscles have been carefully described it is evident that it is the muscles which are derived from the myotomes of the posterior segments, e.g. the hamstring muscles, which are constantly absent or defective. Of course secondary fusion of muscles must necessarily take place, and the altered position and fusion of the bones also give rise to secondary modifications of the muscles.

This explanation, which after all is only St.Hilaire's theory expressed in modern terminology, has the merit that it explains all the essential features of symelian anatomy, the rotation of the limbs, or rather the failure to take place of their natural rotation, their fusion, their symmetry, and the gradual transition of one species into another, the visceral defects, and the absence of anus and external genitalia.

But if we seekto go deeper into the origin of things and ask ourselves what is the cause of this failure of the posterior

posterior segments to evolve, we are met with a difficulty which, following the example of St.Hilaire, we are inclined to leave to the scientists of the future to elucidate. The cause is one which must act at a very early stage in embryonic existence, within the first few days in fact. An examination, (which is not yet completed) of the brain of my specimen, shews an inflammatory condition round the cerebrospinal canal, and it is only a speculation that some very early inflammatory condition may arise in the embryo causing defective formation of the body segments, but nothing is known of such very early ante-natal pathology. On the other hand the failure of the segments to evolve properly may be regarded as a defect, pure and simple of the embryo, an inability of the blastema to form the necessary material for the growth of the segments, and in this view we come very close to the notion of an original defect or monstrosity of the germ, though not in the sense meant by the older writers. Manners-Smith[121] accepts the theory of St.Hilaire, but expresses the opinion that the failure of the limb buds to evolve properly with their consequent fusion must be regarded as a reversion to the primitive condition of the posterior portion of the fin elements of certain fishes. The lateral epiblastic folds in the region behind the anus meet in the middle line and fuse to form the ventral unpaired fin, and

Manners

Manners-Smith thinks that the process which occurs in symeliens is comparable to this unpaired pelvic fin formation, and that the fused lower limb may be regarded as homologous to a certain extent with such a fin. One can only criticise such an interesting and ingenious theory by stating that it is impossible in the present state of biological science, either to prove or to refute it, the question of the homologies of fins and limbs being by no means a settled one.

Two points in symelian anatomy still remain for consideration, viz. the caudal appendage not infrequent in this monstrosity, and the presence of one umbilical artery.

Tails

Caudal appendages are found in various other conditions besides the symelic, and modern embryology has furnished the explanation of their existence and their structure, but I confess I have searched in vain for a satisfactory explanation of their fairly frequent occurrence in symeliens. The tails which have been described have been due in some cases to the backward projection of the lower end of the spinal column, coccyx or sacrum, or have been due partly to this cause and partly to a distinct soft tail-like outgrowth containing nerves, bloodvessels, muscular fibres, and in some cases, a narrow epithelial lined canal communicating with the lower end of the closed

closed large intestine. Some of the tails described have been wholly soft and contained no projection of the spinal column. Embryology can quite fully explain the structure of such tails. In the early human embryo, as shewn by His,[49] a distinct tail is present, and in embryos of about 15 mms. long there are seven coccygeal vertebrae, the last part of which project some distance into the tail but do not reach its extremity. The tail also contains the prolongation of the spinal cord, the termination of the aorta and inferior vena cava, and a mesenchymatous thickening representing the post-anal gut. During development all these structures atrophy, and the tail gradually disappears by alterations and growth in surrounding parts and the reduction or fusion of the coccygeal vertebrae to two, three or four.

If development is arrested in any way then it is clear these tails may persist, the soft ones being due to the persistence of the soft terminal part of the tail (caudal filament of His[49]) and those which contain cartilage or bone to the arrest of growth at a somewhat later stage. With regard to symeliens one must conclude that the most posterior segments which enter into the structure of the tail must persist whilst those slightly proserial to it which form the limbs and posterior part of the trunk are defective or wanting. I have not been

been able to formulate any hypothesis to satisfactorily explain this phenomenon.

Umbilical Arteries. The presence of one umbilical artery in the umbilical cord may be regarded as a constant feature of symelic anatomy, and various teratologists have given varying explanations of this fact. I have given in the fore part of this paper (Vide p. 74) a resumé of the varying disposition of this artery, and will now briefly consider the explanations offered of the condition. There can be little doubt but that the single artery of the cord is to be regarded as a result of the fusion of two arteries. This is especially evident in my own case in which two hypogastric arteries arose separately from the common iliacs and ran round the pelvis to reach the anterior abdominal wall where they fused into one (Vide P 89) and also in the case reported by Moorhead[73] where one single artery arose from the abdominal aorta, and divided into two branches which coursed separately for a short distance towards the anterior abdominal wall, and then fused again to form one single artery running to the umbilicus and cord. Serres long ago pointed out in his paper on the symmetry and conjugation of the circulatory system how frequent was the occurrence of fusion between neighbouring arteries; single umbilical arteries are

are not uncommon in other terata, and occur even in normal foetuses. Reference to the development of the umbilical arteries aids the explanation of the frequency of single vessels in symeliens. Figure XVI is a diagrammatic sketch of the developing umbilical vessels. They arise at first from the lower end of the aorta, as a single vessel (U^1 Fig XVI) which soon divides into two branches (U^2 U^2) which run separately to the cord. At a later period of development, the two hypogastric arteries (U^3 U^3) arise on each side from the common iliacs and run to join the two umbilical arteries (B.Fig. XVI). The portion of the original umbilical arteries intervening between this junction and the aorta degenerates and disappears so that the umbilical arteries come latterly to arise from the common iliac arteries. It is easy to conceive that in symeliens where the branches of the common iliac arteries may often be interfered with, that the primitive condition of origin from the aorta may persist or even the artery may continue single as it is at its origin, or if it does divide, unite again and regain its primitive single condition. The origins of arteries are notoriously variable, and it is conceivable that the origin of the primitive umbilical artery (U^1 Fig. XVI) may shift up and down the abdominal aorta to a considerable extent and may even

even reach the bifurcation and simulate the continuation of the abdominal aorta.

Weigeft has sought to explain the presence of one umbilical artery in a different manner. He pointed out the fact that in the embryo there are several vitelline or omphalo-meseraic arteries, and that under normal conditions only two of these persisted as the superior and inferior mesenteric arteries; but should the development of the normal hypogastrics be interfered with he imagined that an additional vitelline artery might persist and function as the single umbilical artery. If this hypothesis were correct one would expect to find the umbilical artery occasionally as a continuation of the persistent omphalo-meseraic arteries, the superior or inferior mesenteric arteries, but I have not been able to find any record of this, and I think my hypothesis is more in accord with developmental facts, and fits in better with all the known variations of the umbilical arteries in symeliens.

Ballantyne in a very interesting and suggestive paper has adopted the hypothesis of Weigeft, and in addition suggested that the placenta in symeliens is a vitelline and not an allantoic one. He is impressed with the almost constant absence of the lower end of the intestine, the bladder and the urachus, and comes to the conclusion that the allantois and all its derivatives

derivatives are absent, and consequently that the persistent omphalo-meseraic artery must vascularize the placenta. Ballantyne was only able to find eleven references to the placenta and in none of these had a miscroscopical examination of it been made, so he founds his contention chiefly on the condition of the umbilical artery which he considers a persistent vitelline vessel, on the fact that in one symelien examined by him the ductus venosus in the liver was absent, and also that he has been able to find traces of persistent vitelline arteries in the cords of several foetuses. In my own case an injection was made of the umbilical vein, and it was found to be continued into the ductus venosus in the liver, so that the absence of the latter structure is not a constant feature of symelian anatomy. Moreover the umbilical vein gives branches to the liver in addition to being continued into the ductus venosus and it is possible that the absence of the ductus in Ballantyne's case was an accentuation of this fact, the ductus being present but very small. I have also failed to discover any correlation between the presence or absence of allantoic viscera and the origin of the umbilical arteries; in the cases of Sachsse, Behn and myself in which the umbilical artery arose from the hypogastric no trace of uropoietic organs was discovered, whilst in Otto's case nymber CCLX. in which the umbilical

umbilical artery arose from the aorta a urinary bladder and urachus were found. The most recent researches on placentation have failed to reveal at any period of development in the human the slightest hint of a vitelline placenta, and I am inclined to think that Ballantyne's assumption of its occurrence in symeliens is based, as yet, on somewhat slight evidence.

Summary. The conclusions with regard to the etiology of symeliens may be summed up as follow. During the first few days of embryonic existence some cause, at present unknown, so acts at the segmenting vegetative area of the embryo as to prevent the development of the normal number of segments, and the limb buds, by reason of this failure, are fused with one another ab initio, their normal rotation fails to take place, and in the primitive blastema of which the fused limb-buds are composed the developing bloodvessels, muscles, nerves and bones fuse with each other (Loi de l'affinité de soi pour soi) to a varying extent and thus produce all the characteristic features of symelian anatomy. According to the number of segments which fail, the varying genera of symeliens are produced, and thus is explained, as no other theory does, the symmetry of these monsters and the gradual transition from one form into another.

SUMMARY OF NOTES OF CASES.

1. Abramoff and Riezanoff.

Normal labour, child lived four minutes. Tail-like excrescence over the sacrum with an opening regarded by the authors as the anus. Sacrum and coccyx absent, pelvis articulating directly with fifth lumbar vertebra. In pelvis, ischia fused and carry one acetabular cavity subdivided by a ridge into two sockets. In thigh one bone made up of two fused femora. Two patellae - one bone in the leg, cartilaginous mass representing tarsus and metatarsus, three phalanges in the single toe.

Muscles. Ilio-psoas, gluteus, sartorius, gracilis; pectineus, adductores, vasti, rectus femoris, and undetermined muscular fibres. The latissimus dorsi was peculiar, in that it was continued down over the iliac crest to be attached to the great trochanter of the femur; from the deeper layer fibres were continued into the tail-like excrescence.

Viscera. Stomach and small intestine normal, large intestine had a mesentery, rectum terminated in a dilatation communicating by a narrow canal with the opening on the tail. Two cystic kidneys

kidneys and two small testicles were present. One umbilical artery direct continuation of the aorta; the femoral arteries were fused in the thigh and distributed branches to the extremity.

2. Behn.[9]

In this case an accessory limb was present. Penis and scrotum situated on the fused limb, testicles not yet descended into scrotum. The bones of the accessory limb consisted of a femur, patella and part of tibia, accessory iliac bone was present, the iliac bones were fused posteriorly.

Muscles. Rectus femoris, vasti, crureus, sartorius, gracilis, pectineus, semitendinosus, semimembranosus present, long head of biceps only present. A common mass of muscle described between the two femora dividing into two heads and inserted into fibulae and seeming to correspond to short heads of biceps. Gluteus maximus and minimus present. On one side gastrocnemius and soleus with tendo Achilles present. Plantaris present on one side. Flexor, communis, digitorum, flexor longus hallucis, tibialis posticus, tibialis anticus, extensor longus hallucis, extensor communis digitorum, peroneus longus and brevis, extensor communis brevis all present in one limb. On the

the other smaller limb soleus and gastrocnemius wanting. Extensor brevis digitorum, tibialis anticus, extensor longus hallucis with difficulty made out as slender tendons.

Viscera. Intestine ends as a Roman S ascending to umbilicus, ending in a rounded dilatation in cord joined with end of urethra which in the form of urachus reached the umbilicus. Kidneys and bladder absent. Suprarenals normal in size and position.

3. Baster.[8]

No external genitalia, head markedly conical, left radius and ulna seemed shorter than right, no anus but little furrow and pigmented skin in situation. One conjoined limb. Dissection denied; figure of a sirenomelus.

4. Bennington.[19]

Two limbs united from pelvis downward, sole turned anteriorly, nine toes, second left absent. No external genitalia, no anus, pig-like caudal appendage. Above appendage spinal cord ended in truncated appendage directed downwards.

Viscera. Sigmoid ended in a blunt sac, spleen and liver normal. Suprarenals present and large. Kidneys, ureters and bladder

bladder entirely wanting, testicles in inguinal region. One umbilical artery. Both fibulae present. One large os calcis articulated with both fibulae. On the left side middle cuneiform absent, cuboid and external cuneiform fused, sacrum at right angles with lumbar vertebrae normal number. Ilia flattened out, ischial tuberosities flattened and approximated acetabula carried back, pubic and ischial rami fused.

Muscles. Adductors, sartorius, gracilis, flexor longus hallucis and digitorum, tibialis posticus present. Two muscular slips passed up and in between adjacent sides of femora forming a so-called crucial muscle. Rudiments of gastrocnemei present. Gluteus maximus and minimus, tensor fasciae, rectus, vasti, peronei, extensor longus digitorum, extensor hallucis, and tibialis anticus all present, biceps short head only. psoas, pectineus, obturator externus, and extensor brevis digitorum present, popliteus very rudimentary. Semitendinosus, semimembranosus, soleus absent. Posterior fibres of gluteus medius passed into pelvis where they intermingled with others of intra-pelvic origin and invested "tail".

Vessels. At lower end of last lumbar vertebra abdominal aorta gave off one large mesial artery and four lateral ones, former passed out of pelvis with great sciatic nerves. At level

level of knee it divided into three, one posterior and two anterior tibial arteries, Lateral branches represented the two internal and two external iliac arteries, femoral vessels small and indistinct were traced to patella ending in patellar plexus.

Nerves. Great sciatic nerves united and divided into anterior and posterior branches supplying plantar aspect of both feet and the left big toe.

Caudal Appendage. Traced inward invested by fibres from gluteus medius and intra pelvic muscle. Ended abruptly opposite last lumbar vertebra densely surrounded by connective tissue with nerves and bloodvessels. Examined microscopically central artery of some size, the termination of the middle sacral artery, a longitudinally running tube considered to be a vein were found. Windle considers this a true caudal appendage or skin tail, and the muscular fibres were representatives of the curvatores caudis muscles.

5. Du Cauroi [29]

Marie de Mouy Jurée Matrone de Beauvais had delivered a woman of Beauvais of a symelus. No details, simply states "Cet

"Cet enfant avoit toutes les parties superieures et moyennes dans leur situation et confirmation naturelle jusqu'a la region ombilicale, au dessous de laquelle sans aucune aparence de distinction de sexe, sortoit une jambe du milieu de l'hypogastre, bien formée jusqu'au pied qui ressembloit a celui d'un veau."

Cruveilhier.[23]

a. Symelus, ten toes, perfect specimen. No external genitalia. A little tubercle "qui m'a pari être le vestige du clitoris". An anal opening posteriorly from which protruded an appendix hung by a pedicle with cutaneous and mucous wall.

Viscera. No ileo-caecal valve, no vermiform appendix. Distinction between large and small intestine, consists only in difference in calibre and a small mucous fold internally. Large intestine represented by a large sac, folded on itself and terminating in a blind extremity in the pelvic cavity. The small intestine enters the large at the fold and not at the end so that there was a considerable caecum present. Two kidneys present, right voluminous and consisting of a multilocular cyst with no trace of renal tissue, the left very small but healthy. Two ureters which join and at their confluence a rudiment considered

considered as a urinary bladder. Suprarenals ovaries and tubes present. A vestige of the left half uterus in a cylindrical body near to right ovary and tube to which the round ligament is attached. No vagina. To the tubercle both round ligaments were directed.

Muscles. Gracilis, rectus, vasti, semimembranosus, tibialis posticus, extensor longus hallucis, vestiges of pyriformis, quadratus, gemelli, obturator internus and externus. Vestiges of gastrocnemius and soleus were found which lost themselves in fat. Peronei, tibialis anticus, extensor communis, extensor proprius hallucis of each limb are a fleshy mass from which the tendons belonging to each muscle issue. Extensor brevis digitorum perfect.

Skeleton. Sacrum normal, ilia flattened out, no pelvic cavity, ischia and pubes fused, thyroid foramina fused. Rotation of right femur is a little greater than left, right patella smaller than left. Two fibulae distinct and in tarsus only the calcaneal bones.fused.

b. In plate 6 Liv.XXXIII. Figure of skeleton, no description of soft parts. Two femora united in upper third. Two fibulae median and fused, two tibiae. Two feet united by a

a outer borders, nine toes, two fused little toes form median one. Calcanei, cuboids, fifth metatarsus all fused. Pubis completely fused in median line presenting a crest, ischia fused. One large cotyloid cavity forunited heads of femora.

c. Plate 5 Liv.XXXIII. A sirenomelus,hydrocephalic. On left lateral side of lumbar region intestine filled with meconium protruding. Anal appendage present. The protruding intestine was duodenum. Stomach, duodenum and rectum present, the latter terminating blindly. Unfortunately rest of alimentary canal "retranchi sans examen prealable". Anal appendage hid an opening, looked like anus and admitted a probe for a short distance. Pelvis has two openings, separated from one another by fused ischia, on which was found cotyloid cavities receiving heads of fused femora, bodies of pubis fused in front. One bone resulting from fused femora. One single articulation of femur with leg, only upper part of tibiae present, no trace of fibulae, sacrum curved backwards, so that anterior surface looks posteriorly. In upper end of femur three eminences, a median, pepresenting the fused great trochanters, and two lateral, representing the two heads, each with its round ligament. Inferior extremity shows evidence of condyles, two patellae were present.

7.

7. Cortese Francesco[21], "On some cases of anomalous development", Padua.

Well developed foetus with single lower limb ending in a long toe with four joints. Pelvis deficient, single large femur, two patellae, single tibia, rudimentary tarsus and metatarsus and three phalanges. Only the quadriceps extensor cruris muscles mentioned; large intestine ended blindly, rudimentary female generative organs described.

8. Dieckerhoff.[24]

Anus and external genitalia and urethra absent. Colon ended in blind dilated extremity. Kidneys and ureters absent, suprarenals present.

9. Duncan[30], Obstetric Society, Edinburgh, January 10th.1877, exhibited siren nearly full time, 13½ inches long, no appearance of sex, limb everted, patella large and broad, below knee two inches of limb ending in rounded blunt point.

10. Dunn.[31]

Sirenomelus. Child cried feebly, lived an hour. No external genitalia, no anus.

Viscera

Viscera. Colon terminated in a large cul de sac distended with meconium. Kidneys present cystic, ureters and bladder awanting. Kidney vesicles filled with albuminous fluid, urea absent.

Skeleton. Partial union of third and fourth lumbar vertebrae, bones above this level normal. Sacrum and coccyx thrust back so that latter touched lumbar spine. Ischial bones approximated and fused behind pubis. Pubic bones rudimentary, small acetabula blended into single flattened cavity partially divided by a median ridge behind symphysis. Iliac bones convex abdominally from bending back of crests and spine. Single femur, head had two faces looking forwards and upwards. No cervix femoris, single great trochanter received most of insertion of gluteal muscles. In front two lesser trochanters received insertion of ilio-psoas. Shaft of femur thin in middle, below four condyles united laterally. Patellar surfaces directed backwards and outwards, two patellae on posterior aspect with extensor muscles inserted into them. Tibia double tuberosity received ligamenta patellae, tibia terminated in a point one inch below the knee. Placenta, one half much thinner than the other with ridge running between them.

11.

11. Gaddi [35]

Dead born nearly full term foetus, fused lower limb two distinct feet fused along outer border, a large subcutaneous bursa containing pale straw coloured fluid, over the lumbar region; no dissection.

12. Gigli. [40]

Six months abortion, lower limbs fused from pelvis to knee, femora fused. Diaphragm deficient on right side, intestines ending in a cord leading to the umbilical cord. Two testicles present.

13. Graetz. [42]

Pelvis very defective, the left half partly turned to the right, the left inominate bone was reduced to a quadrangular plate and the right, smaller than usual. The left pubis was twisted to the right and its body fused to the back of the right, whilst the rami projected anteriorly in the form of an arc, the left ischium was twisted to the right and fused with the left one; one composite femur. Genito-urinary apparatus completely absent, rectum ended blindly.

14.

14. Henry.[44]

Dead born with lower extremities fused into one. No external genitals, urethra or anus. Kidneys, ureters. bladder, rectum, and internal genitals absent.

15. Julliard.[54]

Full term foetus, fused lower limb with two feet. anus and vulval aperture present. In the pelvis the ilia were turned back, the pubis pyramidal shape with the base forward, the apex between the superior extremities of the femora with which it articulated. No pelvic cavity existed, the sacrum projected directly backwards at right angles to the vertebral column. The femora were rotated outwards, and their trochanters were fused partly with each other and partly with the pubis. Inferiorly they articulated witheach other and with two tibiae; two patellae on the outer aspect, one composite peroneal bone, composite astragalus and os calcis, other tarsal bones normal. Ovaries, uterus, vagina,small bladder, urachus and kidneys present. No mention of alimentary canal.

16. Kidd.[55]

Seven months foetus, lower extremities united as far as

as heel, no external genitals or anus. One umbilical artery continuation of abdominal aorta. Pelvis badly developed. Bladder in rudimentary state, kidneys absent, and Wolffian bodies recognised. Intestines stopped short above rectum. Femoral and crural nerves normal. All muscles normal except adductor magnus common to both limbs.

7. Langsdorff.[59]

Muscles. Ilio-psoas present and normal, other intra-pelvic muscles not distinguished. Fascia lata surrounded composite limb. Gracilis, sartorius, adductors, pectineus, rectus, flexor communis digitorum, flexor longus hallucis, all present. A lumbrical muscle to each tendon. Tibiales postici present. Adductor hallucis muscle fused with extension of tendon of tibialis posticus, to metatarsal bones. Gluteus maximus, medius minimus, tensor fasciae latae, quadriceps, tibialis anticus, peronei, extensor communis digitorum, extensor longus hallucis, extensor brevis digitorum, all present. Lower part of long-head of biceps said to be present, but greater part of each biceps absent, the short head being mostly fused with vasti externus. Semitendinosus, semimembranosus, popliteus, gastrocnemius, soleus, plantaris "et plures musculi minores digitorum pedis, plane desunt."

Circulatory

Circulatory System. Abdominal aorta divided intolarge right common iliac and small left common iliac, the former vessel divided into three branches, the internal iliac and external iliac, and largest of all the umbilical artery, left umbilical artery awanting. Internal iliac divided into gluteal sciatic and pudic branches, larger on right than left. The external iliac became common femoral, gave off profunda femoris ending in muscular branches. The left femoral after giving off profunda perforated the adductor magnus muscle and terminated in branches to flexor longus digitorum and extensor longus hallucis muscles. Inferior mesenteric,renals,lateral sacral and third and fourth lumbar were absent. Large umbilical vein.

Nerves. Large sciatics fused into one trunk not followed out.

Skeleton. Sacrum and coccyx fused and strongly curved, with the concavity posteriorly. Ilia curved backwards so that the outer surface looks posteriorly, and the internal surface anteriorly. Ischia and pubes fused so that no exit from pelvis. two acetabula shallow and closely approached to each other. Femora fused at the upper extremities of the shafts but the heads distinct and articulating separately with the pelvis. Lower

Lower extremity free and the right rotated outwards much more than the left. Two patellae and two tibiae, fibulae fused into one bone in the middle line. The astragalus and calcaneal bones of each foot fused with one another into one mass. In the right tarsus five other ossicles present, and in the left six. Two metatarsals in the right foot, and three in the left. Six phalanges in the right foot and four in the left.

8. Lewers.[61] Skiagram of a Symelus, no details, all bones of lower limb present.

9. Meadows.[69]

a. Symelus, born alive, lived three quarters of an hour, made feeble attempts at crying, and moved the stump. Liver large, small intestine normal. Ascending and transverse colon distended with meconium. Descending colon small, and ending at sigmoid. Rectum represented by a small tube two inches long, admitting a probe, closed at the lower end and lying free. Spleen normal, suprarenals large, complete absence of urinary apparatus. Ovary and convoluted Fallopian tube present on each side, no vagina. No external genitalia, no anus. Anterior crural and sciatic nerves present. Abdominal aorta bifurcated normally, no mention made of hypogastrics. Cavity of pelvis very

very shallow, and bones cartilaginous except alae. On under surface one cotyloid cavity articulating with fused femora. Two patellae on posterior aspect, leg bones represented by a short pointed bone, one and a quarter inches long. Well developed flexor, extensor, and adductor muscles, well supplied with arteries and nerves.

b. Symelus, born at full time, lived a few minutes. No anus or external genitalia, lower extremity like caudal appendage moving backwards and forwards like a hinge joint. One and a half inches from extremity a similar hinge joint. Large intestine ended abruptly at sigmoid and considerably distended with meconium. Spleen normal, kidneys, suprarenals, ureters, and bladder absent. Two small oval bodies about the size of a pea, ovaries probably, lay in the pelvis connected with each other by a small transverse band of thickened tissue, probably representing Fallopian tubes or uterus. No proper pelvic cavity floor of abdominal cavity formed by the joint by which the lower extremity or Caudal appendage was articulated with trunk. Small foramina for passage of blood vessels and nerves, abdominal aorta divided into two common iliac vessels passing through openings, nerves passed also in two main trunk, All other viscera normal. The two iliac vessels fused into one after

after exit from pelvis. Something like a femur found forming principal part of lower extremity. Two patellae, small hook-like, one inch long.

20. Milroy. ½

Uromelus, eight months old, no anus or external genitalia, caudal appendage two inches long on the lower part of sacrum. One bone in thigh, three in leg, knee and ankle joints rigid. One foot sole anterior, six toes. Large intestine distended enormously with meconium terminated at the left side in a cul de sac. A second portion of intestine occluded at both extremities, passed into tail. Kidneys, bladder, ureters absent. One testicle in each right iliac region. Two hypogastric arteries, internal iliac vessels passed out with sciatic nerves to supply leg. Pelvis small, ilia flattened, pubis projected forwards, obturator foramina on each side, tuberosities of both ischia united, and on lower and outer surface a deep oblong depression for head of femur. Latter showed signs of duplicity, shaft completely fused, lower extremities separate and two distinct knee-joints. Three trochanters, one posterior, two anterior, one patella. Two tibiae, and one fibula between and behind them. Astragalus, scaphoid, and cuboid were single bones. Four cuneiform bones.

21.

21. Moorhead. ¾

Sirenomelas, born at full time, dead for some days. Tapered to sharp point, appearance like a tool projected forwards at 150° with trunk. On anterior aspect below symphysis pubis a puckered genital scar, no anus, high up over back of coccyx, anal scar. Stomach and intestines normal, caecum above right iliac fossa distended with meconium. Descending and transverse colon also distended. Descending colon terminated in the left iliac fossa in a pointed extremity. Descending colon almost entirely free attached by loose mesenteric fold to peritoneum over the hypogastric artery. Kidneys, ureters bladder absent, suprarenal capsules present and large, all other abdominal viscera present and normal. Aorta emerging from under cover of pancreas gave off a large single branch which passed almost directly forwards to umbilicus, this branch was larger than the continuation of the aorta. Shortly after its origin it divided into two branches which ran side by side for a short distance, and again united into a single trunk before reaching the umbilicus, so that only a single artery entered umbilical cord. Hypogastric artery in its intra-abdominal course was covered by a peritoneal fold which practically divided the lower part of the abdomen into two halves. In right half

half small intestines, in left half distended sigmoid flexure attached by mesentery to the fold of peritoneum over artery. Aortic trunk divided at fourth lumbar vertebra into two common iliac, gave off small internal iliac branches to pelvis, and was continued as external iliac which were continued into the femorals. Pelvis represented by a depression in peritoneum on each side of the median peritoneal fold. Testes having well marked epididymus, vas passed up on each side in peritoneal fold over hypogastric, and disappeared close to pancreas; traced microscopically further up as a small duct lined with columnarcells.

Muscles. Sartorius, gracilis, fused adductors, muscle resembling short head of biceps, ilio-psoas, gluteus maximus, medius and minimus all present. Extensor group fused posteriorly, rectus femoris attached below separately to two distinct patellae.

Nerves. No genito-crural nerves present, anterior crural large, second, third and fourth lumbar nerves ended in mass of extensor muscles posteriorly, lumbo-sacral cord normal, joined other sacral nerves to form a single trunk passing through foramen in front of sacrum to terminate in gluteal muscle.

Arteries

Arteries. Femoral artery gave off below Poupart's ligament a large muscular branch accompanying anterior crural nerve into extensor group of muscles. Main trunk continued down the front of the thigh below the sartorius and adductor groups, and ended as a very slender twig at the extremity of the limb. A superficial saphenous vein on each side was found joining the femoral vein.

Skeleton. Thirteen ribs on each side, thirteen thoracic vertebrae, sacrum and coccyx formed by four incomplete bony vertebrae and four cartilaginous nodules, the whole structure being directed almost straight backwards between the iliac bones. Iliac fossae expanded and directed forwards, bodies of pubic bones directed forwards in the shape of a beak projecting over the upper part of femora. True pelvis very shallow almost completely osseous floor owing to the union in middle line of the ischial tuberosities and ischial spines. Three outlets, first below sub-pubic angle filled with fibrous tissue, second between ischial tuberosities and ischial spines, third between ischial spines and front of sacrum. Through latter gluteal nerves escape from pelvis. Femora completely fused groove along middle line in front and behind indicated duplicity Small foramen in lower third of shaft, cartilaginous heads projected

projected outwards to articulate with acetabula. An extensive shelf of bone indicated fused great trochanters. Each hip joint surrounded by distinct capsule, heads of femora flattened, and acetabula shallow. Lower end presented three separate articular surfaces separated by septa of fibrous tissue, attached to the intervals between the corresponding articular surfaces of tibiae. Lateral condylar articular surfaces normal, middle triangular with ridge indicating bilateral character, two, separate patellae at back of joint. Both tibiae fused, tapering to point, no trace of fibulae. Lower end of limb composed of five small cartilaginous nodules united by fibrous tissue, in upper two bony centres present.

22. McLaren.[64]

a. Symelus exhibited, fused lower limb feet united by outer edges, great toes to the outer side. "Penis" large, springing from coccyx.

b. Symelus born alive, died almost immediately. Placenta fatty degeneration and friable. One lower fused limb, feet fused along outer border, three distinct toes on each foot. Anteriorly at junction of abdomen with lower extremity two inches below umbilicus and in the middle line a small papule present. At a corresponding part posteriorly and one and a half inches

inches below coccyx hangs like a caudal appendage a well formed "penis" with a pervious canal without trace of scrotum, testes or anus. Two patellae.

23. Orsolato.[78]

Twin birth, one child born alive and well, the other dead and with the inferior extremities fused, ending in one toe. A small tail or appendage over the sacrum with an aperture leading to the bladder. Ischia fused, compound femur, two patellae, one bone representing tibiae and fibulae, three phalanges. Intestine terminated blindly, large bladder with urethra directed backwards and communicating with the cutaneous appendage on the sacrum. Two testes with vasa deferentia. One umbilical artery.

24. Otto.[80]

No. CCLX. Sirenomelus, ended in a cone. Umbilical cord contained only two bloodvessels, anus and external genitalia absent. Small tail from back of pelvis.

Viscera. Liver, stomach and spleen normal, small intestine lay on left side. Large intestine ended blindly in a large sacular extremity in pelvis filled with meconium. Suprarenals present, kideys and ureters absent, urinary bladder small, empty and lying a little to left side, neck of bladder was

continued

continued into a narrow canal, the vestige of a urethra. Small well formed uterus and vagina present, latter a small cylindrical body without cavity. Fallopian tubes,ovaries, round ligaments all present. Umbilical vein and vena cava inferior all present. One umbilical artery arising from the aorta. Sacrum and coccyx absent. Ilia joined with last lumbar vertebra. Fused ossa innominata, small foramen closed with fibrous tissue where vagina and urethra ended. One acetabular cavity, one single femur with one head, but inferiorly two condyles. One tibia, patellae and fibulae absent.

No.CCLXI. Hydrocephalic and numerous defects about head, ears and eyes absent, cleft lip and palate, oesophageal and laryngeal orifices shut, mandible absent. External genitalia and anus absent. Inferior extremity conical, terminated by a foot (uromelus) with three toes. Heart, lungs, oesophagus, awanting. Diaphragm vestigial. Stomach, liver, spleen, pancreas, right kidney with suprarenals all awanting. No distinction between large and small intestine, ended in a dilated sac. Small left suprarenal and kidney present, no bladder. Two testes, right one near kidney, left one near inguinal ring. Umbilical veins present, although liver absent, one umbilical artery. Five cervical vertebrae, eleven thoracic, eleven ribs, sternum divided

divided longitudinally into two, five lumbar vertebrae, last fused with pelvis, sacrum and coccyx absent. Pelvis fused on inferior and posterior aspects, one femur, head of one tibia.

No.CCLXII. Symelus, two feet, five toes each. A large sac filled with fluid was attached to occiput. Umbilical cord dilated into a round sac for some distance. External genitalia and anus awanting. Small fovea where genitals usually present. Small intestine ended blindly distended with meconium, passed out at umbilicus and caused swelling in that region. Other abdominal viscera normal, except for a small separate large intestine lying in pelvis. One umbilical artery arose from the left side of the aorta at the level of the second lumbar vertebra. On left side suprarenal and vestige of kidney. No trace of bladder. In pelvis left half of female genital organs found, ovary, tube and rounded fleshy body simulating uterus, rudimentary vagina described. Pubes and ischia fused, sacrum present, coccyx absent. On left side fourteen ribs, on right side six, first very short not reaching sacrum. Right lung only one lobe. Sciatic and obturator nerves present.

No.CCLXIII. Symelus, five months' foetus, two feet five toes each, anus and external genitalia wanting. Viscera extroverted from opening in abdomen. Stomach, intestines, spleen, liver with gall

gall bladder, two testes and kidneys present, no trace of umbilical cord although umbilical vein ascends to end in liver. Only a vestige of umbilical artery. Abdomen separated from thorax by transverse septum. No bladder, intestine ended as a sac. Eleven thoracic vertebrae, five lumbar shewing spina-bifida. Pelvis fused posteriorly and anteriorly, one acetabulum one femur inferiorly divided into two, two patellae, two tibiae one fused fibula. Almost all muscles were present except glutei and rotators of the femur which were only indicated by muscular fibres. The muscles interposed between the femora and tibiae were fused. Saphenous nerves were in one common trunk, obturator and crural nerves were separate. From the posterior lumbar fissure two sciatic nerves issued which fused. Tibialis posticus and anticus muscles were also noted as present

No.CCLXIV. Only a skeleton. Scoliosis, certain of thoracic vertebrae fused. Six right ribs, first and second, and third and fourth fused. Thirteen left ribs much longer and more curved than right. Two arose from second vertebra of which superior and smaller was fused with first rib, sixth very short, eighth and ninth had common cartilage. Sternum short, broad, no ossification present. Sacrum and coccyx deficient behind. Two ossa inominata fused and joined with last lumbar vertebra. No cavity nor exit from pelvis. Right arm awanting, and various defects

defects of arm and hand on left side. One fused femur shewing no signs of duplicity. One patella, rudimentary tibia, fibulae and foot awanting.

No.CCLXV. Sirenomelus, born with a well formed twin, seven months. One inferior extremity ending in a point. Umbilical cord contained two vessels only. Pelvis very narrow, anus and external genitalia absent. Intestine ended in a sac dilated with meconium. Suprarenals absent. Uropoietic organs completely absent. Lowest part of abdominal cavity divided into two by a fold of peritoneum. One ovary with tube and half of uterus found. Umbilical vein usual course. Aorta gave off on each side two equally developed hypogastric and crural arteries and then curved in the anterior margin of the above mentioned fold of peritoneum, and in front of the uterus towards the abdominal parietes, and ran in the middle line towards the umbilicus. Obturator and crural nerves present, sciatics absent. Two ilio-psoas muscles, no vestige of glutei; sartorius muscles, flexor adductor and extensor muscles fused. Two left upper ribs fused, sacrum and coccyx awanting, pelvis fused with last lumbar, inominate bones fused, anterior part ended in a crest representing symphysis pubes, two small foramina for obturator nerve. One common acetabulum. One femur with almost no

no neck, two patellae situated posteriorly, fused by inferior margin, and upper portion of tibia present.

25. Pasanisi.[81]

Foetus without abdominal parietes and absence of diaphragm. Two kidneys and two ureters, single umbilical artery (a very bad description).

26. Rafferty [89]

Child lived eight hours, no dissection allowed. Abdominal cavity small. Genito-urinary organs represented by a small round aperture, situated according to figure, in front of thigh below groin surrounded by a slightly elevated fleshy ridge. Bones could be felt, no anus. Feet joined together at heel, outer borders fused, usual number of toes. Figure shews a symelus with external characteristics similar to specimen described in this paper.

27. Sacchero [97]

Full time child, died immediately after birth, lower limbs fused, ending in a toe-like appendage. Sacrum and right ilium wanting. One composite femur, one small bone at right angles to femur representing the tibiae and fibulae, one small patella

patella. Large intestine accompanied the umbilical artery to the umbilicus and ended there in a blind dilated extremity. Two kidneys, ureters and bladder, the latter open at umbilicus present, ovaries and Fallopian tubes present.

28. Sachsse.[98]

Symelus, eight toes, plantar aspect of feet turned forwards, vertebral column in the middle was bent with convexity to the right. External genitalia and anus awanting, a little above where latter ought to be a small canal was found admitting a probe for scarcely two lines. Above this canal a cone of skin stood out prominently. Only seven toes seen from the plantar aspect on dorsum eight seen, the eighth being between the third and fourth not exceeding four lines in length and lacking the nail. Some circular and longitudinal muscular fibres seemed to run to the conoid process found above coccyx. The left abdominal ring occupied by a ligamentous cord which seemed to descend from the left kidney.

Viscera. Liver small and further to left than right. Transverse colon dilated and rectum ended as a distended sac. Ovaries and Fallopian tubes present on both sides. Urachus running from neighbourhood of tube to umbilicus terminated like a beam only loosely connected with peritoneum. Vestige of great omentum

omentum found adhering to transverse colon. Kidneys, ureters and bladder absent, large suprarenals present. In pelvis a rounded body was found from which a canal ran down into pelvis. Uterus was a spherical body with a round ligament from which a cuneiform process like a vagina descended to the foramen above mentioned, situated above usual seat of anus. The canal arising from rounded body in pelvis joined the vagina this rounded body was filled with a gelatinous substance.

Bloodvessels. Aorta gave off below the phrenic arteries one suprarenal dividing into two. Aorta above second lumbar vertebra divided, right branch ran to pelvis where it divided into two, of which the larger trunk was continued as umbilical artery to bean-like body above described. The smaller was continued beneath Poupart's ligament as external iliac and femoral arteries. No internal iliac seen. The left undivided branch of the aorta was continued as femoral artery.

Skeleton. Six lumbar vertebrae. Ischia fused behind with each other, and in front with pubes, closing outlet of pelvis below, except posteriorly above fused ischia, the other boundaries of this opening being the sacrum and coccyx, and latterly the sciatic notch on ilia. The fused descending pubic rami projected down like a crest between the femora, femora rotated outwards

outwards. The fibulae were completely fused and situated behind and between tibiae. The metatarsals of the fourth digits were fused in mid line in such a manner that only seven digits were seen on the plantar aspect but eight on the dorsal, no calcanei noted.

Muscles. Pyriformis muscles fused at margin. Tensor fasciae latae, glutei, gemelli, obturator internus on the right side, obturator externus and pectineus all present. From posterior aspect of fused ischia a fleshy muscular bundle arose, the tendinous fibres of which were attached to both femora between the head and great trochanter. Beneath this muscle another, parallel to the femur, was observed which took origin from the great trochanter. Adductors were normal. Below the knees the tibiae were bound firmly together by fascia. Sartorius bellied, vasti externi, interni, crurei, all present and normal, except for change of position due to rotation outwards; graciles present. Semitendinosus and semimembranosus absent. Short head of biceps fused with adductor brevis, long head fleshy, and inserted into usual place. The inner aspect of the two muscles was bound together above the external condyle by a fleshy band. The popliteal tendons seemed to decussate and each was bound by fibres to the external femoral condyle. Tibialis anticus, extensor communis digitorum, extensor proprius hallucis, extensor brevis digitorum all present. A small

fleshy membrane attached to inferior extremity and fused with flexor brevis pollicis was thought to be abductor pollicis. Tibialis posticus and flexor digitorum muscles present, lumbricales fibrous but not made out.

9. Sirena Santi.[100]

a. Single inferior extremity with two feet united at heels, the limb at right angles to the trunk and apparently attached at the lumbar region; lumbo-sacral spina-bifida abdomen and pelvis open anteriorly with viscera projecting. Ischia fused, ascending ischial rami and descending pubic rami awanting, the pelvis behind vertebral column and without muscles, the pelvic cavity bounded in front by sacrum at the sides by the ilia and behind by the horizontal pubic rami. The acetabula were placed in the mesial line inside the pelvis and the femora came out horizontally from the pelvis and appeared to articulate at an acute angle with the sacrum.

B. A case of "Dicephalus dibrachius sirenoides" (Taruffi) which from the umbilicus downwards became thinner and finally terminated in a conical stump with small toe-like appendage. Iliac bones fused into one plate, in its middle a flattened heart-shaped piece of bone representing the pubis with two tubercles inferiorly the rudiments of the ischia, composite femur and tibia, latter ending in a point. Two complete heads and two arms.

30.

30. Manners Smith [21]

a. **Symelus.** Thirteen dorsal vertebrae, thirteen ribs on the left side, six lumbar vertebrae. Iliac bones well developed, ischia fused. Femora and patellae separate, fibulae fused, fourth and fifth metatarsal bones fused, cuboids fused calcanei fused.

Muscles present. Gluteus maximus, G.Medius, G.Minimus, pyriformis, obturator internus, fused inferior gemelli, fused quadratus femoris, obturator externus, short head of biceps adductor magnus, A.longus, A.brevis, gracilis, sartorius, rectus femoris, vastus externus, vastus internus, crureus, peroneus longus, peroneus brevis, extensor communis digitorum, tibialis anticus, extensor longus hallucis, extensor brevis digitorum, popliteus, flexor longus digitorum and flexor longus hallucis fused, tibialis posticus, flexor brevis digitorum, abductor hallucis, adductor hallucis obliquus, adductor transversus, flexor brevis hallucis.

Nerves. Single large sciatic nerve, gluteal nerves and muscular branches.

b. Sirenomelus. Last lumbar vertebra articulated with the

the ilium, scoliosis in lumbar region. Ilia fused into iliac shield, ischia fused, pubis rudimentary. Femora and patellae fused, pointed bone represented bones of leg.

Mass of fat represented gluteal muscles, obturator externus, adductor magnus, A.longus, A.brevis, gracilis, sartorius, rectus femoris, vastus externus fused, vastus internus, crureus.

c. Sirenomelus. Ischia fused, ilia separate, femora fused, single pointed bone in leg, two patellae.

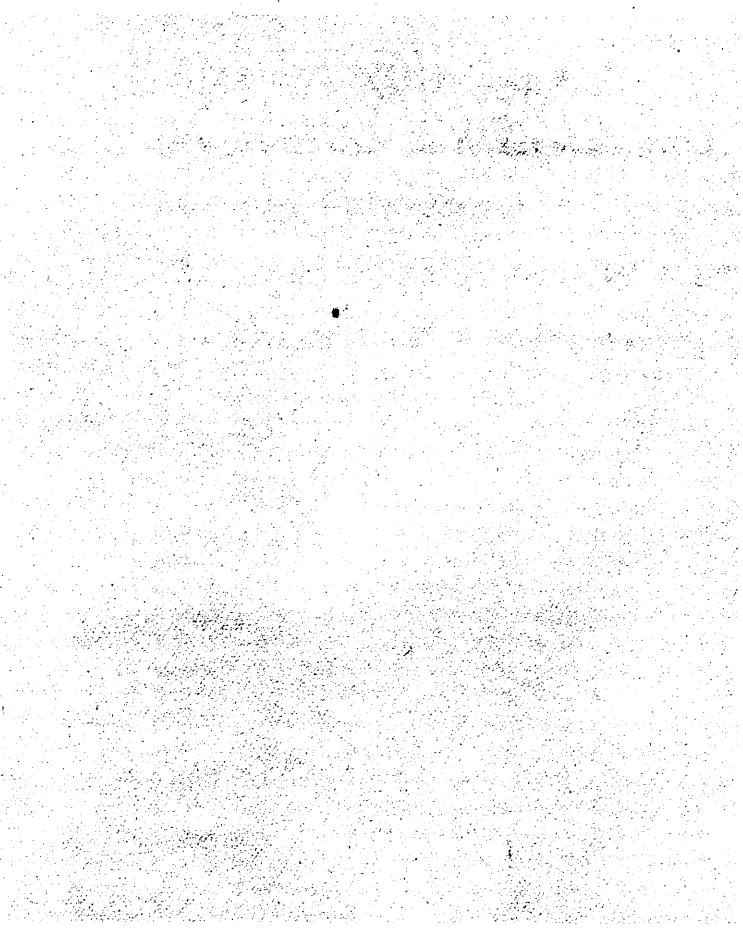
Muscles present. Gluteus maximus, medius, minimus, adductor magnus, A.longus, A.brevis, vasti, crureus.

Testes present in inguinal region, vasa deferentia joined the rectum, large intestine terminated in cone shaped blind extremity. Kidneys, bladder and urethra were present, kidneys large and cystic, urethra.

31. Supeville.[28]

Foetus about seven months. No mark of sex. Instead of legs a bag running to a point extremity of which is cartilaginous. In bag, bone three inches long covered with muscular flesh

flesh articulating with sacrum. Ossa inominata awanting; <u>below anus</u> which is in middle of os sacrum there is small tail like that of a pig.



T A B L E I.

External Genitals present.

1.	Teacher & Coats.	A rudimentary penis described.
2.	Cruveilhier.	Vestige of a clitoris found.
3.	McLaren.	A penis?
4.	Julliard.	Vulva and vagina found.
5.	Vrolik.	One testicle in a scrotal fold.
6.	Rafferty.	Rudiment of a penis?
7.	Behn.	The only authentic case of a penis with a urethra and a scrotum.

T A B L E II.

Anus present.

1. Teacher & Coats.
2. Cruveilhier
3. Cruveilhier
4. Sachsse
5. Abramoff & Riezanoff.
6. Julliard.

T A B L E III.

"Tails" present

1. Otto, observation CCLX.
2. Cruveilhier
3. Bennett
4. Sachsse
5. Rossi
6. Superville
7. Milroy
8. McLaren ? (says penis)
9. Abramoff & Riezanoff.
10. Hofer
11. St.Hilaire
12. Ruge
13. Ballantyne
14. Huesker.
15. Gray

T A B L E IV.

S e x.

Male	Female	Doubtful	Undetermined
Otto CCLXI.	Otto CCLX.	Rossi	Otto CCLXIV.
" CCLXIII.	" CCLXII.	McLaren	Cruveilhier
Teacher & Coats	" CCLXV.	Kidd	Duncan
Bennington	Cruveilhier.	J.P.Henry	Rafferty
Behn	Dieckerhoff.	Dolkowski	McLaren
Milroy	Sachsse.	Hofer.	Lewers
Moorhead	Meadows 2.	Graetz.	Pasanisi
Hartmann	Bocrhaave 2.		Gaddi
Hottinger	Cortese		Santi-sirena 2.
Gigli	Huesker.		
Majer	Ehrmann.		
Koehler	Julliard		
Vrolik	Jackson.		
Orsolato	Sacchero		
Wolff	Gray.		
Calori			
Solger			
Labougle			
Bennett			
Ruge			
Abramoff & Riezanoff			
Odisio			
Manners Smith (3)			

T A B L E V.

Hydrocephalus present.

1. Otto CCLXI.
2. " CCLXII.
3. Cruveilhier
4. Ballantyne
5. Gray.

T A B L E VI.

Kidneys & Suprarenals.

1. Otto CCLXIII. Kidneys present.
2. " CCLXII. Left kidney vestigial, left suprarenal present
3. Teacher & Coats. Kidneys present.
4. Cruveilhier. Two kidneys and suprarenals
5. Bennington. Suprarenals present, kidneys absent.
6. Behn. " " " "
7. Dieckerhoff, "Left uropoietic organs normal."
8. Sachsse. Suprarenals present, kidneys absent.
9. Rossi. Left kidney and suprarenal present.
10. Dunn. Kidneys present.
11.

TABLE VI. Continued.

11. Meadows. Suprarenals present, kidneys absent.
12. Moorhead. " " " "
13. Abramoff & Riezanoff. Two cystic kidneys.
14. Sacchero. Two kidneys present.
15. Manners-Smith, Two kidneys present.

T A B L E VII.

Bladder, urethra & ureters present.

1. Otto CCLX. Bladder rudimentary, urethra rudimentary.
2. Cruveilhier, Two ureters confluent and rudimentary bladder.
3. Kidd. Rudimentary bladder
4. Sacchero. Bladder open at umbilicus.

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EXPLANATION OF FIGURES.

Figure I. Photograph of specimen seen from in front. The rotation of the legs and their fusion along their outer surfaces and the position of the soles are all well seen.

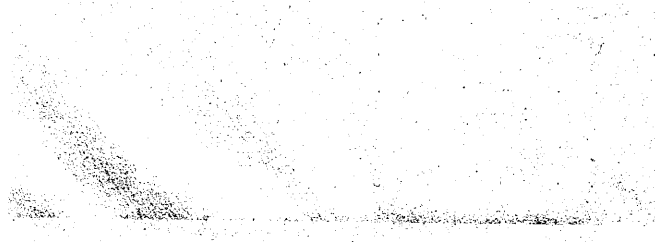


Figure II. Photograph of specimen seen from the side.

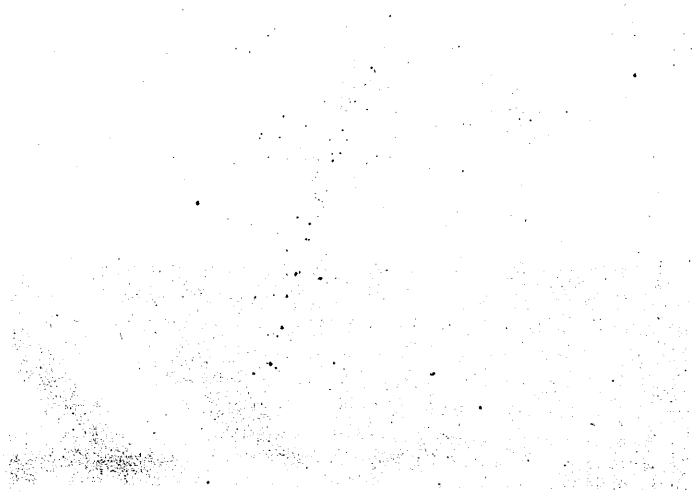
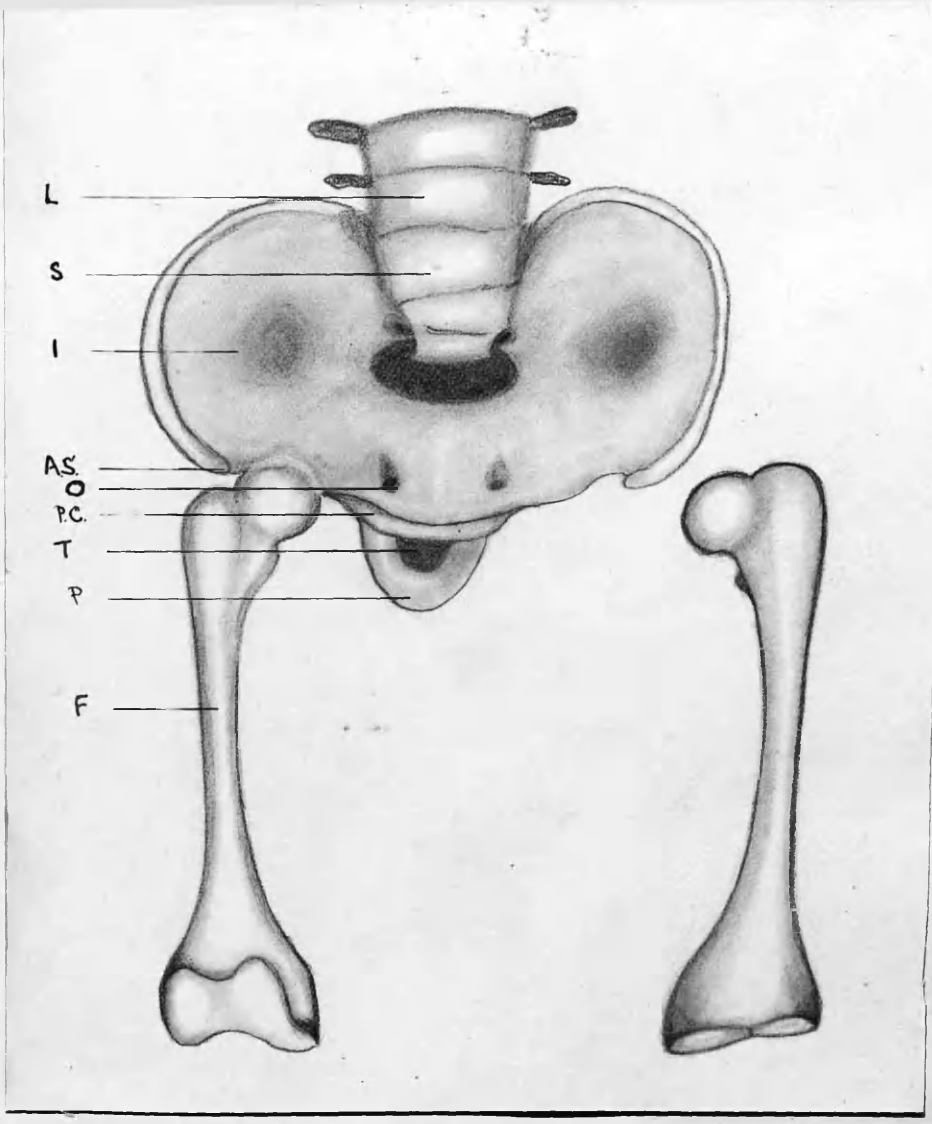


Figure III. Photograph of specimen seen from behind, the small button-like caudal appendage is seen projecting above the normal site of the anus.

Figure IV. View of the pelvis and femora from in front. The left femur has been disarticulated from the Pelvis. L. Lumbar Vertebrae, S. Sacrum, I. Ilium, P. Anterior end of keel of bone formed from fusion of pubis and ischium, T.Thyroid foramen, O. Obturator Foramen, A.S. Anterior Superior Spine, P.C. Pubic Crest, F. Femora.

Figure V. View of the pelvis from behind S.C. Lower end of Sacrum and Coccyx projecting backwards and upwards, L. Lumbar vertebra, I. Ilium, Is. fused Ischial tuberosities, A. Acetabulum, P.S. Posterior Superior Spines, A.S. Anterior Superior Spines.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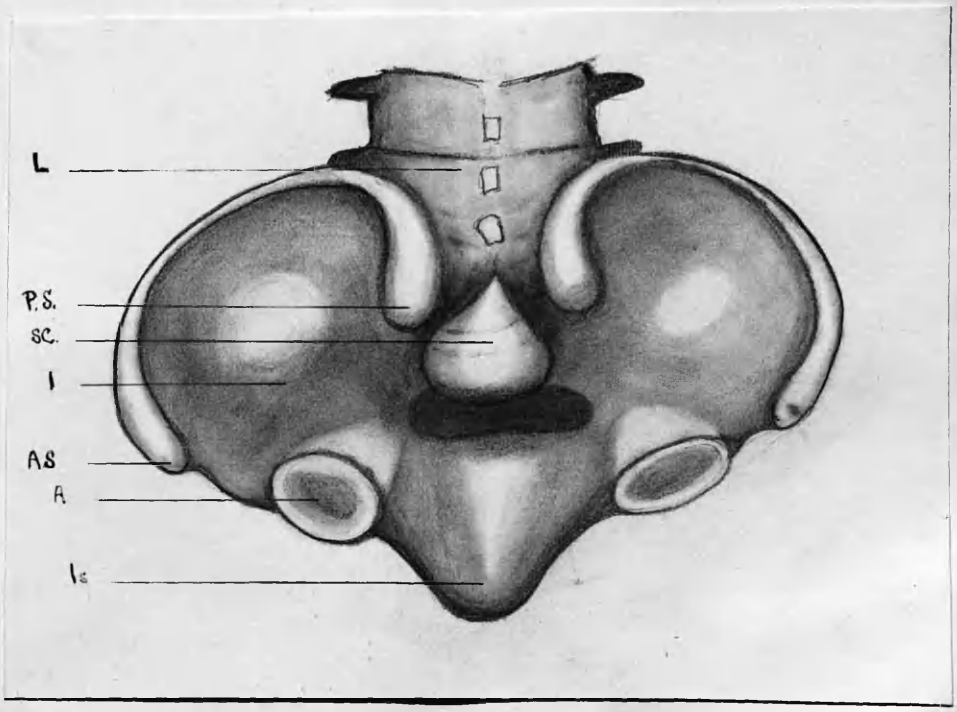
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Figure VI. View of the bones of the leg and foot seen from the posterior aspect of specimen. T. Tibia, F. Fibula, O.C. fused Ossa Calcis, A. Astragalus, S. Scaphoid, Cb. Cuboids, C. Cuneiforms, M. Metatarsals, F.M. Fused fifth metatarsals. P.Phalanges. This figure is not on the same scale as Figs.IV. & V.

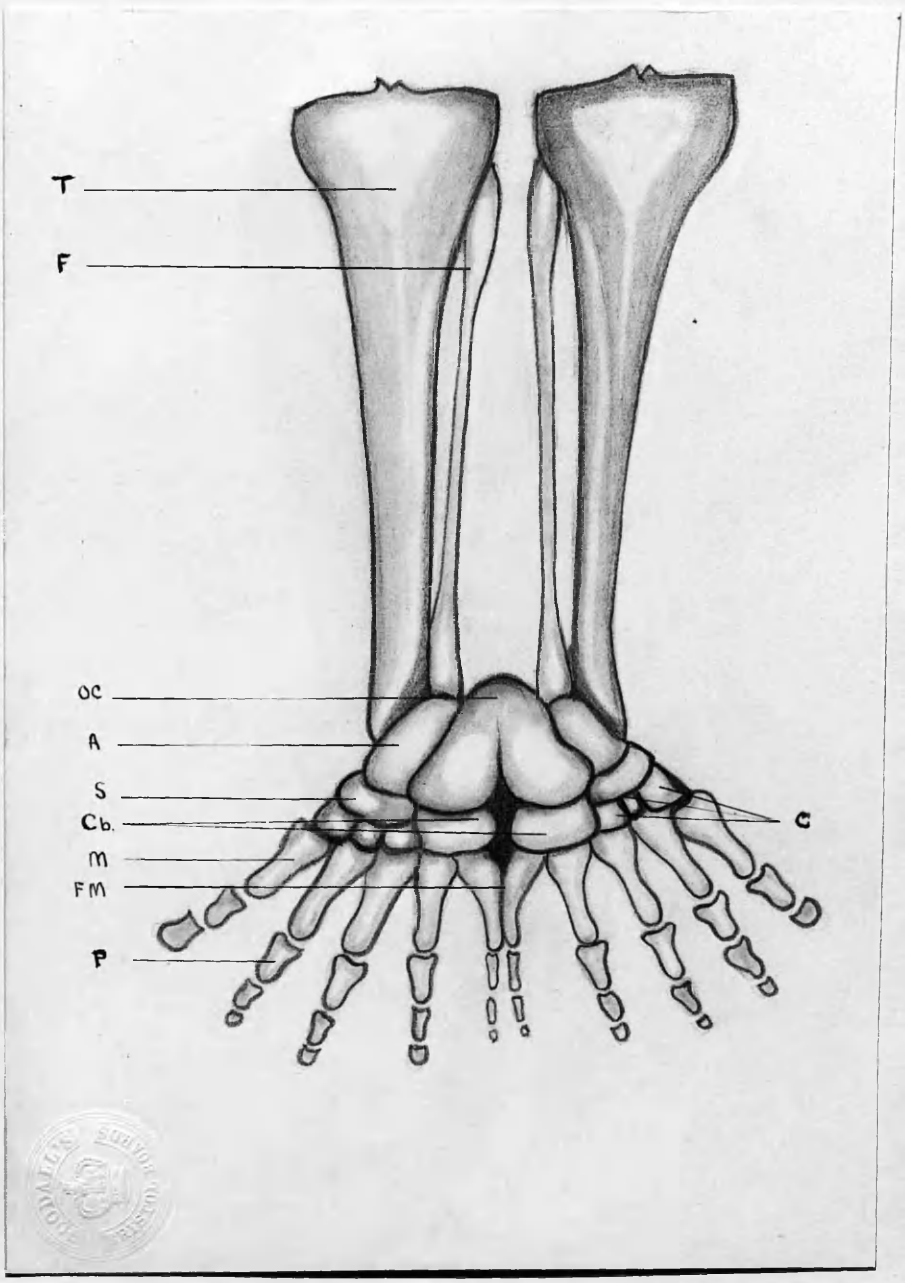
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Figure VII. View of a dissection of the muscles of the gluteal region and posterior and upper part of thigh. G.Gluteus Maximus cut and reflected up and down, G.M.Gluteus Medius, P. Pyriformis, D. Mass of muscle representing probably Obturator Internus and Gemelli muscles, F. and E.E^{1} Fused Quadratus femoris muscles. B. Short head of Biceps, S.B. Semimembranosus, S.T. Semitendinosus, A. Adductor Magnus, V.E. Vastus Externus, S.N. Sciatic Nerve, on the right side issuing from the pelvis in two divisions one of which pierces the pyriformis.

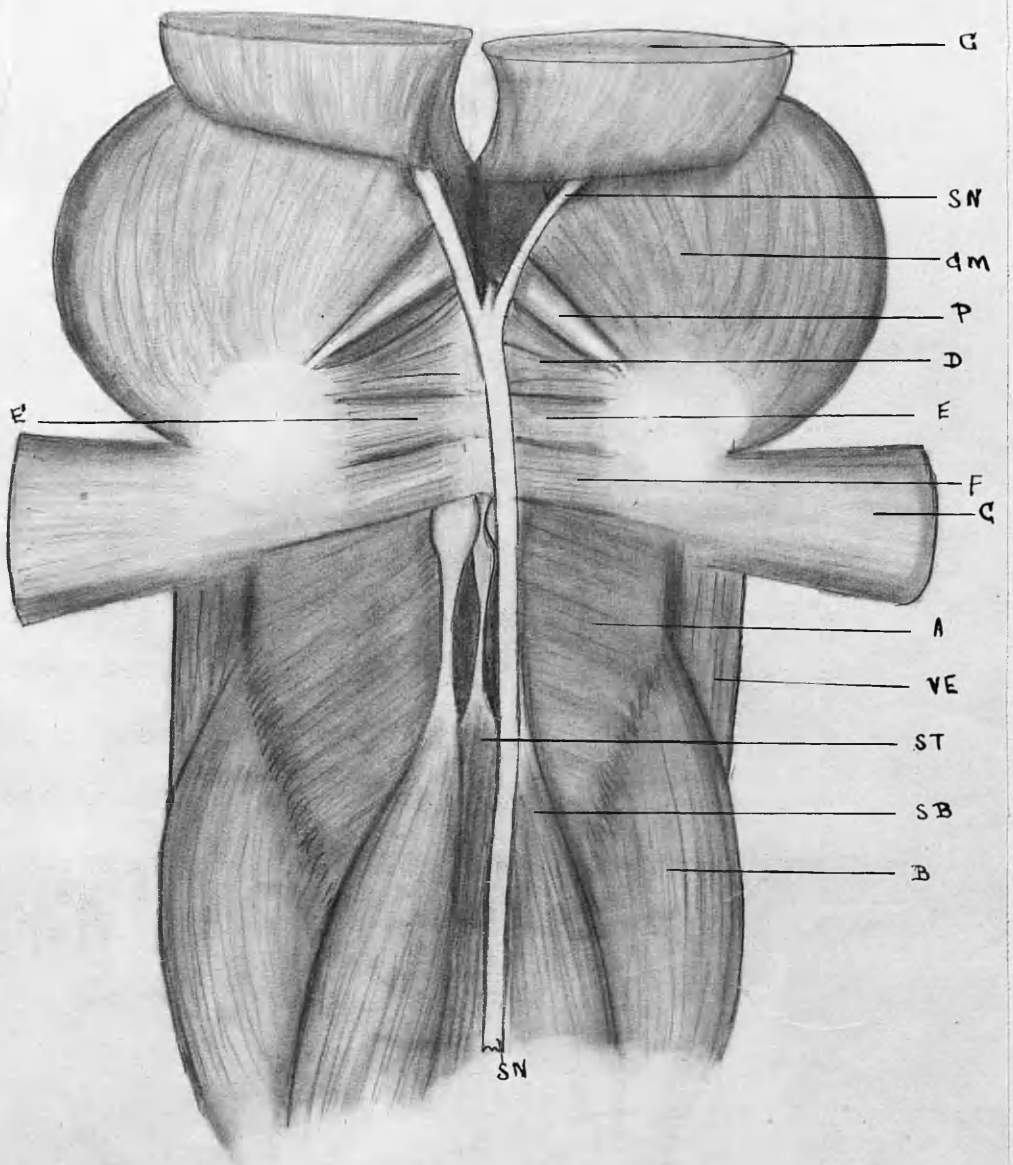
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Figure VIII. View of a dissection of the muscles of the front of the thigh. E.O. External Oblique, I. Iliopsoas, P. Pectineus, A.L. Adductor Longus, S. Sartorius, A.M. Adductor Magnus, G. Gracilis, S.T. Semitendinosus, S.B.Semimembranosus, A.E.S. Aponeurotic expansion from sartorius, V.I. Vastus Internus, R.F. Rectus Femoris, Pa. Patella.

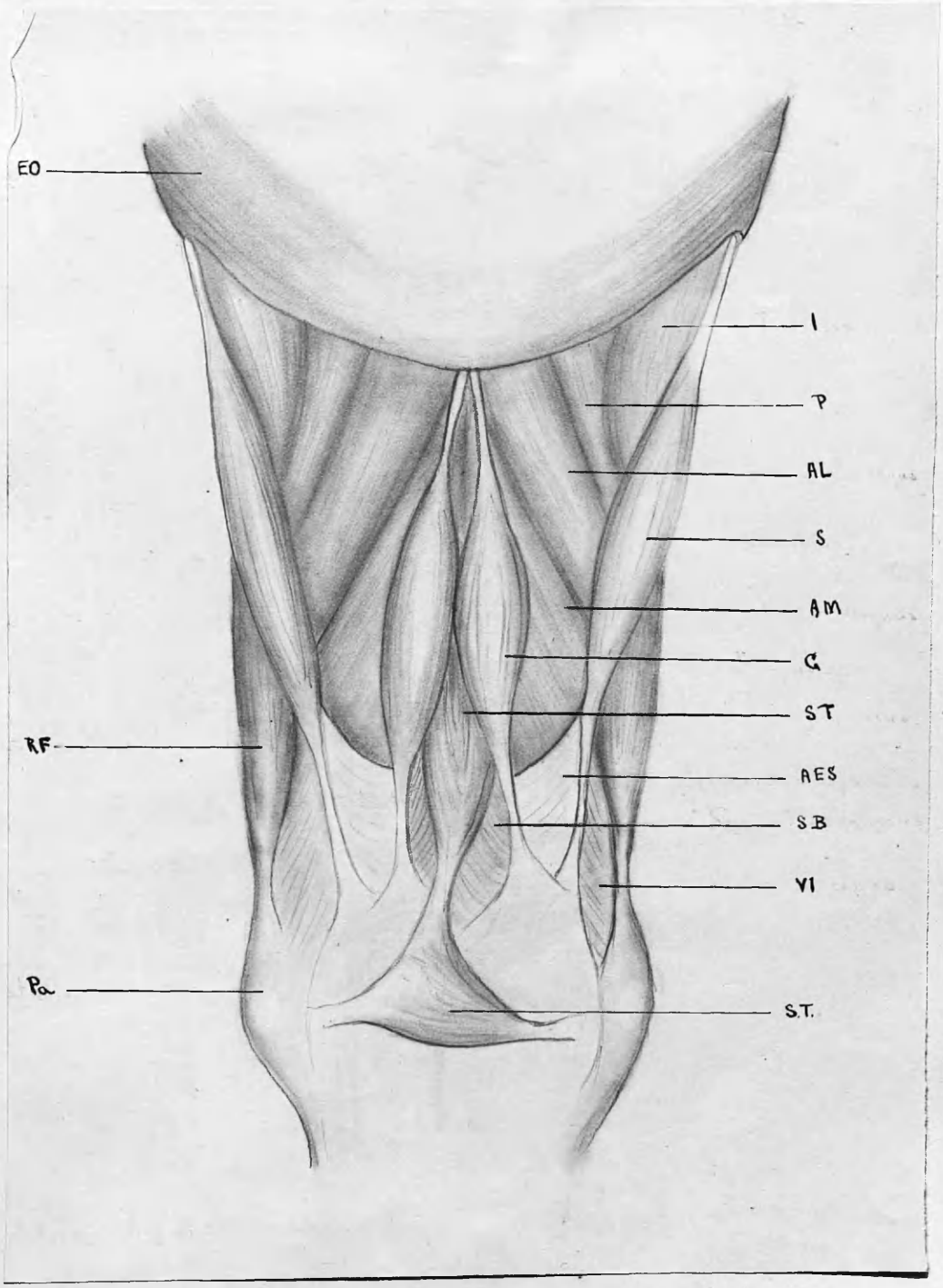
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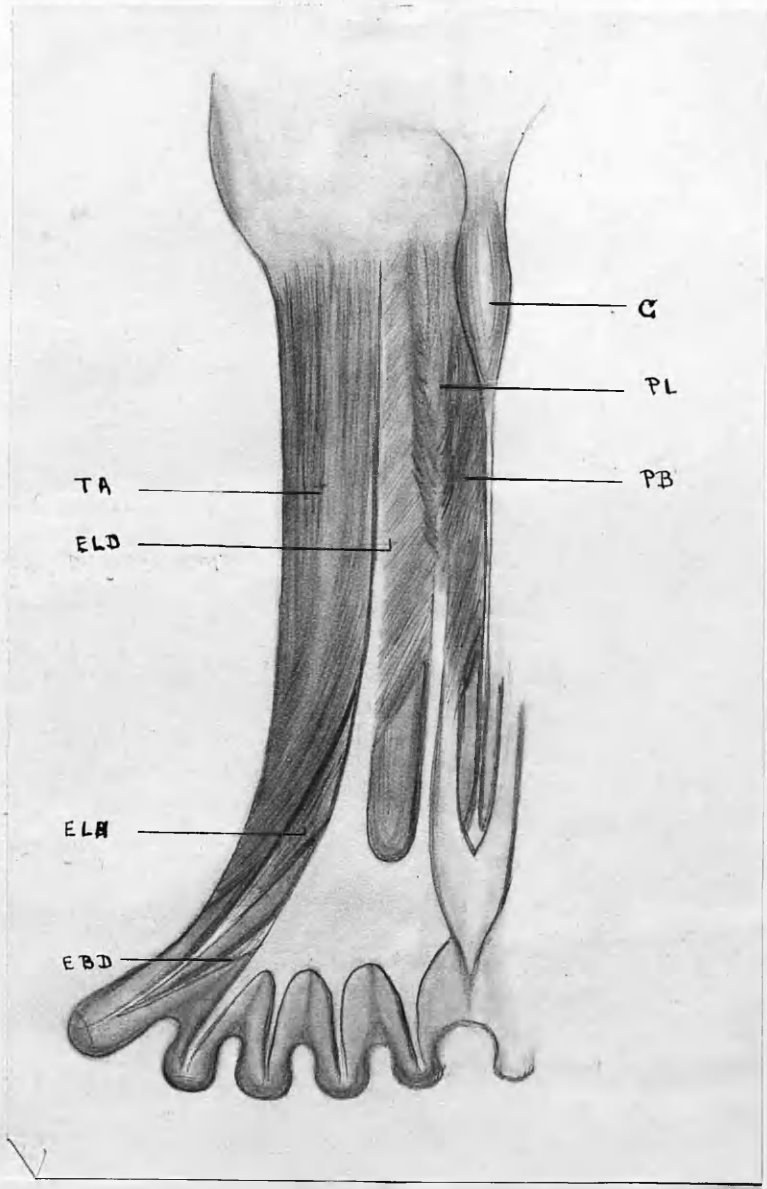
Figure IX. View of a dissection of one half of the posterior aspect of the leg and foot. T.A. Tibialis anticus, E.L.H. Extensor longus hallucis, E.L.D. Extensor longus digitorum, E.B.D. Extensor brevis digitorum, P.L. Peroneus longus, P.B. Peroneus brevis. G. Gastrocnemius.

Figure X. View of a superficial dissection of the sole, F.L.D. Flexor longus digitorum, T.P. Tibialis posticus, L. Lumbricales, T. Transverse band connecting innermost tendons of the flexor longus digitorum muscles. P.T.N. Posterior Tibial Nerves.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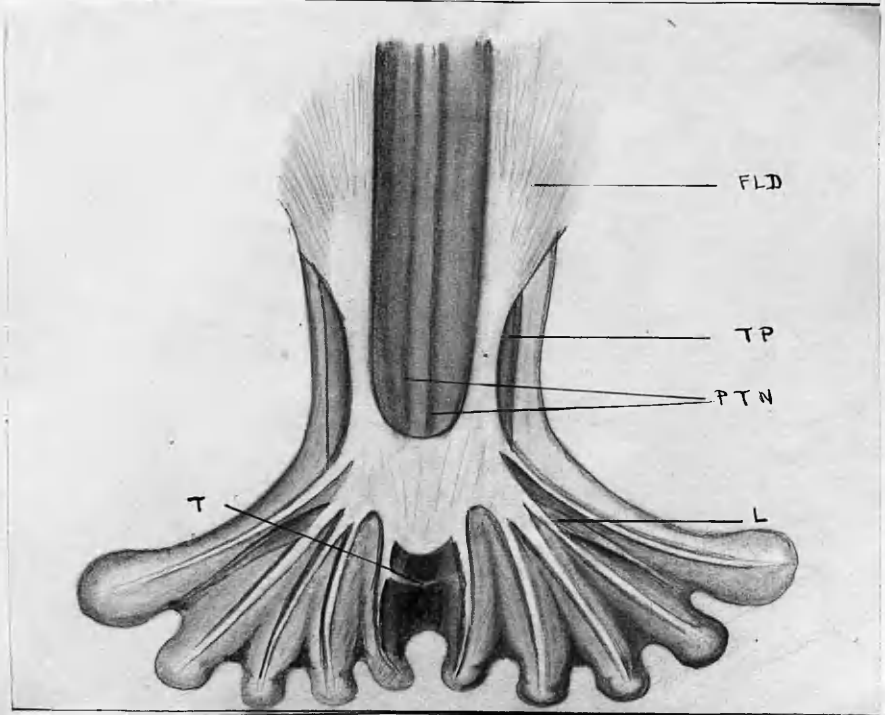
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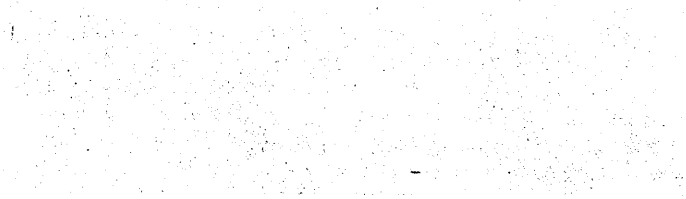
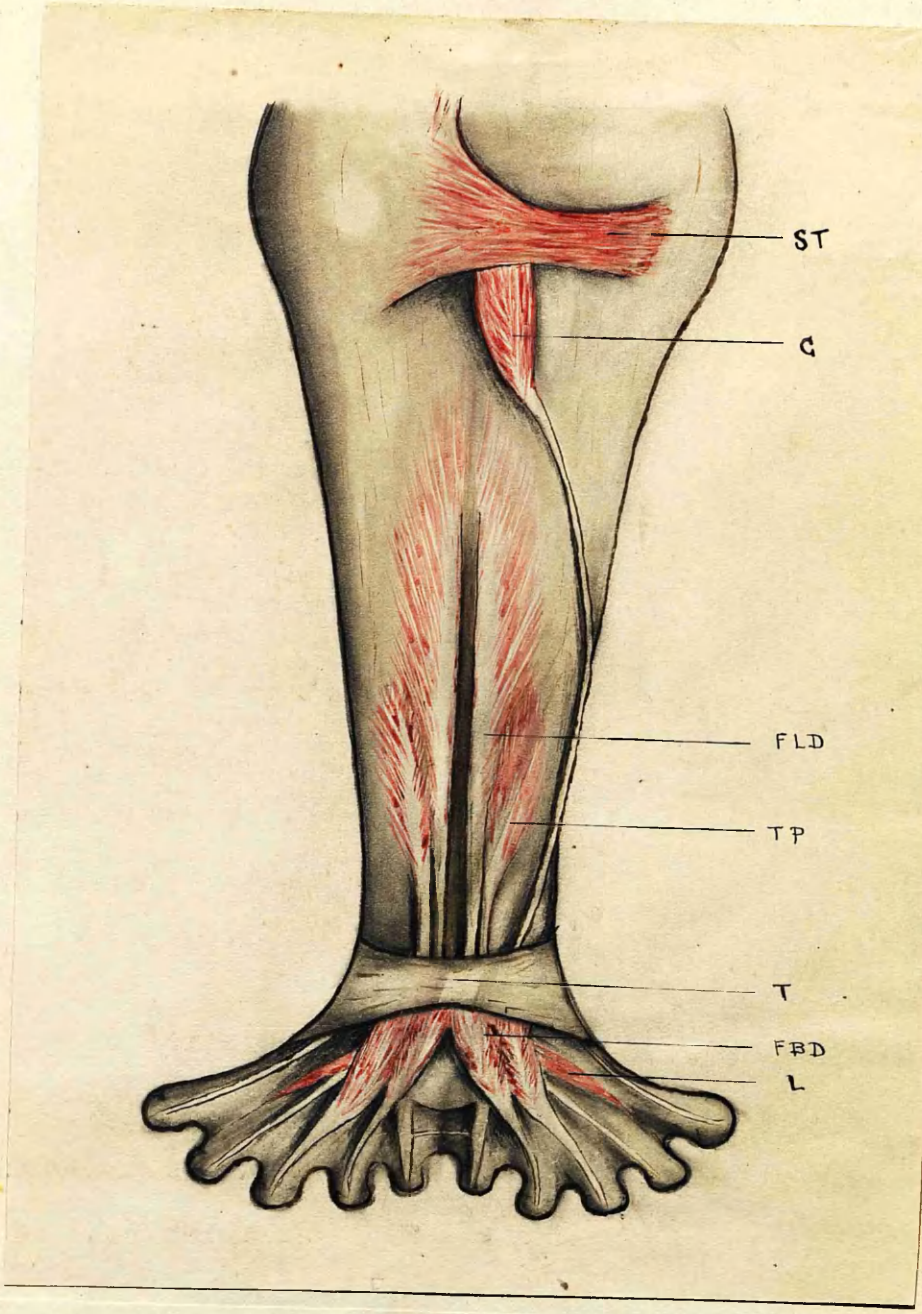


Figure XI. View of dissection of the anterior aspect of the leg and sole of the foot. S.T. Semitendinosus, G. Gastrocnemius, F.L.D. Flexor longus digitorum, T.P.Tibialis posticus, F.B.D. Flexor brevis digitorum, L. Lumbricalis, T. Transverse band of fascia.

Figure XII.The internal generative organs seen as dissected out under water. U.R. Right half of uterus. U.L. left half of Uterus. R.L. Round ligament of the Uterus, F.T. Fallopian Tube, O. Ovary, M.S. Mesosalpinx.

XI



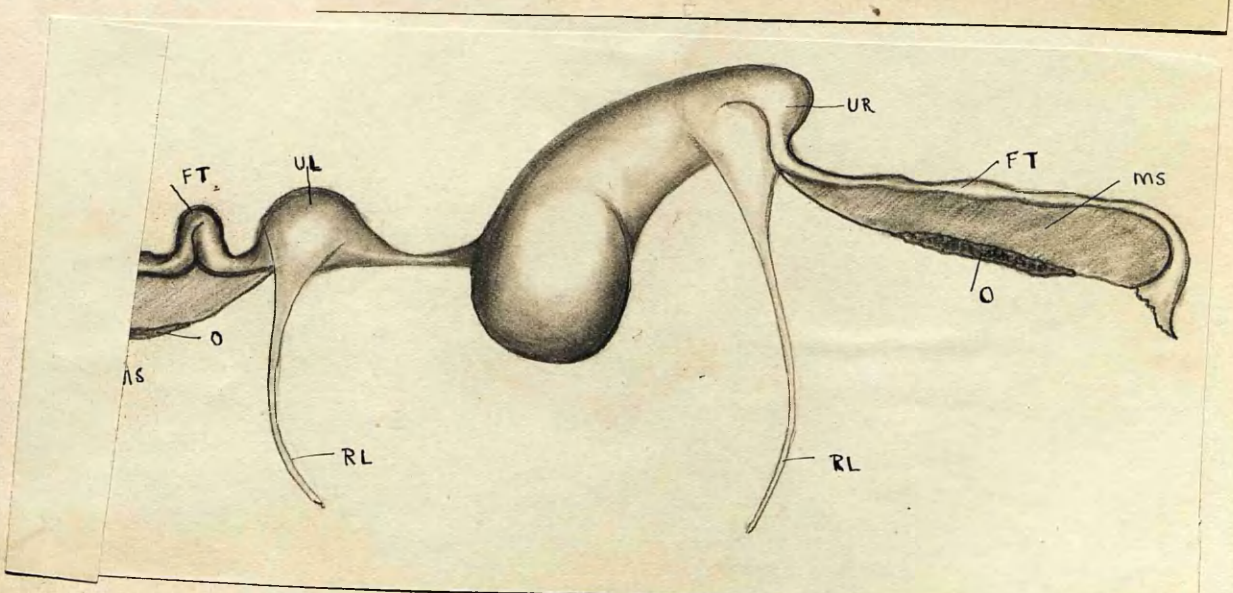


Figure XIII. View of deep dissection of the anterior aspect of the leg and foot. The flexor longus digitorum muscles have been cut and turned down. F.L.D. Flexor longus digitorum muscles, P. Popliteus, T.P. Tibialis Posticus, F.L.H. Flexor Longus Hallucis, I.M. Interosseous membrane with posterior tibial nerves lying on it. G. Gastrocnemius with its tendon pulled out, F.B.H. Flexor Brevis Hallucis, A. Accessorius A.H. Abductor Hallucis.

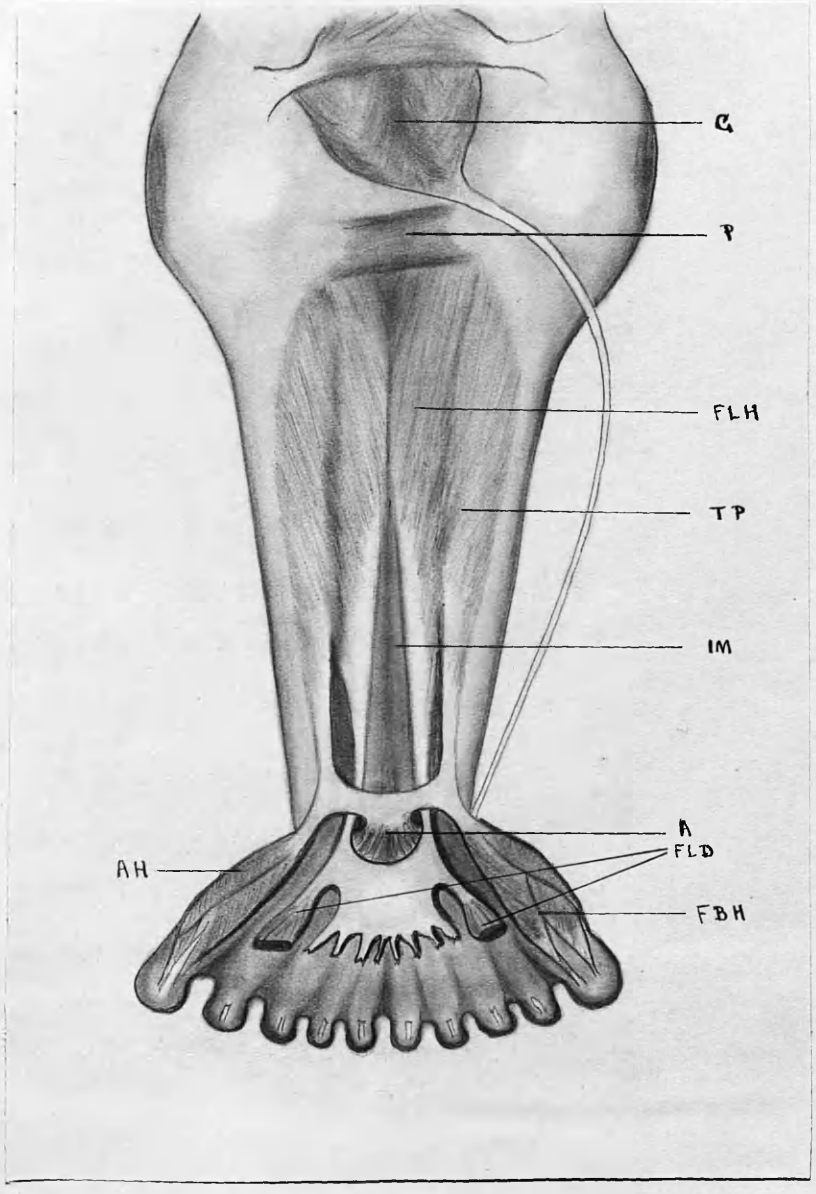

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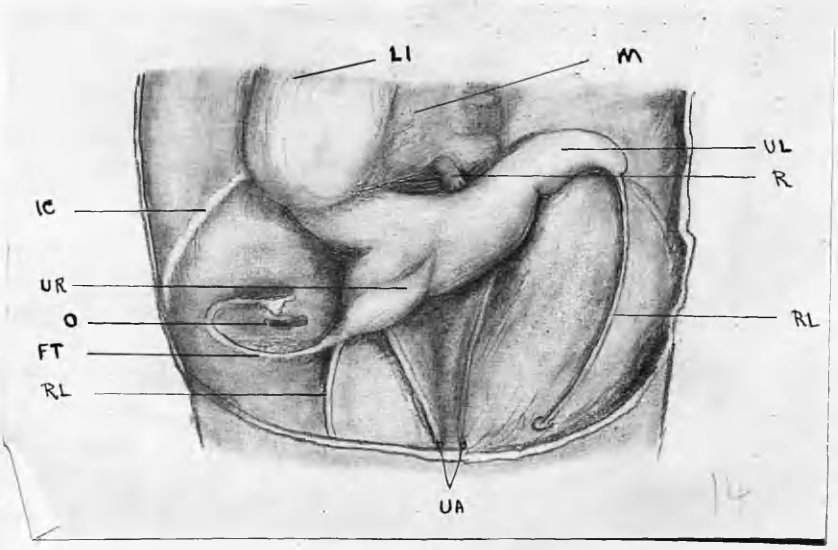
Figure XIV. View of the pelvis viscera. The left half of the uterus is pulled somewhat to the left and the large intestine to the right. L.I. Blind extremity of large intestine, U.L. Left half of uterus, U.R. right half of Uterus, O.R. Right Ovary, F.T. Right Fallopian Tube, R.L. Round ligament of the uterus, U.A. Umbilical arteries, I.C. Iliac Crest, M. Mesentery, R.Rectum.

Figure XV. View of a dissection done under water of the constricted terminal portion of the large intestine. L.I. Blind extremity of large intestine, 1, 2, 3, 4 Four globular masses, 5 Leaf shaped mass, 6 oval mass, 7 elongated cord.

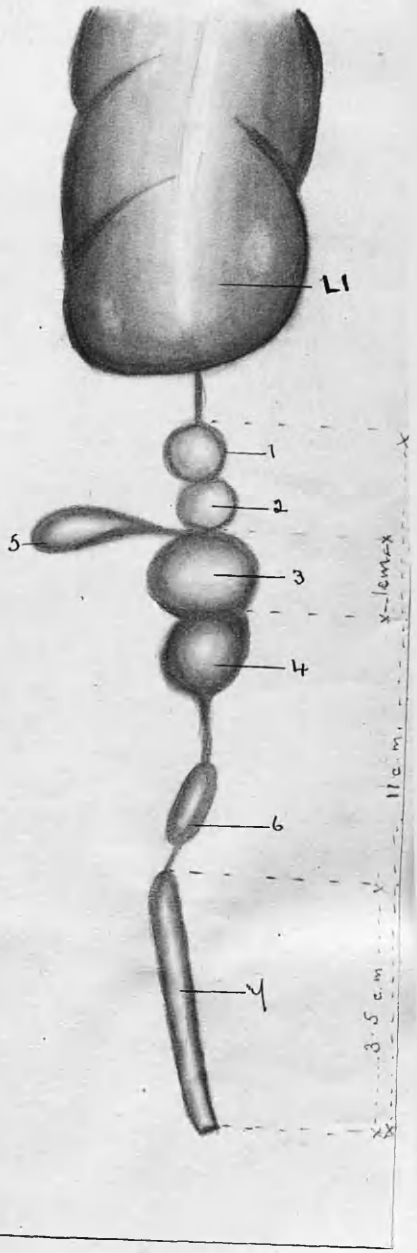
Figure XVI. Diagram (after McMurrich) of the development of the umbilical arteries . U^1 The originally single umbilical artery arising from the aorta and dividing into the two branches U^2 U^2 which later atrophy and disappear. U^3 The hypogastrics arising from C.I.the common iliacs B. Junction of Umbilicals and hypogastrics. S. Middle Sacral. The light shaded part from U^1 to B. ultimately disappears.

Figure XVII. Diagrammatic view of the termination of the posterior tibial nerves in the soles of the feet.

XIV



XV



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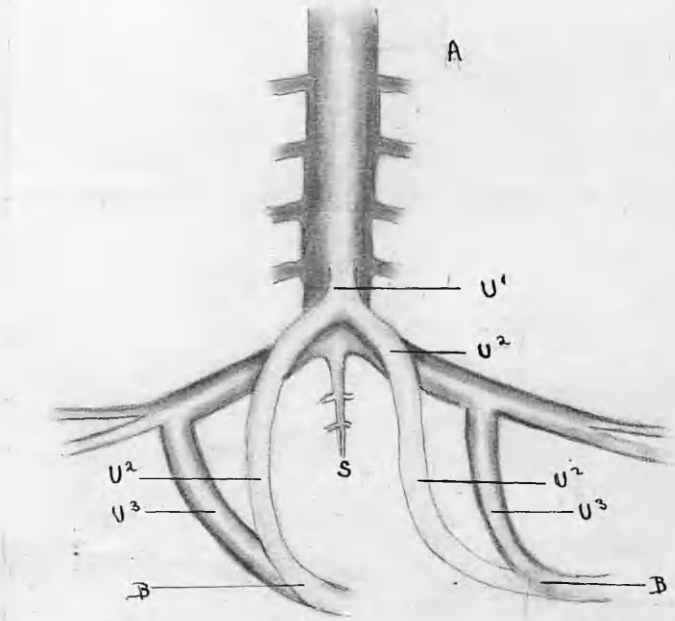
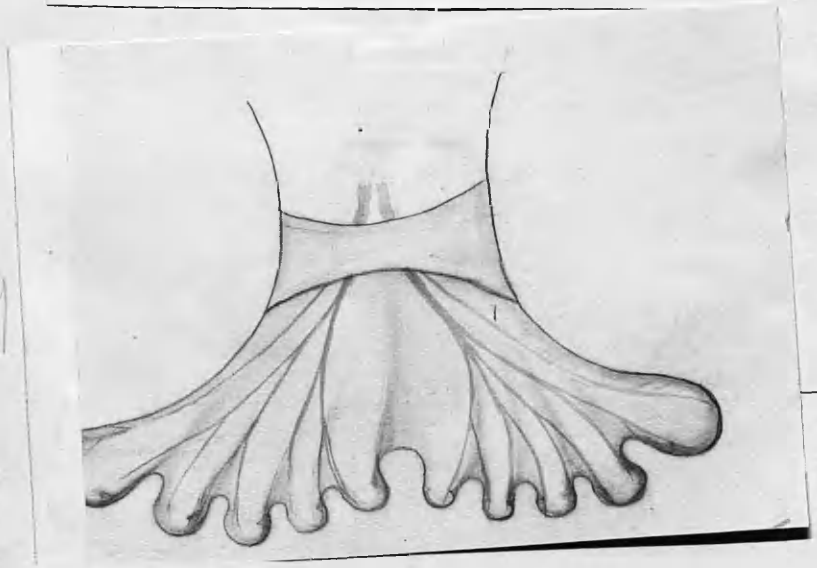
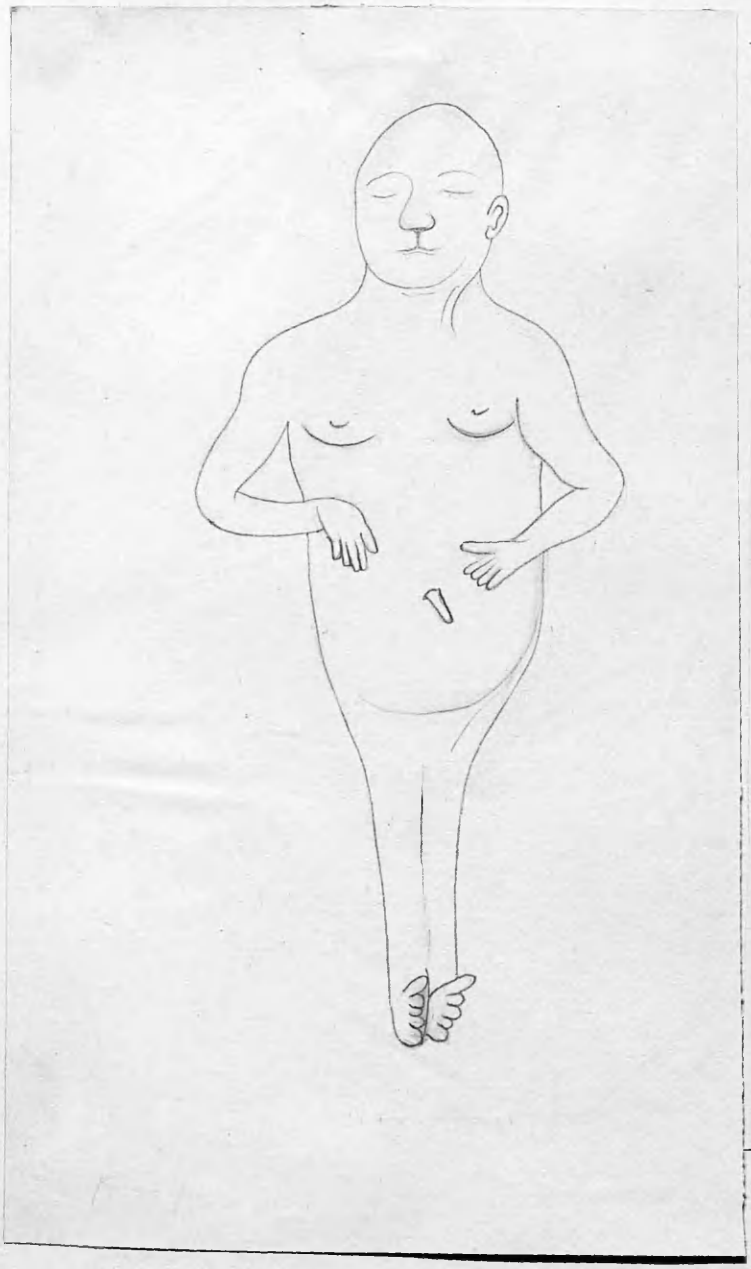


XVII



Figures XVIII. & XIX. Figures of symeles, XVIII. from Cruveilhier and XIX from Ballantyne.



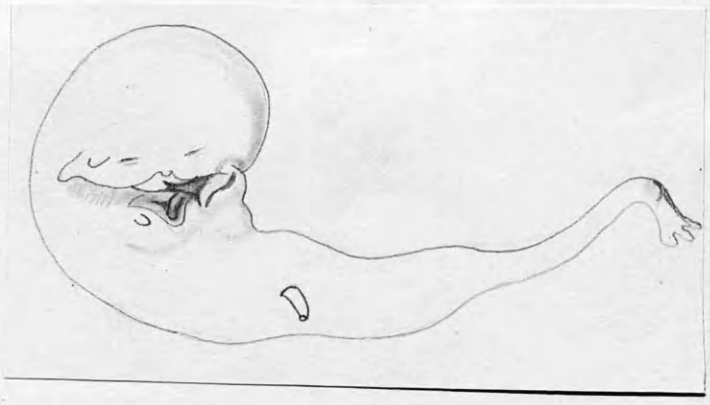
XVIII

XIX

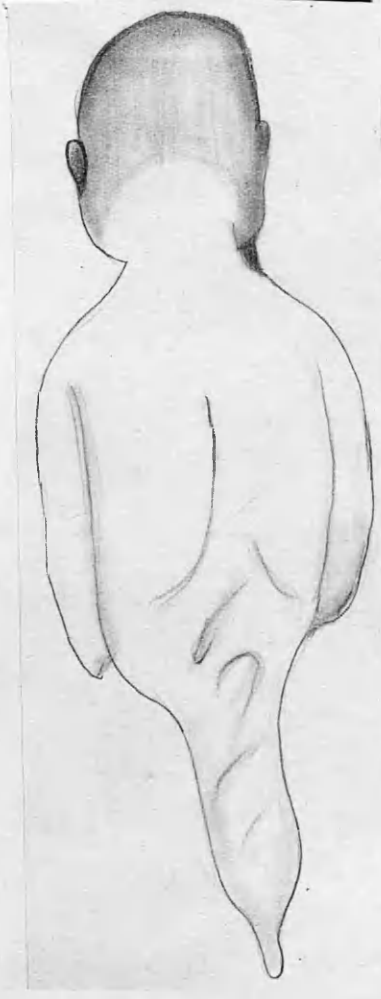
Figures XX. & XXA. Figures of Uromeles, XX. from Behn, and XXA. from Otto case CCLXXI.

Figures XXI. & XXII. Figures of sirenomeles, XXI. from Ballantyne and XXII. from Cruveilhier.

XX

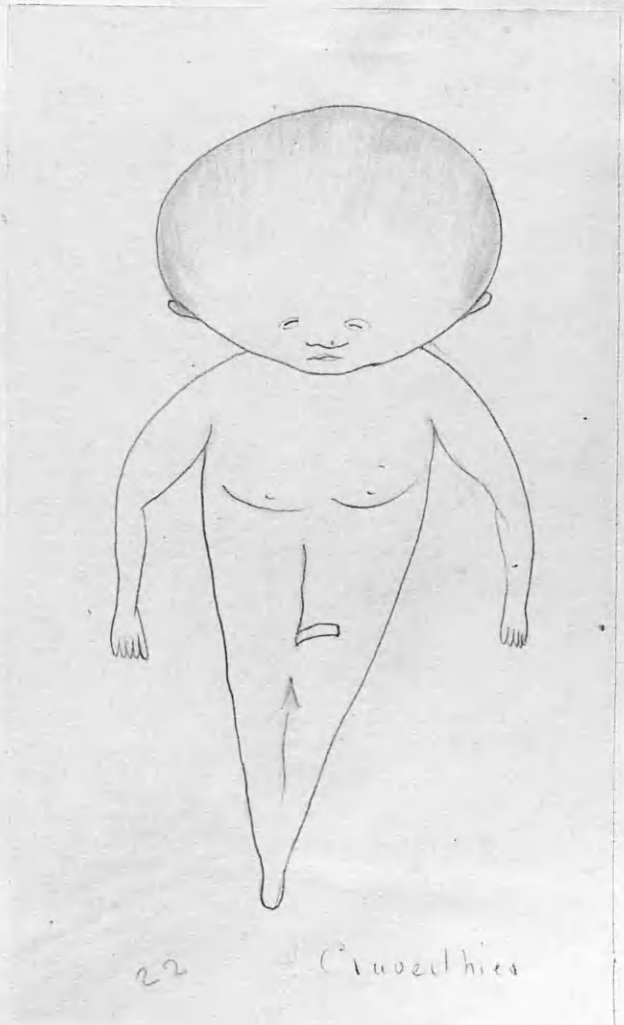


XX A



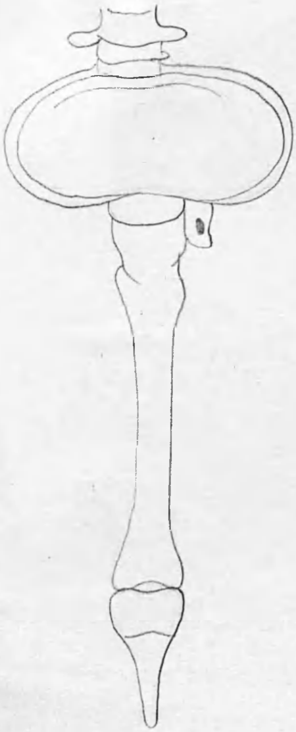
XXI

Posterior Aspect

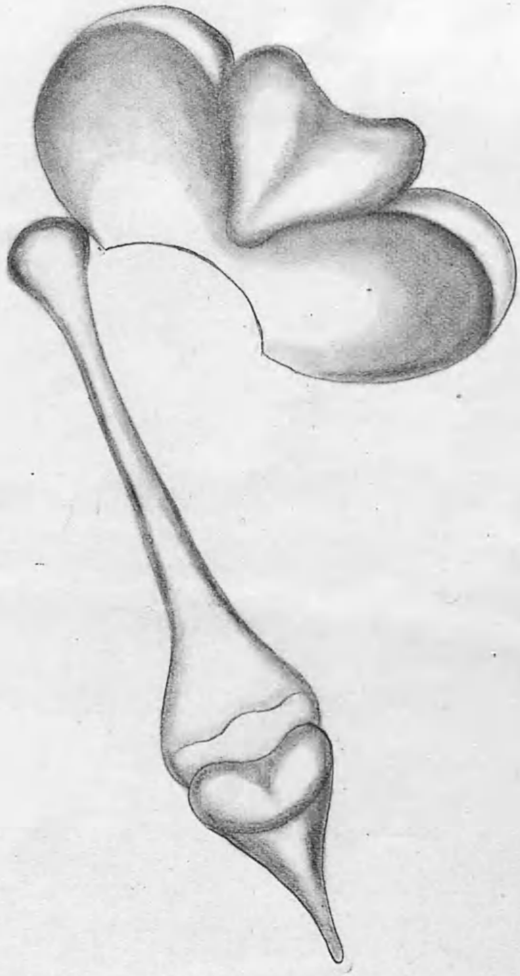


XXII

Figures XXIII. & XXIV. Skeletons of Sirenomeles, XXIII. from Vrolik and XXIV. from Manners-Smith.

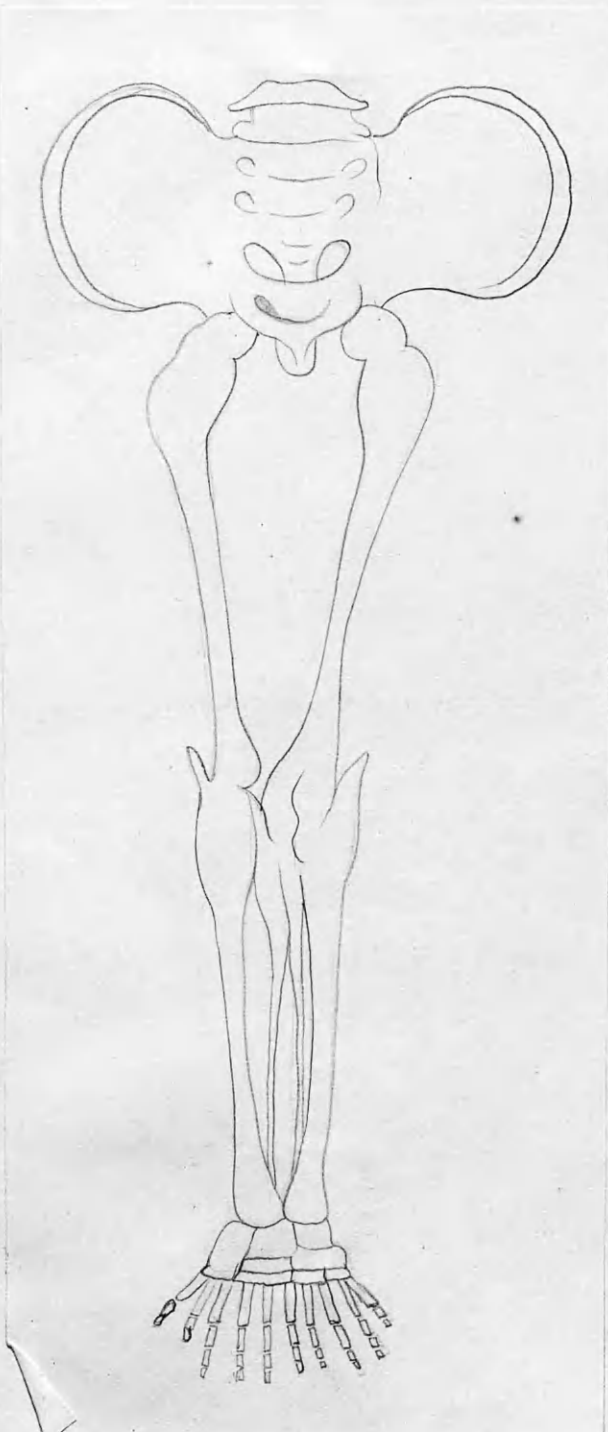


XXIII

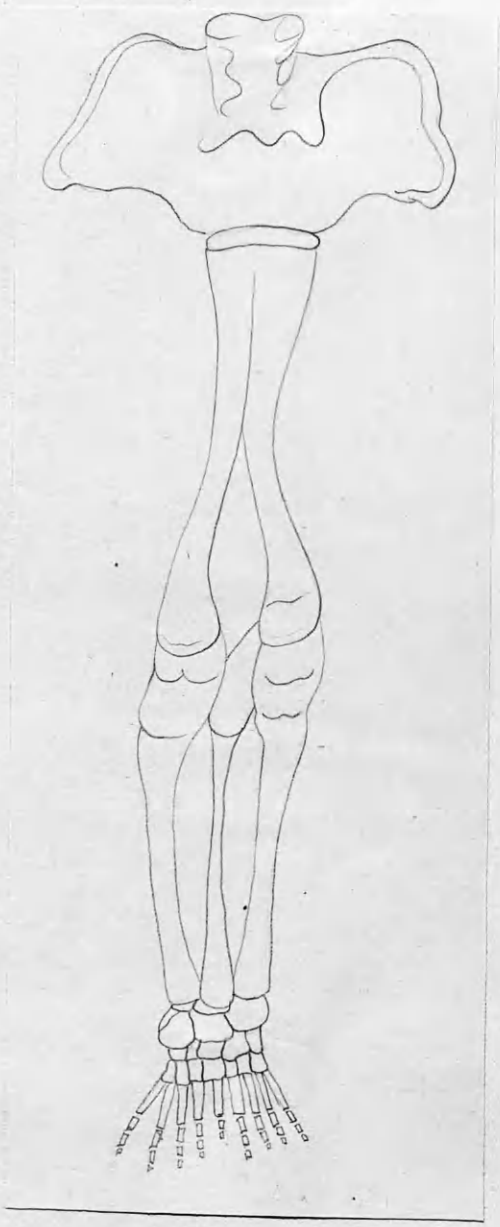


XXIV

Figures XXV. & XXVI. Skeletons of Symeles from Cruveilhier.



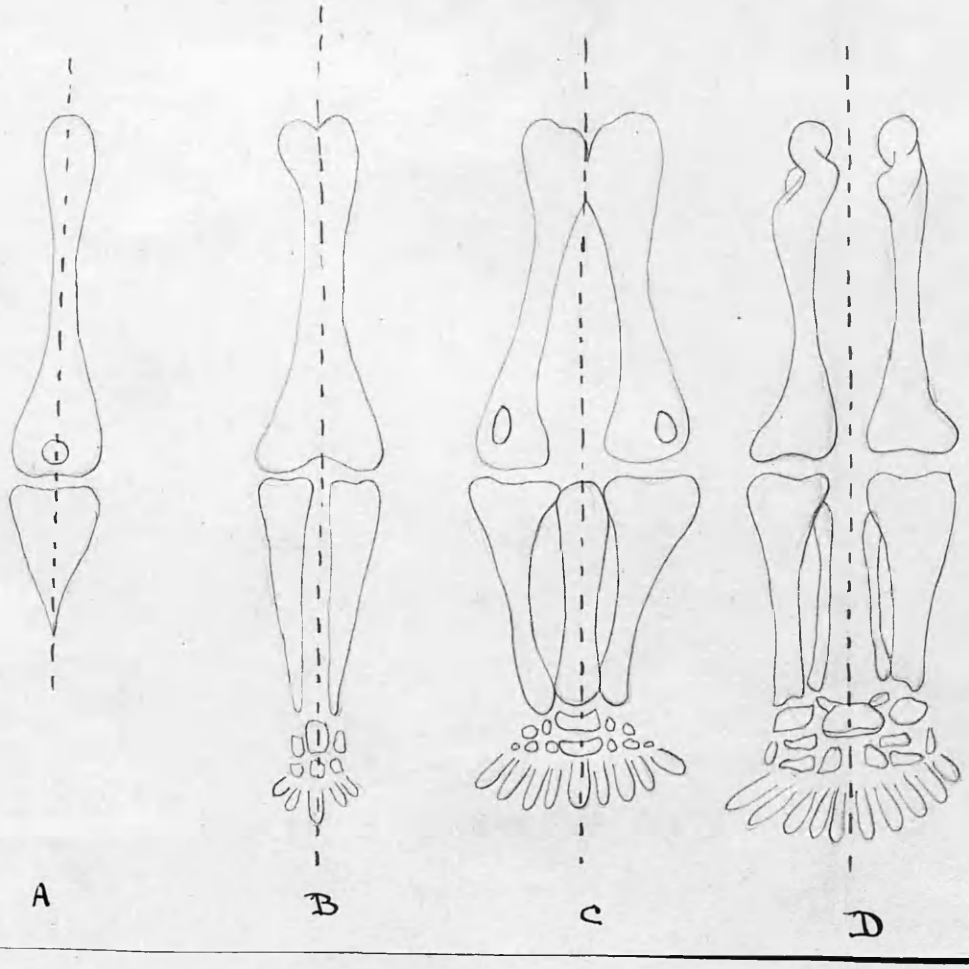
XXV



XXVI

Figure XXVII. Views of skeletons of symeliens taken from various sources to shew the gradual transition of one form into the other, A. Sirenomelus, B. Uromelus C.& D. Symeles.

Figure XXVIII. Schema (after Bolk) to shew the primitive condition of the os innominatum and the segments entering into its structure.


A
B
C
D

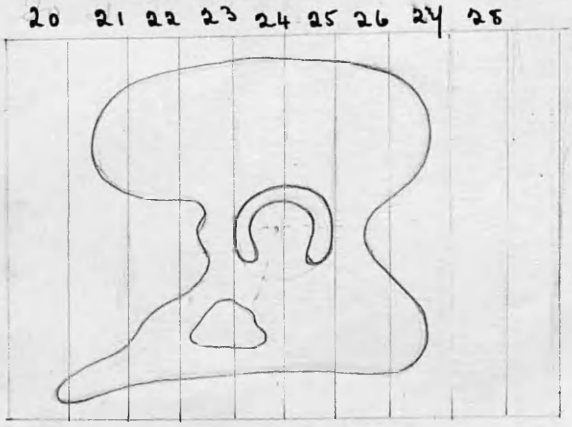

20 21 22 23 24 25 26 24 28

Figure XXIX. Diagram of the os innominatum shewing the muscular attachments. The numbers indicate the segments from which the muscles get their nerve supply and consequently the segments which enter into the structure of the muscles.

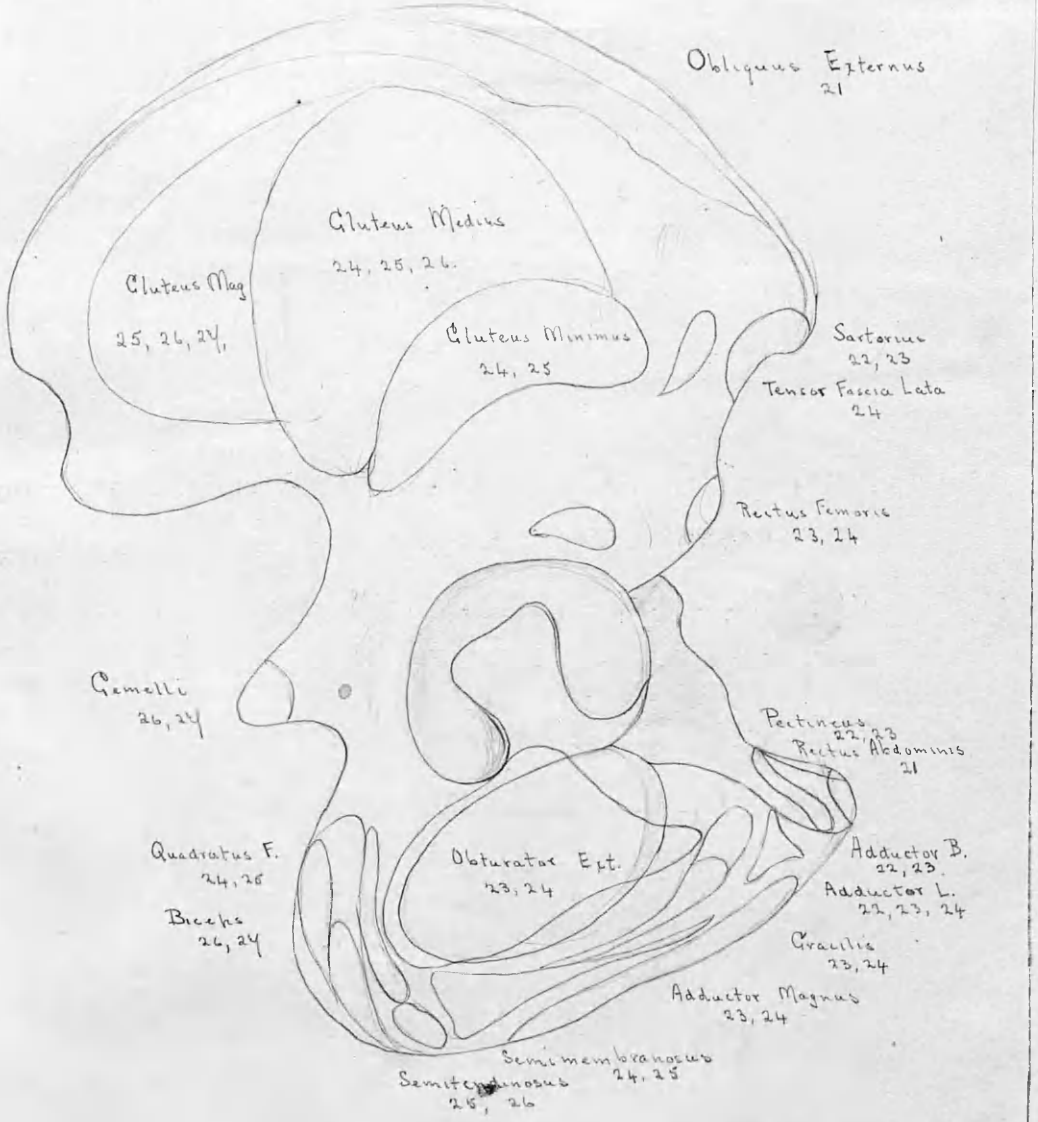
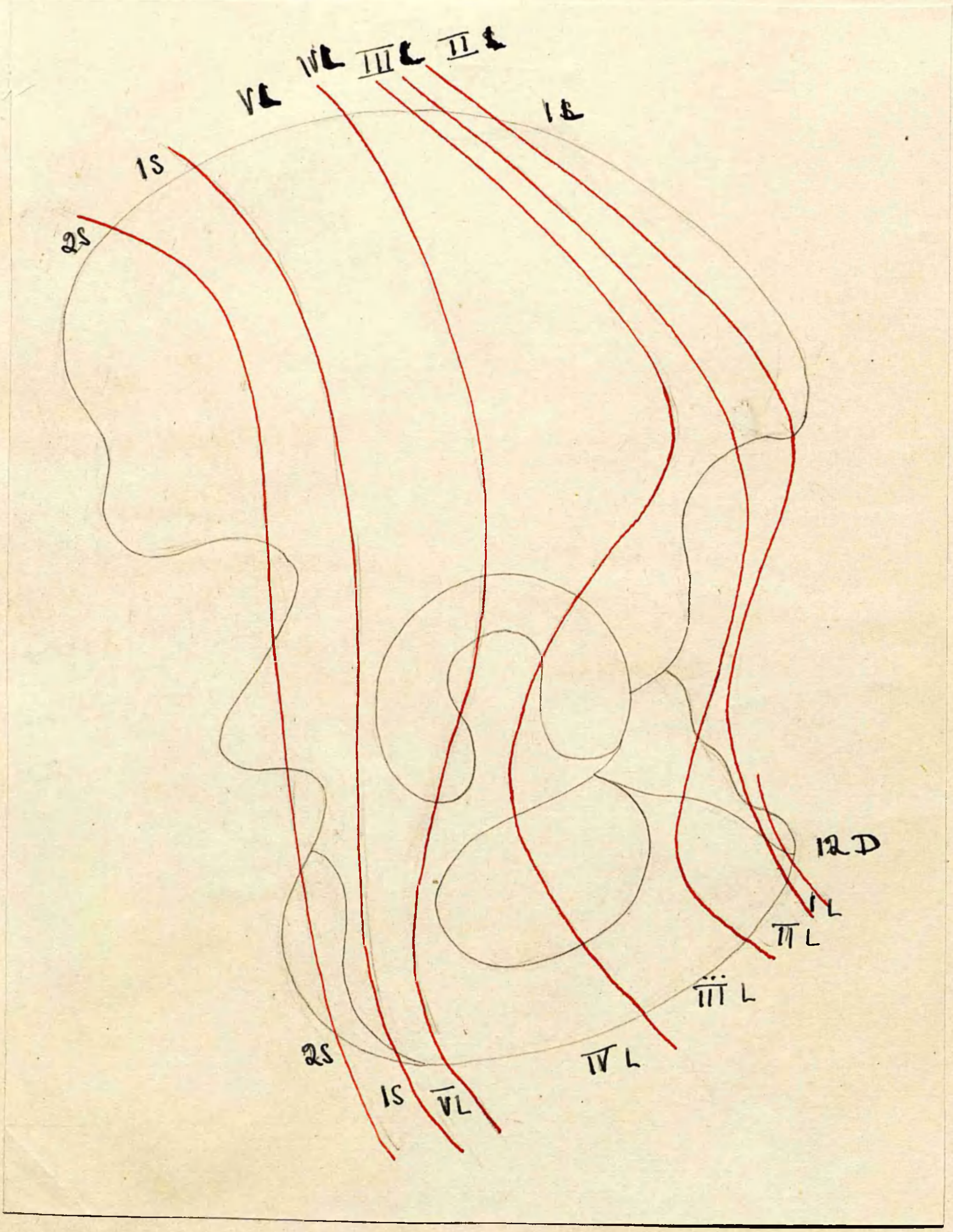

Obliquus Externus
21
Gluteus Medius
24, 25, 26.
Gluteus Mag
25, 26, 24,
Gluteus Minimus
24, 25
Sartorius
22, 23
Tensor Fascia Lata
24
Rectus Femoris
23, 24
Gemelli
26, 24
Pectineus
22, 23
Rectus Abdominis
21
Quadratus F.
24, 25
Obturator Ext.
23, 24
Adductor B.
22, 23.
Adductor L.
22, 23, 24
Biceps
26, 24
Gracilis
23, 24
Adductor Magnus
23, 24
Semimembranosus
24, 25
Semitendinosus
25, 26

Figure XXX. Schema (after Bolk) of the segments which enter into the structure of the os inominatum. The red lines indicate the boundaries of the segments. I.L.- V.L. the lumbar segments, 1S-2S the sacral segments, 12D the twelfth dorsal segment.

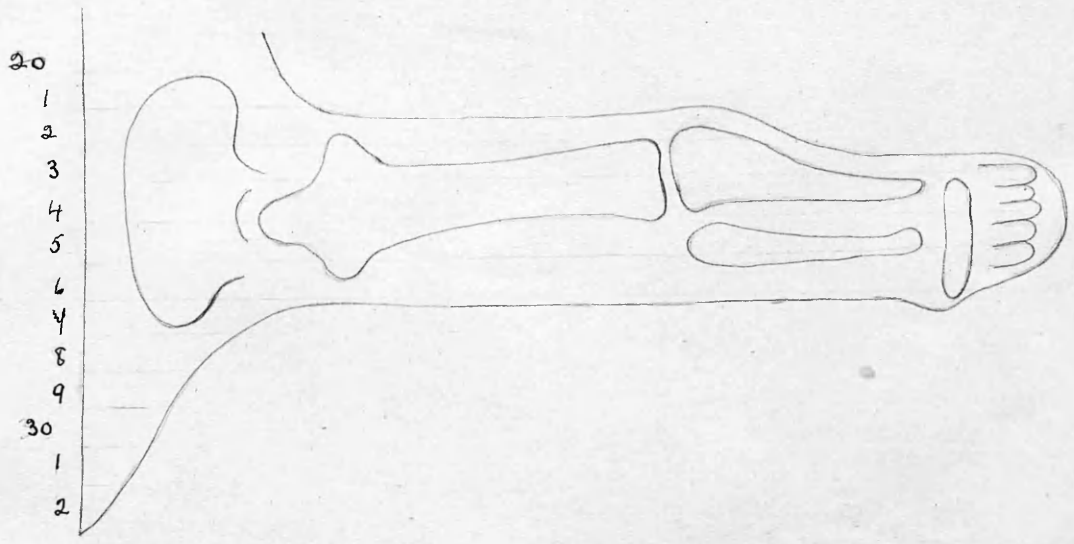


30

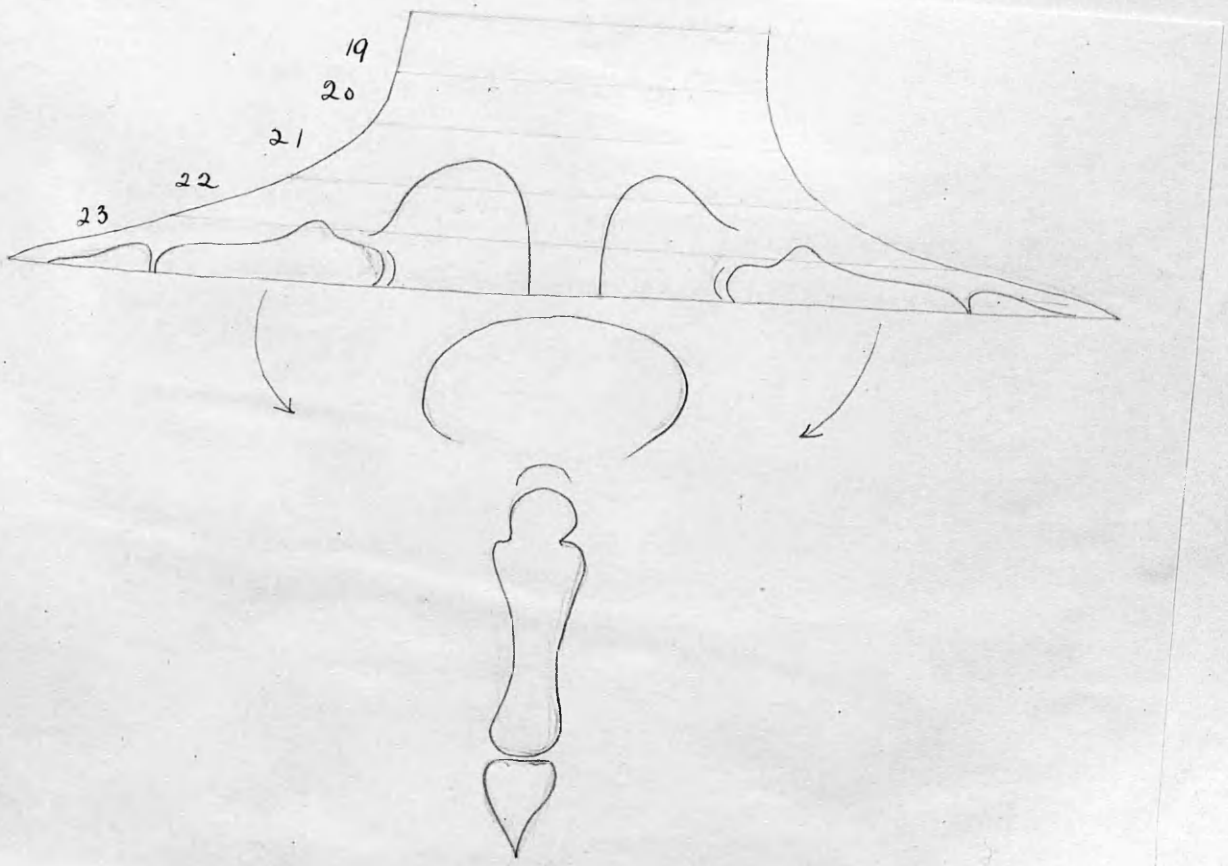
Figure XXXI. Schema (after Bolk) of the segments composing the inferior limbs. Only the ilium which develops in the dorsal parts of the segments is shewn, and the limb is drawn, for clearness, as if it projected at right angles to the trunk. The parallel lines indicate the boundaries of the segments.

Figure XXXII. Schema to illustrate how defect of the posterior segments produces the symelian type of monster.

XXXI

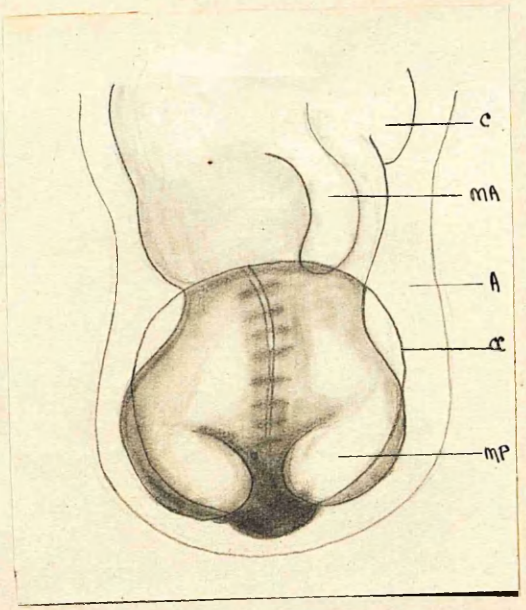


XXXII

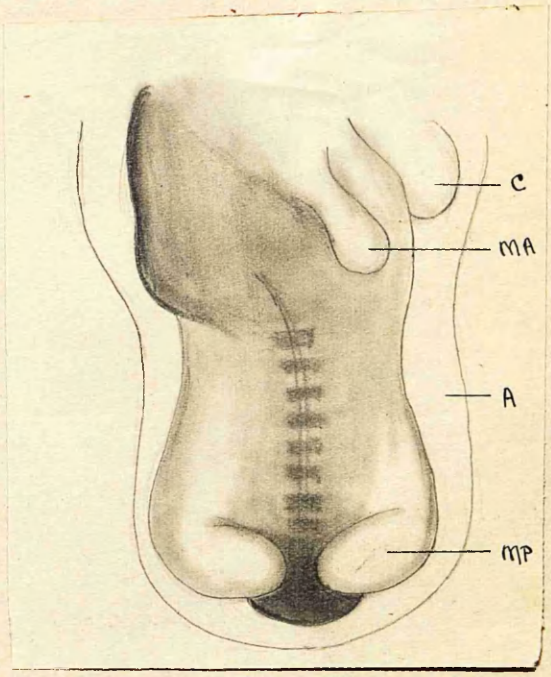


Figures XXXIII. & XXXIV. From Dareste to illustrate how amniotic pressure produces symeliens. M.A. Anterior limbs, M.P. Posterior limbs, C. Heart, A. Amnion, C.C. Capuchon.caudal.

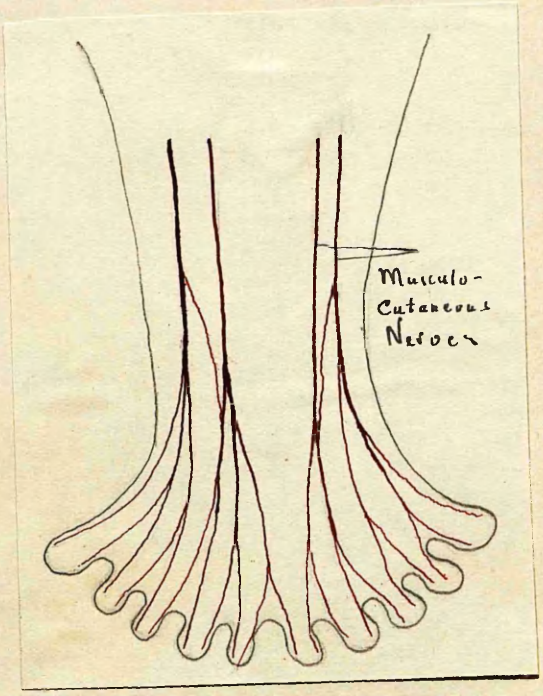
Figure XXXV Diagrammatic sketch of the distribution of the musculo-cutaneous nerves on the dorsum of the foot.



XXXIII



XXXIV



XXXV