

SPOLIA ANATOMICA, ADDENDA II

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TWENTY-TWO FIGURES

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A CONGENITAL INTRA-CRANIAL, INTRA-DURAL ADRENAL

The cadaver containing this strange anomaly was that of a male native of Germany. The cause of death at the age of 73 years was assigned to chronic cardiac disease. Fortunately for us the body had not been autopsied. It had been received three days after death and had been preserved as is customary with us for dissection.

Messrs. Kelker and Geistweit, two of our medical students, who removed the brain in the course of their dissection called my attention a few minutes after removal of the brain, to a small body attached to the spinal portion of the left accessory nerve.

This body which was roughly cylindrical in form lay upon and was attached to the nerve along its dorso-medial surface. It was located directly cranial to the place where the vertebral artery pierces the dura. The body and a portion of the nerve were excised by myself in the presence of these gentlemen.

Since I took the enlargement for a neurofibroma I did not note its vascular or other relations as I should have otherwise done. The specimen was carefully removed, however, and its remarkable preservation has surprised everyone who has examined sections microscopically. Yet the cadaver had not been embalmed until three days after death. Dissection was not begun until seven months later and the specimen not removed until nine months after receipt of the body.



Fig. 1 Intra-dural adrenal, external view. Natural size. *a*, pedicles; *b*, loose outer capsule.

The specimen which is roughly cylindrical and measures 1.5 by 0.8 cm. is represented in natural size in figure 1. Upon inspection it is evident that the corpus proprium is surrounded by a loose capsule which bulges here and there and very evidently contains blood and pigment. The stalks which leave either pole of the specimen look somewhat like blood vessels but feel rather firm and cord-like.

Upon transverse section at its midpoint, it is seen that a very symmetrical white cylindrical body with rounded ends is surrounded by a scarcely discernible capsule and contained in a very loose outer envelope. The latter contains some blood in its looser portion only, for it is closely apposed to and seems to fuse with the capsula propria in the other half of its perimeter. It is this outer capsule which gives the specimen the peculiar irregular outline seen in figure 1.

The consistency of the specimen as well as its color made one think of the cerebral cortex. Under low magnification the cross-

section is slightly oval in form. The main portion of the section is composed of a fairly uniformly-constituted, slightly-granular mass with radial striations as represented in figure 2. The connective tissue capsule which varies greatly in thickness is quite closely applied to the contained tissue. Over that half of the perimeter where the outer capsule is thinnest the outer portion of the latter is reflected and forms a thick folded cushion of connective tissue which contains fat and a mass of blood. In the space between this outer reflected portion of connective

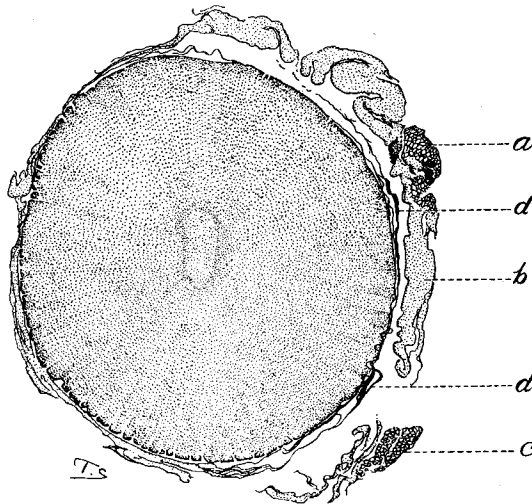


Fig. 2 Intra-dural adrenal. Cross sections under low magnification. *a*, fat; *b*, connective tissue; *c*, blood; *d*, muscle.

tissue and the inner portion of the capsula propria there is a large space which seems to contain some blood.

Under higher magnification the nature of the specimen at once becomes evident for very characteristic glomerular and fascicular zones can be recognized instantly. The former although very narrow, is very characteristic in many places. The latter is relatively longer than in human adrenals and shows a far better radial arrangement. In fact both these zones in this specimen remind one strongly of the appearance of cross-sections of the adrenal of the dog. The reticular zone is composed of a

solid mass of cells near the center of which an irregular circle of somewhat darker cells is seen as indicated by the shading in figure 2. Although these darker cells are not equally abundant in all sections of the portions cut serially, they remind one very strongly of cells from the medulla of the adrenal. The arrangement of the very evident fascicular zone is so symmetrical that the appearance of the section may justly be said to be pretty.

Under still higher magnification the cell boundaries and the nuclei are seen to be splendidly preserved in many areas as shown in figure 3. Since the walls of the capillaries are collapsed they are inconspicuous except here and there in the outer zone.

Only minor evidences of degeneration are present except in certain very small areas in the fascicular zone, which are composed of small masses of granules which stain deeply with hematoxylin. The central portion of the sections in some portions of the specimen, contains a few small clefts which do not look as though they resulted from post mortem changes or shrinkage. The relatively thin and loosely applied connective tissue capsule sends fine septa into the glomerular zone from its inner looser portion. Its outer looser portion also contains fat and unites with masses of extra-capsular connective tissue which contain fat, blood vessels and also some relatively large and many small masses of chromaffine cells. These irregularly-formed and irregularly-distributed cell masses stain deeply with chrome salts and in many places are arranged indistinctly curved cords. Since some space is left between these cords of cells the structure of the carotid gland is simulated quite closely in these areas, a small portion of which is shown in figure 4. Large and small very definitely circumscribed ovoid masses of chromaffine cells are also contained in the capsula propria. In these masses the cells are not so definitely arranged into cords however. One of these chromaffine bodies is so large that it has indented the glomerular zone beneath it as shown in figure 5. Chromaffine cell groups and fat are also found in the capsular extensions on both ends of the specimen, and on one end a great deal of pigment was found scattered about as fine gran-

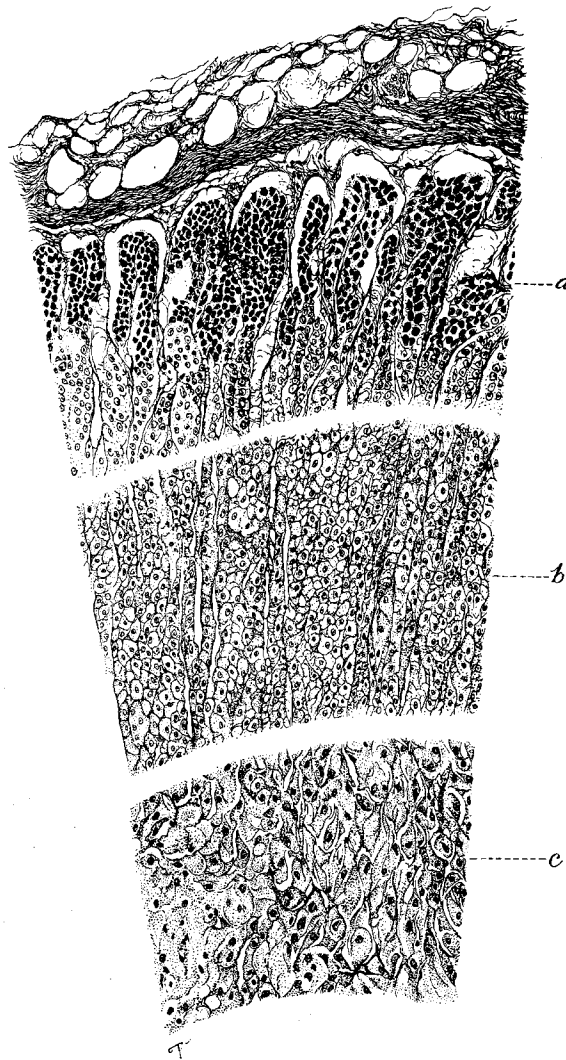


Fig. 3 Portions of the glomerular, fascicular and reticular zones and medulla.
× 475.

ules or as larger masses in the connective tissue which formed the extremity. It was this end which contained only a very small group of chromaffine cells in the portion examined in serial sections. Free erythrocytes were also found in this por-

tion which nevertheless was relatively non-vascular and the connective tissue of which was not so well-preserved. Considerable areas of degenerated blood were also contained in it besides a small oval body with a thin fibrous capsule, composed of granular material containing a small number of degenerated cells of various kinds, the identity or origin of which could not be determined.

But more surprising than all of these constituents is the presence of a good-sized bundle of striped muscles muscle in the external surface of the outer portion of the reduplicated capsule.

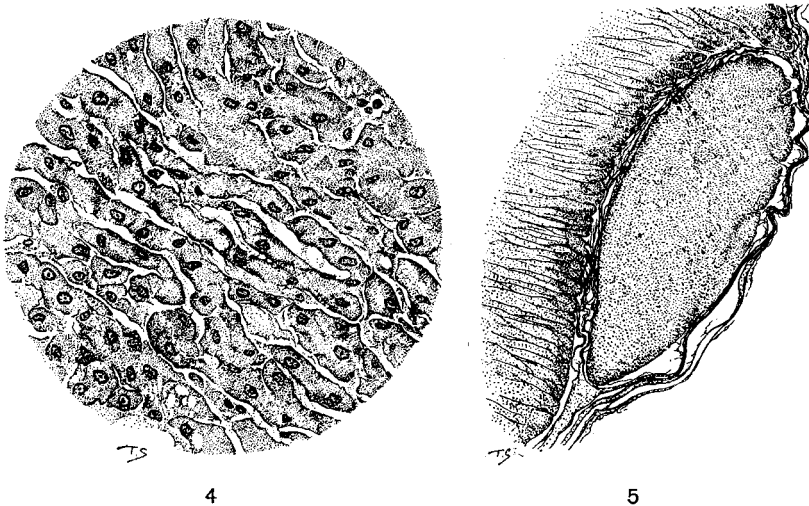


Fig. 4 Chromaffine cell masses from outer capsule. $\times 750$.

Fig. 5 Relation of large intra-capsular chromaffine body to the adrenal.

Until the direct connection with and indeed the inclusion in the reflexion of the capsule propria, of this muscle mass had been conclusively established by following the serial sections I was inclined to regard it as an accidental inclusion in spite of the suggestive staining reactions of the strand of connective tissue with which the portions first seen were so intimately associated. These muscle fibers are so well-preserved that the transverse striations are very plainly visible in some of them. Their location is indicated at *c* in figure 2. Strands of the spinal portions

of the accessory nerve are also contained in the capsule which also contains very wide exceedingly thin-walled vessels and a good deal of fat. It is very well-preserved except in certain small areas.

The structure of this specimen and of the surrounding tissues make it very evident that it is not metastatic in origin. Not the least indication of malignancy can be seen anywhere and the only possible explanation of its presence here, it seems to me, is that a small mass of early embryonic mesenchyme was in some way included in the dura. This mesenchyme must then have differentiated into all the constituents of the adrenal, into chromaffine bodies, striated muscle, connective tissue and fat, the presence of which tissues prompts one to put the specimen among teratomata.

Various writers on pathological anatomy seem to be agreed that the so-called primary hypernephromata occur only in the abdominal cavity. It is said that they are found but rarely in the pelvis; that they occur mainly in the kidneys but rarely also in the liver, ovary, testes, ureter and the broad ligaments of the uterus. Upon the advent of malignancy these aberrant adrenals may, to be sure, metastasize as any other malignant growth to any part of the body. None of the writers consulted have referred to or have themselves described anything at all comparable to what is here reported, however, and were it not for the fact that this supernumerary adrenal is accompanied by striped muscle one might, in spite of the chronological difficulties even, be inclined to consider the possibility of later transportation or even of the migration of specific cell masses which then formed the various complexes. But its location on the spinal portion of the accessory nerve between arachnoid and dura, together with the peculiar vascular relations which it undoubtedly must have had with the meningeal vessels, alone make such a supposition quite untenable. Such a supposition would also imply the transportation of all these various cell islands at least in part by the cerebro-spinal fluid, to this peculiar location.

The very small amount of medulla within the specimen with restriction of the sympathetic elements almost wholly to the aberrant and extra and intra-capsular isolated chromaffine bodies is remarkable however, especially in that location. From the appearance of the specimen one gets the impression that although the sympathetic elements attempted to penetrate the cortical mass they only succeeded in reaching the capsule and the surrounding connective tissue leaving the corpus proprium overwhelmingly epithelioid.

THE RELATION OF SKELETAL TO BODY WEIGHT IN THE ADULT GUINEA PIG

From computations based on statistics given by Donaldson ('15) in table 53 the weight of the dried skeleton forms 1.94 per cent of the body weight in the new born, 4.38 per cent in the half grown and 4.09 per cent in the adult rat. Waldeyer ('10) gave the weight of the skeleton of two women of 40 years as 3.306 kg. and 3.585 kg. and that of a centenarian of 102 years as 1.185 kg. Although the body weights are not given he weights given for these three fat-free skeletons indicates that they formed from 3 to 6 per cent of the normal average body weight. From the accompanying table it is seen that the skeleton of the adult guinea pig forms a somewhat smaller percentage of the body weight, than that of man but somewhat less than that of the rat. One would I think, expect this from a mere comparison of the body forms of the rat and guinea pig.

Since only ten guinea pigs were used for this determination the percentages obtained can, to be sure, not be regarded as being so near the actual for the guinea pig, as are those of Donaldson for the rat. Nevertheless with three exceptions, the percentages obtained agree very well indeed, thus reducing the probable error. Number 26 was not pregnant and hence less fat. Pig No. 35 was in the early and pig No. 20 in the late stages of pregnancy. Hence the divergences noted in these cases may probably be accounted for by these things. Similar differences are also found in Donaldson's large series and could, to be sure, be accounted for very easily by varying conditions of nutrition alone.

All animals in this series of ten pigs were pregnant, save No. 26. The weight of the uterine contents was, however, always subtracted from the total body weight before percentages were calculated.

The skeletons were cleaned by heating the fresh carcass in a 1 per cent solution of gold dust for five to seven hours. They were then dried for one week in a thermostat at a temperature of 54 to 55°C. after which the first weighing was done. Next they were placed in benzine for six to seven days in order to extract the fat and dried at room temperature for a week. The second weighing was then done. The treatment was exactly the same in several groups which were handled together.

From the percentages representing the relative weight before and after treatment with benzine it is seen that the reduction in weight amounts to 4 to 5 per cent of the weight of the cleaned, air-dried skeleton. This is a remarkably low amount of fat when compared with the results given for other animals.

NO. OF PIG	DURATION OF PREGNANCY	BODY WEIGHT	DRY SKELETON	PERCENTAGE	SKELETON DE- PRIVED OF FAT	PERCENTAGE
20	64	751.30	30.400	4.04	29.555	3.93
21	51	722.00	25.550	3.53	24.420	3.38
22	48	813.50	29.700	3.65	28.400	3.49
23	44	844.20	28.520	3.37	28.097	3.32
26	0	751.00	33.300	4.43	32.870	4.39
27	33	943.85	31.520	3.34	30.737	3.25
28	31	866.56	30.780	3.55	29.172	3.36
29	29	692.66	24.730	3.57	23.420	3.36
31	25	901.50	30.790	3.41	29.875	3.31
35	15	688.30	28.840	4.19	27.770	4.03

LYMPHOID NODULES IN THE LIVER OF ALUCO PRATINCOLA

In a specimen of the common barn owl—*Aluco pratincola*—lymphoid nodules of varying though small, size were found distributed at random throughout portions of the liver. The latter which looked wholly normal had been removed from a young owl about six months old. It contained no signs of inflammation or degeneration, either macro- or microscopically, and the young owl which had been under observation for some months had never shown any signs of illness.

These accumulations of lymphocytes mixed with erythrocytes were of microscopic size, the largest measuring only a small fraction of a millimeter. Most of them were irregular in form and included extensions of the parenchyma of the liver into them. Not rarely, however, one of the smaller follicles was surrounded by a very thin but distinct layer of connective tissue which could be regarded as a capsule. Those observed contained neither germinal centers nor an evident reticulum.

The lymphocytes were crowded together and included relatively few erythrocytes. When small collections of erythrocytes were present they were usually segregated fairly well from the lymphocytes. The nuclei of the latter were not pyknotic but vesicular, as is the case within the lymph follicles of lymph nodes. No polymorphonuclear leucocytes or giant cells were seen in these follicles and no evidence of any phagocytosis was observed. The lymphocytes were not arranged in cords but were scattered about miscellaneously and no lymph vessels or sinuses were observed. Comparatively large blood vessels were, however, not infrequently seen near these nodules, penetrating them, and forming sinusoids within them. The general appearance is indicated in figure 6.

LYMPHOID NODES IN STRIGIDAE

From an examination of 31 species including 14 families Jolly ('10) concluded that, among birds, lymph nodes are found only in some members of the group 'Lamellirostres' of the family Anatidae. Jolly failed to find them in *Branta bernicla* L. for example. Thirteen species of 'Lamellirostres,' all of which fall in the family Anatidae and one in the Phoenicopteridae were examined by Jolly. Ten in the former and one in the latter, viz., *Phoenicopus roseus* Pall, contained lymph nodes. Of the other families examined none were found to possess lymph nodes. These families included: Alcidae, 1 specimen; Colymbidae, 2; Laridae, 1; Ardeidae, 2; Otididae, 1; Tetraonidae, 4; Columbidae, 1; Picidae, 1; Corvidae, 1; Alaudidae, 1; Sturnidae, 1; Fringilidae, 1; Strigidae, 1; Polyborinae, 1.

The inclusion of a specimen of *Strix flammea* L. in this list attracted my attention because I had incidentally in the course of other investigations, come upon what I took for lymph nodes, in a specimen of *Aluco pratincola* (*Strix pratincola*) the common barn owl. These nodes were found in the abdominal and thoracic cavities and were taken for lymph nodes when removed. Unfortunately, however, since they were incidentally removed and since two other owls were then available, the exact loca-

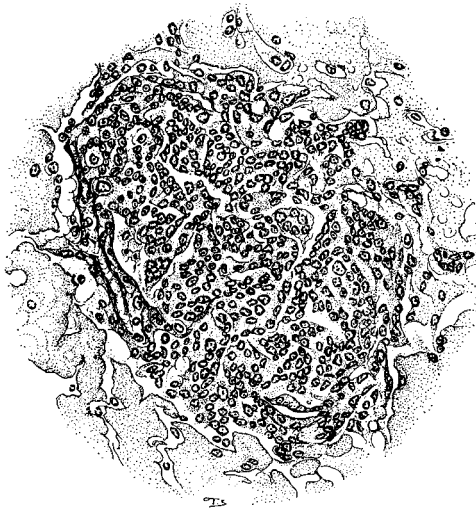


Fig. 6 Lymphoid nodule from the liver of *Aluco pratincola*. The surrounding hepatic parenchyma is merely indicated. $\times 475$.

tion of these nodes was not specially noted at the time of removal. The specimens were fixed in Zenker's solution, however, and were found to be unmistakably lymphoid in structure.

These nodes were cylindrical in form, 2 by 1 mm. in size and pale grey in color. This color may be accounted for by the fact stated by Jolly, that the sinuses of the lymph nodes of birds seldom contain enough blood to make the nodes look pink. Under low magnification no germinal centers or lymph sinuses were evident, although the parenchyma was an open one. In spite of the pale grey color of the gross specimens and the ab-

sence of blood-filled sinuses the stained mounted sections seen under low magnification suggested hemal nodes. Upon closer examination it was seen however that this was due to the presence of an unusually large number of large pink hyaline looking cells (fig. 7) which suggested erythrophages. These cells were scattered throughout the section of the node and contained vesicular nuclei which were generally located near the periphery. Although not contained in sinuses they are apparently somewhat comparable to those described by Jolly in the sinuses of lymph

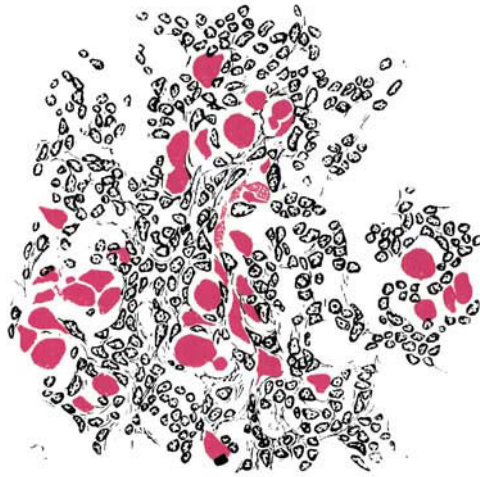


Fig. 7 Portion of a lymphoid nodule showing distribution of polykaryocytes and large acidophile cells. $\times 750$. a, capillary.

nodes of birds, as containing cellular débris within their protoplasm. The débris according to Jolly was composed of remnants of nuclei, erythrocytes and blood pigment all of which were "transformed into globular masses taking an acidophile stain."

Rarely polykaryocytes of the above type were also seen. These were extremely large and the protoplasm not infrequently contained what seemed to be remnants of nuclei. Sometimes larger, irregular masses which apparently had been formed by the coalescence of polykaryocytes were also found. These

masses were far larger than any I had ever encountered before in any lymphatic tissues examined (fig. 8). Since distinctly or indistinctly outlined erythrocytes were, however, never seen within these cells one is lead to doubt whether these large cells were really erythrophages for the nuclei of the erythrocytes unless destroyed before ingestion or extremely rapidly after that, should have been visible in some cells at least.

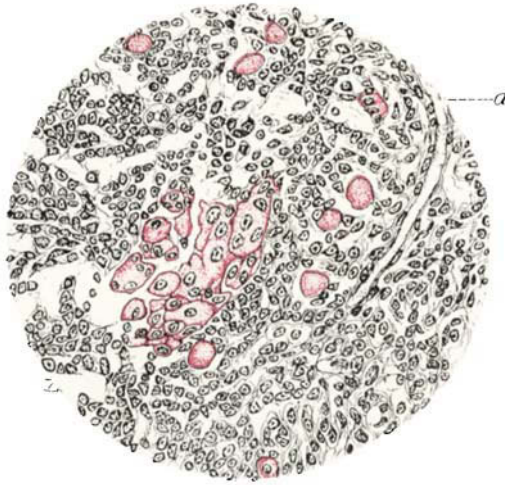


Fig. 8. Portion of a lymphoid nodule. $\times 515$. a, capillary.

CAPILLARY CAPSULES IN THE SPLEEN OF ALUCO PRATINCOLA

During the examination of sections of the spleen of the owl, under low magnification, small groups and isolated syncytial-like masses with a small central opening with a circular or more or less elongated form especially attracted attention. These capsules characteristic of birds gave the impression that the spleen was studded with extremely large multinucleated giant cells, were always contained in the areas of lymphocytes and were absent in those areas of the spleen which were largely or almost wholly composed of erythrocytes. Upon higher magnification it was found that the small central openings contained in these masses were fine vascular capillaries which were

surrounded by a capsule of an epithelioid syncytium which was from four to six times as thick as the caliber of the capillary. Whenever some of these capsules were cut more or less obliquely and also when adjacent capsules coalesced, large irregular masses with smooth outlines resulted, but whenever the capsules were cut transversely the small capillary was usually centrally located in the section. Not rarely two small capillaries one of

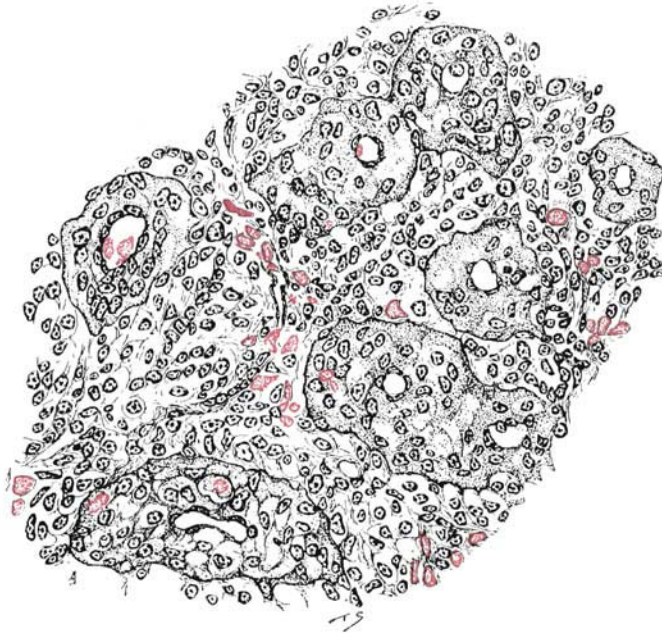


Fig. 9 A group of capillary capsules of the spleen of *Aluco pratincola*. $\times 750$.

which was eccentrically placed were contained in such a cross section. Some of these capsules lay directly beneath the splenic capsule or even caused it to bulge. They were always well-defined and sometimes surrounded the capillary at the point of branching. Because of this fact and because of the consequent fusion of such adjacent and other capsules and perhaps also for other reasons, the size of these capsules varied considerably although there was but little variation in the caliber of the enclosed capillaries (figs. 9 and 10).

Not infrequently two fairly concentric circles of nuclei were evident in cross section of these capsules. The outer circle lay directly beneath the periphery and the inner directly around the capillary. The latter was, of course, formed by the nuclei of the endothelial cells of the capillary and except for a slightly smaller size and a somewhat more oval form the nuclei forming the inner and outer circles seemed to be identical in appearance. They were always vesicular and contained a number of distinct chromatin granules. Sometimes they were distributed irregularly throughout the cross-section of the capsules. The inter-nuclear protoplasm stained pink with eosin and was non-granular. Cell boundaries were never recognizable and no cells except rarely a few isolated erythrocytes or fragments of such were seen in the syncytium of the capsules.

In some cases the capsules instead of being composed of an epithelioid syncytium were composed of such merely along a narrow margin of their periphery and in the region immediately surrounding the capillary. The intervening space is partly filled with a rarefied tissue the individual nuclei of which are surrounded by small more or less confluent, amounts of protoplasm giving these portions the appearance of mesenchyme.

Aside from these capsules the entire absence of Malpighian corpuscles attracted attention. Not a single corpuscle was found in the sections examined and the only substitute for them were these large circum-capillarial capsules surrounded by lymphocytes. Since as many as a dozen of these capsules often lay quite closely together forming rather large pink-staining masses which were surrounded by blue-staining lymphocytes they were very conspicuous. The portions of the spleen examined contained few large sinuses, a considerable quantity of erythrocytes, few trabeculae and had a thin capsule.

Kyber ('70) found the capillary capsules in the dog to be 0.05 mm. wide and 0.15 mm. long. According to Kyber, Fenenko also described capillary capsules first so-named by Schweigger-Seidel, ('62) who worked on the pig. They were discovered by Billroth, ('57) in birds and described by Müller ('65) in frogs,

reptiles and birds. Bannwart ('93) found them in the cat and Kultschitzky ('95) in *Putorius vulgaris*.

Kyber thinks that they are formed by local distensions (*Auf-treibungen*) of the adventitia of the arteries, which then enclose the splenic parenchyma in the form of a thin sheath of the ends of the terminal arteries. Kyber states that previously to his publication they had been described in the pig, dog, cat and hedgehog only, but Bannwart states that Müller found them indicated in the mole and rabbit also and found them in capsules but non-striated muscle and polymorphonuclear leucocytes were never noticed. The very large size of the capsules in the owl's spleen as well as the large caliber of the capillary are evident by a mere reference to the figures.

PHAGOCYTOSIS IN THE LIVER OF *FELIS DOMESTICA*

The animal from which this specimen was obtained was an old but well-nourished pregnant female. The four foetuses and one abnormal ovum were about 3 cm. long. Although the cat had been handled very carefully and was killed in a gas chamber the abdomen was found full of fresh blood. Upon inspection of the viscera it was found that blood was oozing from the whole of the ventral surface of the liver and upon gently wiping the surface with a wad of cotton it was evident that the oozing came from small dark discrete points, the central veins. A little firmer wiping abraded the thin capsule and exposed the parenchyma of the liver. The latter was very friable and yellow but the other viscera appeared macroscopically normal except that the ovaries were cystic.

Upon microscopic examination the capillaries of the liver which contained but little blood, were found to contain numerous erythrophages as shown in figure 11. These cells which had a distinct cell membrane and a flattened crescentic nucleus which had been pressed against the cell wall, were about the size of the cells of the hepatic parenchyma. They were engorged with erythrocytes the outlines of which were still plainly visible in many of them. No phagocytosis was present in the spleen, sections of which showed a rather rarefied parenchyma.

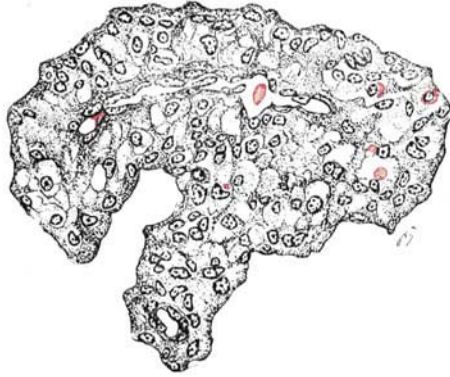


Fig. 10 Two adjacent partly fused capsules containing a branching capillary. $\times 720$.

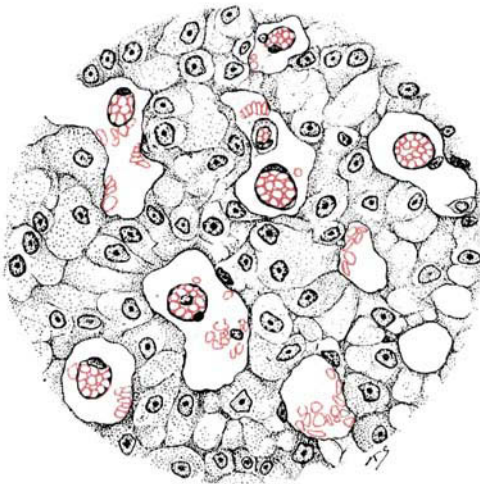


Fig. 11 Phagocytosis in the liver of a cat. $\times 1050$.

The kidneys showed a few old lesions but nothing else of consequence.

In spite of the very active phagocytosis of erythrocytes in the capillaries of the liver of this cat I found no indication whatever of phagocytic activity on the part of the hepatic parenchyma itself as observed by Browicz ('99). Nor did I see instances of

phagocytic activity on the part of the attached endothelial cells such as was observed by Heinz ('01). Nevertheless, the character of the phagocytic cells suggests an endothelial origin and to that extent confirms Kupffers ('99) conception of the phagocytic capacities of the endothelium of the liver. The entire absence of phagocytosis in the spleen of this cat would also seem to preclude an extra-hepatic origin of the erythro-phages in this case.

Hemorrhage into the abdominal cavity and apparently always from the liver, was also observed not infrequently in other animals killed by the use of illuminating gas. Since the animals are placed in a roomy lethal chamber and the gas turned on so slowly that death almost invariably results without a struggle, I can only suggest that for some reason unknown to me, extreme congestion of the liver with a possible change in permeability of the capillary and capsular walls must occur during death by the use of illuminating gas.

THE ARCHITECTURE OF THE PROXIMAL EXTREMITY OF THE HUMERUS

While scrutinizing the nature and the extent of the epiphyseal line in mature bones my attention was attracted to small areas adjacent to the epiphyseal line, in which the spongiosa is not infrequently absent. Often when not completely absent it is rarefied. These areas which were observed in the humerus, recalled Wards triangle and the similar rarefied areas in the spongiosa of the bodies of the vertebra and of the os calcis. Closer examination of a series of humeri showed that rarefaction or absence of the spongiosa were correlated with the retention of the epiphyseal line or plate. These absorption areas were always located in the lateral region of the shaft directly under the greater tuberosity a region in which the epiphyseal plate is best preserved. It is interesting and significant that a similar although not a corresponding absorption of the spongiosa can also be rarely seen near the epiphyseal line of the great tochanter of the femur.

As shown in figure 12 these absorption areas occur on both sides of the epiphyseal plate and their size and the completeness of the absorption of the spongiosa, seem to vary directly with the completeness and strength of the epiphyseal plates.

Whenever a part or the whole of the epiphyseal line was marked by a partial or complete bony septum or by two parallel thinner septa, the areas devoid of spongiosa were found the largest. Sometimes, however, there was only a partial absence or a rarefaction of the spongiosa and as shown in figure 12 when no epiphyseal line was evident there was no indication of absorption. If on the other hand the epiphyseal line was absent altogether no absorption areas were found. This relationship would seem to suggest that a strong epiphyseal plate relieves the spongiosa about it of most even if not of all, of the strains and stresses and thus causes its atrophy and rarefaction and finally its complete absorption. This conclusion would seem to be supported by the occurrence of all manner of transitions between a perfectly normal spongiosa and complete absorption and it is significant that the trabeculae of the spongiosa which are still preserved extend mainly at right angles to the epiphyseal plates thus acting as braces to relieve lateral strains.

That the presence of such remnants of the epiphyseal plates has resulted in the absorption of the spongiosa is also suggested by the specimen of the humerus shown in figure 13. This specimen shows a large absorption area in the spongiosa, directly beneath the site of the great tuberosity, in which the spongiosa has completely disappeared probably in consequence of the disuse following articular disease. This humerus came from an extremity in which the long head of the biceps and the compacta in the region of the tuberosities had been completely destroyed by arthritis. There is no evidence of pathological processes within the spongiosa, however, Although the compacta of the humeral head shows some erosion it is also very evidently atrophic. Since the spongiosa around the empty area shows nothing suggestive of a pathological process it seems not unlikely that in this case absorption of the spongiosa may at least have been hastened by, even if not directly caused by, a lessened use during disease.

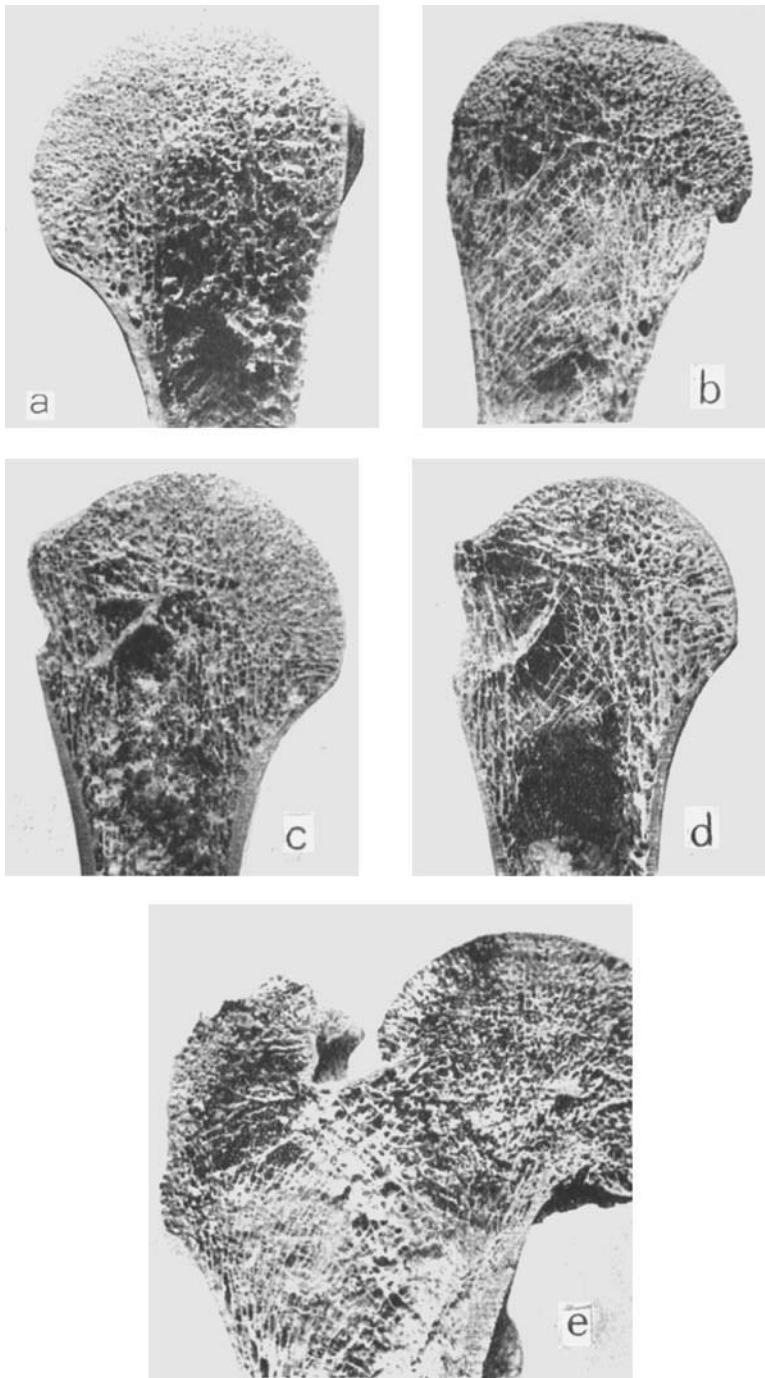


Fig. 12 Absorption near epiphyseal plates in three humeri and a great trochanter of the femur.

SERIAL TRANSVERSE BONY MEDULLARY SEPTA OF THE TIBIA

von Recklinhausen ('93) described transverse partitions as not infrequently occurring in the broad and thick portions of the diaphysis of long bones where the compacta is thin. He states that as many as twelve such partitions may be present in the lower end of the femur when the latter seems inflated (aufgetrieben) when viewed from the outside. According to von Recklinghausen transverse septa may also occur anywhere in the tibia and rarely also in the fibula and ulna, but never in the



Fig. 13 Absorption area under the greater tuberosity in a case of chronic articular disease.

humerus and in the upper femoral regions. They were also found regularly in the bones mentioned when multiple exostoses were present, in femora with a short neck and, in general, in bones of light weight possessing the loose texture characteristic of osteomalacia. They were also found in bones from females below ten to twenty years and also in the upper extremity of the tibia of a twelve year old dog. von Recklinghausen emphasized that these septa may be distributed at regular intervals and may be found even in the middle of the shaft where the compacta is thickest. He concluded that they are remnants of the solid

portions of the bone which originally formed the epiphyseal plates of the growing bone, and have no mechanical significance.

The occurrence of isolated complete, partial or fenestrated transverse septa in the shafts of certain long bones, is of course very common, but the presence of a series of parallel septa at comparatively short intervals as shown in figure 14 is rare.

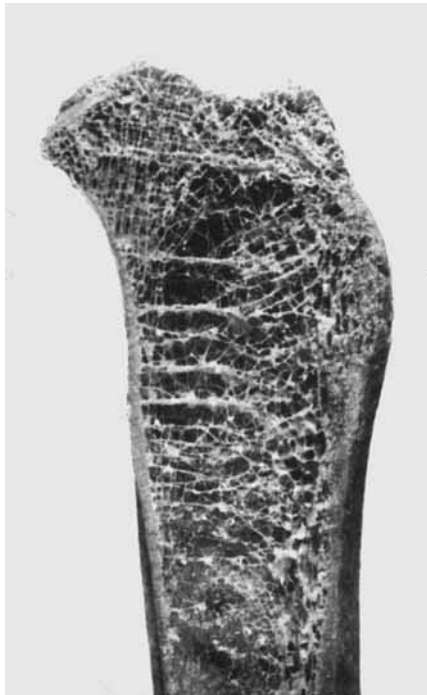


Fig. 14 Tibia with transverse septa.

This specimen also deserves special comment because of the rarefaction and the nature of the spongiosa between the septa. The atrophy of the spongiosa near and between the septa can, it seems to me, be attributed to the presence of the transverse septa. Although none of these five partitions are complete and although all of them are fenestrated, rarefaction of the spongiosa is especially evident near them. All of these septa are found in the dorsal portion of the proximal extremity

of the tibia and three of the five are much stronger than the other two which are composed merely of a framework of spongiosa. The spongiosa between the septa is represented by a few very fine strands only and these extend mainly in a ventral direction at right angles to the septa.

Nothing observed in this specimen militates against von Recklinghausen's belief that such septa are remnants of former epiphyseal plates, but transverse septa located at or very near the midpoint of the shaft of a long bone could hardly be regarded as having such an origin. Moreover, the rarefied spongiosa in the proximity of the septa and also between them, indicates quite clearly that such septa are not necessarily or even very probably, wholly without mechanical significance as von Recklinghausen suggested.

INIAL FOSSAE AND CANALS

The skull shown in figure 15 I owe to the generosity of one of our former students Mr. Benjamin R. Hewitt. It was taken from an Indian Mound near San Jose, California, and as shown is markedly deformed. Although the deformation is marked it is nevertheless quite symmetrical and shows itself mainly by a decided flattening in the occipital region and of the vertex. The forehead is an extremely receding one, a gentle depression marks the glabella and the supra-supraciliary regions. The skull is decidedly prognathous and the norma frontalis which forms an angle of approximately 40 degrees with the vertical, is roughly parallel to the occiput. The obelion is located about 3 cm. posterior to the line passing through the mastoid processes and is marked by two small pits about 3 cm. apart which lie on opposite sides of the sagittal suture and which probably represent obliterated emissary foramina. The cerebellar fossae are deep, that on the right being the deeper, as usual. The floor of the left fossa is exceedingly thin and defective, partly no doubt from post mortem decay. The portion of the occipital bone bounding this fossa is much thinner, however, being only a few millimeters thick. All the sutures are still evident on the exterior and a good-sized 'os Incae' is present. The linea nucha



Fig. 15 Indian skull with inal canal *a*, rear; *b*, side view

suprema is very evident but the linea nucha superior can not be identified definitely. A very marked external occipital protuberance is present. This protuberance takes the form of a

torus 4.5 cm. long and somewhat over 1 cm. high at its midpoint. One centimeter above the protuberance there is found a very marked but definitely circumscribed oval pit 1.2 by 0.7 cm. deep. The canal leading from this pit is obstructed in part, by a plate of bone about 1 mm. thick the edge of which has very probably been destroyed.

On sagittal section of the skull it is seen that the canal is somewhat irregular in form being obstructed by the thin plate of bone mentioned above, on the inferior portion near its inner orifice. The latter is irregular in form and measures 7 by 7.5 mm. Since the canal is funnel shaped the outer orifice is much larger, measuring 1.8 by 0.8 cm. in the transverse and vertical diameters respectively.

The mastoid foramina are small, the parietal are obliterated but the jugular foramina are large. Hence it seems to me that one could hardly assume the presence of obstruction to the venous return and regard this canal as an enlarged occipital emissary vein. Moreover, were it to be regarded as such it would for several reasons be an extremely rare instance. The occipital emissary vein is usually small, it not infrequently pierces only one table and is often absent altogether. It is true that the canal in this skull leads partly into the sulcus for the left lateral sinus but the character of the canal itself is wholly different from the enlarged mastoid canals not infrequently seen especially in rachitic skulls as emphasized by Merkel. It is possible, to be sure, that the canal in this skull has nothing in common as to its origin, with the sulci and fossae found in this region in the other skulls. Nevertheless if it is to be regarded as an enlarged emissary canal its character can only be explained by assuming a decidedly deforming influence upon it by the forces which deformed the skull.

It is impossible to find a satisfactory embryological explanation for this peculiarity and since three other Indian skulls in a small collection of 60 possess, roughly similar depressions in exactly the same location, it is probable that these pits or defects have another origin. It is true that these defects lie in the region of the union of the interparietals with the supraoccipitals

but their character does not suggest a developmental origin. In one of the other three specimens there is a small circular depression about 3 mm. deep at the center and $1\frac{1}{2}$ cm. wide. The other two skulls merely have very irregular small depressions and a fourth shown in figure 16 has a definite larger depression directly in front of the superior nuchal line.¹



Fig. 16 Indian skull with peculiar depression

It is true that Frasseto ('02) in a purely theoretical and hypothetical discussion says that an inial fontanelle was described by Maggi ('00) and by Staurenghi ('99). I have examined a number of papers by these authors but have been unable to find anything in their comparative anatomical studies at all comparable to what is here described and pictured.

¹ In view of Dr. Hrdlička's large acquaintance with skeletal remains gathered in widely different parts of the world and especially with American Indian remains, I brought the accompanying illustration to his attention. My expectations were fully justified, for Dr. Hrdlička has a series of specimens with similar, even if not identical, characteristics in the Smithsonian Collection.

NOTES ON 'SENILE' ATROPHY OF THE CALVARIUM

The erratic nature of bone resorption on the calvarium in the region of the parietals and sutures must continue to impress everyone. This is particularly true since we are in the habit of attributing the differences in relative degrees of senile atrophy between the bones of the upper and lower extremities, to differences in activity. Waldeyer ('10) also had recourse to such an explanation in connection with the findings in his unique study of the skeleton of a centenarian but in the case of the peculiar concentric atrophy of the calvarium we are left without this explanation.

Voigtel (1804), Lobstein ('24), Rokitansky ('44), Virchow ('54) and Maier ('54) were among the earliest investigators who described examples of this peculiar form of atrophy. Voigtel who refers to several earlier authors pictured a specimen from Meckels collections in which the atrophic area measured 3 by 2 inches. In one of the two cases reported by Virchow the bone in the atrophic area which measured 2.5 by 1.5 inches was, only " $\frac{1}{2}$ a line thick." According to Virchow the atrophy in the regions of the tubera parietalia never extends beyond the 'linea semicircularis' the insertion of the temporal muscle always definitely limiting the area. Virchow found atrophy present in other regions of the calvarium, however, and also noted joint changes.

Maier who likewise described two specimens of calvaria reported a case of death following fracture in one individual. Maier like Virchow, emphasized the porosity of the whole calvarium, the whiteness of the atrophic and the yellow color of the preserved areas, and spoke of the presence of a peculiar reticulated appearance due to the presence of lighter stripes among the yellow. Maier, however, found that the atrophic area extended beyond the 'lineae semicircularis.' In the first skull reported by Maier the bone in the region of the 'tuber parietalia' was translucent over an area as large as a 'Zwölf-kreutzerstück,' that is, about 3.5 cm.; and as thin as 'Postpapier.' In the second skull the atrophic area was two inches long and one inch wide.

In reporting the case of a woman of 90 years who had suffered a fracture of the calvarium indirectly as a result of such atrophy, Humphrys ('90) also stated that "The most common parts for the extreme thinning are the parietal bones on the side of the sagittal suture, midway between it and the tubera, causing the remarkable symmetrical depressions of which many specimens exist." Humphrys also was impressed by these "changes of an opposite nature" in old age—the absorption from without and the deposit from within.

Rokitansky suggested a probable relation to lues but Virchow, Maier, Humphrys, Ziegler, Aschoff and others all refer the atrophy to senility alone. Smith ('06) called attention to the fact that this form of atrophy is rare in European crania and stated that Humphrys found only six instances of it in European museums. According to Smith this peculiar form of atrophy is common in ancient Egyptians and never affects the parts of the calvarium covered by muscles. Smith further stated that a ring of bone 1 cm. in diameter is always left around the parietal foramina. Although out of the 70 specimens examined by him, not one was found below the age of 25 or 30 years, Smith nevertheless concluded that "It cannot be regarded as a senile change because it frequently occurs in crania where the coronal, sagittal and lambdoid sutures show no trace of closing." Although this atrophy was not found limited by sex, Smith found it present only in skulls taken from the tombs of the wealthy from the period between the fourth and nineteenth dynasties. Smith came to the conclusion that this atrophy is not congenital but is due to a continuous, slight pressure because he found, "This cranial thinning only in those people who were accustomed to wear wigs of enormous proportions and of great weight." Smith added by the way of qualification, however, that a causal relation does not necessarily exist between the two.

The first calvarium upon which I wish to comment is one with a roughly rectangular depression 3 by 5 cm. long and 2 mm. deep over the mid-frontal region. The borders of this depression are very regular and smooth and a roughly corresponding

bulging of the inner table is present but the two do not coincide exactly and cannot definitely be attributed to fracture. The portions of the coronal and practically all of the sagittal and lambdoid sutures which show on this calvarium are obliterated internally but are still evident externally.

The thickness of the calvarium varies from 4 to 9 mm. and measures 5 to 7 mm. over the depressed area. The sulci of the middle meningeal artery are not deeper than usual but the arachnoidal and lacunar depressions are unusually large and deep, some of them extending well through the outer table. Yet on the whole this calvarium is heavy and its general appearance does not suggest senility. Compared with the measurements of Anderson ('00) which it is unfortunately very difficult to utilize because they are recorded in sixty-fourths (!) of an inch, this calvarium is above the average weight. The diploe are quite well-preserved but the lamina are thick. Only the right parietal foramen is preserved.

The second specimen which is very evidently senile has a small absorption area over the sagittal suture about 2 to 3 cm. anterior to the obelion, and a similar though less pronounced area on the lateral mid-parietal regions directly medial to the temporal ridges. The coronal and lambdoid sutures show faintly on the exterior and the whole anterior vault of the skull up to the absorption area in the mid-line shows definite vascular and nerve markings. The sulci for the right supraorbital nerve extend beyond the coronal suture.

The internal surface of this calvarium is rough and shows considerable deposit. There are several exostoses in the frontal region and also deep tortuous arterial sulci. The condition of the rest of the skeleton would suggest that a marked reaction probably of syphilitic origin, was present. Although the frontal sinuses are small this calvarium measures over 1 cm. in thickness. The lamina externa and interna are very thin but the diploe thick and well preserved. The coronal and lambdoid sutures are faintly indicated externally and the right parietal foramen is well-preserved.

The third specimen is a very light calvarium in which the location of the sutures is marked by sulci. There is a very shallow and narrow sulcus over the coronal suture but the sulci over the dorsal half of the sagittal and the lambdoid sutures are deep and wide and by their nature remind one at once of the peculiar large absorption areas in the parietal bones above referred to. As shown very imperfectly by the photograph in figure 17 there are roughly-corresponding, comparatively large absorption areas in the posterior mid-parietal regions. Both



Fig. 17 Calvarium showing absorption areas

these parietal absorption areas and the central sagittal area contain small areas varying from 1 to 4 sq. cm. in which the bone is less than 0.5 mm. thick. This calvarium which is light and thin, measures 7 mm. in thickness at the lateral border of the parietal absorption areas. This is the greatest thickness found. Except for a slight roughening along the superior sagittal sulcus there is no evidence of bone deposition on its anterior. The figure formed by the sagittal and lambdoid absorption areas although T-shaped, has nothing in common with the T-scars of the dolmen skulls reported by Manouvrier ('04). Since the latter have a mechanical origin being according to Obermeier,

due to scraping for aesthetic or dedicatory purposes they have a wholly different character. The slightly pitted outer surface of this calvarium also suggests senility. The sutures and parietal foramina were totally obliterated.

The fourth and most interesting specimen is from the body of a female 72 years old. The whole cadaver except the lower portion of the face, suggested senility and considerable loss of

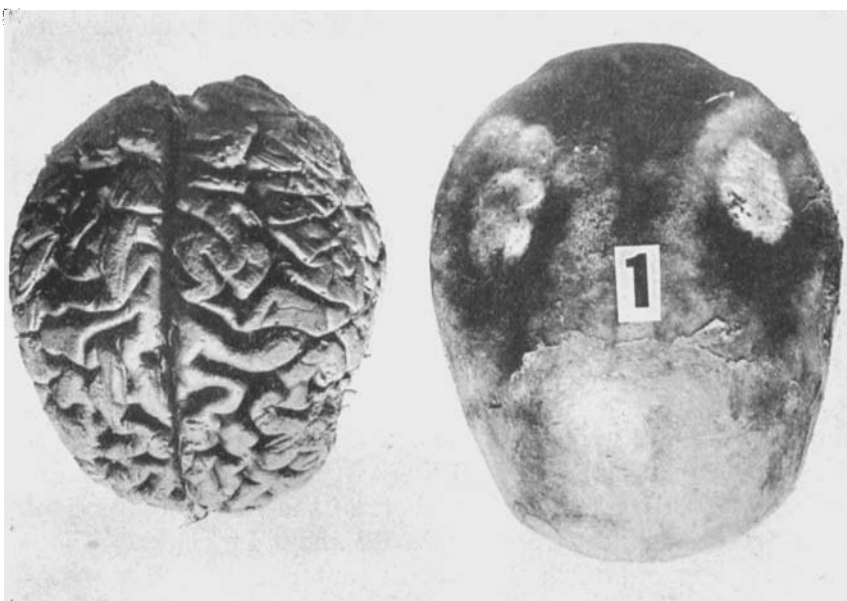


Fig. 18 Deep 'senile' excavations in the parietals with the accompanying brain.

weight relatively shortly before death. The deep parietal excavations shown in figure 18 attracted attention as soon as the body was unwrapped and recalled the descriptions of Humphry, Maier and Smith and an illustration in Ziegler ('02). Comparatively slight sagittal pressure on either side in these areas, produced the peculiar crackling sound of thin bone.

The scalp was not abnormally adherent anywhere but the calvarium was apparently very thin except perhaps along the

ridges which surrounded the depressions. The large frontal sinuses were outlined indistinctly through the thin lamina externa. Upon removing the calvarium the dura was found decidedly adherent to the calvarium as is customary in old skulls. It was especially adherent over part of an area 2 by 1 cm. where the inner table of the right frontal sinus was completely absent. The dura here fused with the sinial lining which was not especially adherent to the bony wall. There was no evidence on this calvarium of bone formation, except in the region opposite the left pterion where a small rough hemispherical nodule 7.5 mm. at the base and 3.5 mm. high projected into the cranial cavity. This nodule which was imbedded in the posterior end of the mid-frontal gyrus, was somewhat adherent with its base, to an oval depression to a rough plate of bone about 6 by 10 mm. in size on the inner table. The rough scale-like character of the inner table in the region of the frontal sinuses, a few scattered much smaller plaques of bone on the inner table and the deep arterial sulci with steep walls all suggested the deposition of bone on the interior.

As indicated by the depth of the fossae the absorption of the parietals is almost complete on both sides, their thinnest portions measuring less than 0.5 mm. over several small areas and less than 1 mm. over the whole of the rest of the floor of the depression which covered oval areas about 4 by 3 cm. These areas as measured on the level of the outer table were approximately 8 by 5 cm. large and were surrounded by a slanting wall about 1 cm. high. Although the thickness of these surrounding bounding walls on both sides, measured from 9 to 12 mm. the rest of the calvarium in the non-depressed areas was only 7 to 10 mm. thick. In addition to the marked absorption in the areas mentioned, that in the temporal regions was also very noticeable, yet this calvarium still measured 1.6 mm. in thickness, at a point 2.5 cm. above the internal occipital protuberance. About 3 cm. above the external auditory meatus it measured 3.8 mm. Although the thickness of the calvarium 1.7 cm. above the orbits was 1.7 cm., the inner table which was

absent in some places opposite the frontal sinuses was only 0.75 mm. thick and the outer only 1.25 mm.

Numerous small areas of total absorption were also present over comparatively large areas of the tegmen tympani. The three largest of these areas in the tegmen measured 3 by 2 mm. and while those on the right side were smaller the tegmen nevertheless looked honey-combed. Small absorption areas extend anteriorly quite close to the sulcus for the middle meningeal artery. The digital impressions and juga cerebralia were not very evident.

The brain showed no very marked atrophy but the arachnoid was very thick especially over the whole frontal region. It was web-like and not unlike loose cotton in gross structure, about 4 mm. thick and very adherent throughout. After fixation in formaline the brain weighed 1035 gm. The stature of the body was 158.3 cm.

The evidences of senility were not confined to the skull, however, for the ribs were represented by a mere shell of very thin, pliable bone which could easily be compressed between the fingers. The costal cartilages except the first, however, showed no signs of calcification even in their interior. They contained only a few small grayish dots which had not, however, proceeded to the stage of calcification. The laryngeal and nasal cartilages were not calcified either and the mandible was not markedly senile. The preservation of the latter was due to the fact that portions of the lower incisors, the canines, the left and right lower premolars, the roots of the first right lower molar and the stumps of two roots of the second right lower molar were preserved. That the roots of the absent teeth had not been lost very long before death is shown by the irregularities of the gums due to unabsorbed remnants of the alveolar processes. The rest of the skeleton is markedly senile.

I have also been repeatedly impressed by the character of a general absorption occasionally seen in the posterior region of the parietals. Not rarely this absorption stops almost completely when the lambdoid suture is reached thus causing the squama of the occipital to rise like a wall along the suture. It

is exceedingly difficult to understand what can be responsible for the character of the absorption in this region of the parietals. The lambdoid suture appeared normal in all these cases and we cannot have recourse to muscle action as preservative agents. There was no evidence of rickets in these cases.

Although the senile character of such atrophies of the calvarium as here reported has been and may be called in question, yet in these cases the atrophy probably was not due to the continuous pressure of a lesser weight, as Smith concluded for Egyptian skulls. Although the ages vary considerably the histories of these cases unfortunately are not available. The fourth case was that of a woman born in this country. Hence weight bearing with the head, can be quite confidently excluded. Moreover, the erratic location of these atrophies as well as their peculiar shape makes it exceedingly difficult to conceive how pressure could be exerted upon those areas unless the head were born well-flexed upon the chest during exertion which would interfere seriously with respiration. Besides weight-bearing or pressure of considerable magnitude and for long periods of time do not result in such atrophy.

THE RELATION OF BRAIN ATROPHY TO CRANIAL ATROPHY

A case of very marked brain atrophy in an old woman, accompanied by congenital porencephally might be expected to furnish some evidence even if slight, of the relation of cerebral atrophy to the thickness of the overlying calvarium. Since the decrease in the volume of the cerebral cortex and the accompanying enlargement of the lateral ventricles do not cause a decrease in intra-cranial pressure it might be assumed that no deposit of bone should occur on the internal surface of the calvarium in consequence of brain recession. This is especially true since in cases of hydrocephalus an increase in intracranial pressure is accompanied by thinning of the calvarium and because constant pressure from other causes has a similar effect. Nevertheless, thickening on the interior of the calvarium in the lateral frontal regions in consequence of deposit of bone from within as

noted by Humphry, ('58) is very common in connection with atrophy of the frontal lobes in senility. But until more is known about the cause of deposition of bone on the inner surface of the calvarium it would be wrong to assume that there is a causal relationship between the two. Especially since we do not know why in one case of atrophy there is marked absorption within with consequent thinning of the calvarium and decided broadening of the arterial sulci with their final obliteration through absorption, while in the other, on the contrary, there is just as marked a thickening in consequence of deposition within accompanied by deepening of the arterial sulci to such an extent that large portions of the vessels may be almost enclosed.



Fig. 19 Primary congenital porencephaly

The brain showed in figure 19 was taken from the body of a woman 75 years old, dead of myocarditis. Neither the skull as a whole nor the calvarium showed any markedly senile changes. After fixation in formaline the brain weighed 1034 grams. However, there had been some post mortem drying and shrinkage. The meninges were normal but all the cerebral arteries were somewhat sclerotic. Atrophy of the left hemisphere seems clearly more marked than that of the right. This is evident even along the longitudinal fissure, the frontal lobe and the lateral and central sulci. Marked asymmetry in the shape and the arrangement of the gyri also exists. This is especially notice-

able in the porencephalic area which lies in the posterior extremity of the medial frontal gyrus and affects the latter and also the pre-central gyrus in the region around the posterior extremity of the inferior frontal sulcus. The defective area measures 2.9 by 2.1 cm. and is approximately 2 cm. deep. The nature of the surrounding gyri as well as the condition of the corresponding area on the right side and that of the brain as a whole seem to indicate that this defect is not due to senile atrophy but to faulty development. This assumption was confirmed by section of the brain. There were no evidences whatever of lesions and the gray substance was as thick at the bottom of the porencephalic area as elsewhere. It was merely a case of failure of this area to develop properly and the defect is hence truly congenital.

The peculiar arrangement and form of other gyri also suggests this. The arachnoid bridged over this depressed area and the overlying calvarium showed a gently rounded eminence on the interior and also a corresponding depression on the exterior. The calvarium here was also slightly thicker than the corresponding area on the other side but because of the corresponding depression of the outer table this increase in thickness was only very slight. The respective thicknesses at corresponding points on the two sides of the calvarium were 8 and 6 mm. The fact that the outer table was depressed over this area also indicates, it seems to me, that the local cerebral deficiency was a congenital rather than an acquired defect for, with the latter, one might expect a thickening of the calvarium from within unaccompanied by a depression from without.

Although the left hemisphere plainly looked more atrophic than the right it nevertheless weighed 11 grams more. The measurements for length, breadth and width of the two hemispheres were practically equal, but considerable differences between the volume of the two ventricles was found to exist. The volume of the right ventricle was 24 cc. and that of the left 20 cc. which accounts in part for the deceptive appearances. The volume of these ventricles is also considerably above the average found by Harvey ('09) who gave the ventricular volume for

brains with an average weight of 1314 grams as 15.08 cc. for the left and 13.49 cc. for the right side. Considerable differences in ventricular volume were encountered, however, by Harvey.

The character of this calvarium does itself not suggest senility. The parietal foramina are obliterated but the lambdoid suture is still preserved within, and the coronal sagittal and lambdoid sutures, especially the last two, are still well-marked externally. The whole inner surface of the calvarium is slightly rough, however, plaques of new bone are found here and there and the region of the superior sagittal sinus is marked by a broad ridge which was apparently moulded upon the broadened longitudinal fissure. No absorption areas are present externally and the arterial sulci are not especially marked. Indeed, those over the depressed portion of the calvarium which covered the porencephalic area are especially shallow thus also suggesting that there has been no special deposit of bone there. The thickness of the calvarium in the lateral frontal region is 1.1 cm. The diploe are sclerotic and the calvarium which has a thickness of 5 mm. in only a few places, is heavy and strong.

The clinical history of this case could not be obtained but a careful examination of the entire body revealed no evidence of defective muscular development or of asymmetrical atrophy as a result of developmental conditions or of paralysis. Section of the cord showed it to be symmetrically formed and no gross signs of degeneration could be detected.

The greatly emaciated condition of the cadaver was rather puzzling and remained unexplained until the stomach was opened. It was somewhat dilated but otherwise normal save for the presence of a papilloma directly in front of the pyloric orifice. This tumor which was 3 cm. long arose from an enlarged base which lay partly upon the gastric margin of the pyloric sphincter but which was not adherent to the gastric musculature. The body was 1 cm. wide and 0.5 cm. thick being flattened dorso-ventrally and the free portion distinctly papillomatous.

The pyloric musculature was not hypertrophied and the base of the tumor was alone sufficient to completely obstruct the ori-

fice. Since the papilloma was freely movable its inclination toward the antrum probably did not prevent it from being forced against the pylorus and thus further obstructing the passage of gastric contents into the duodenum. Hence it seems highly probable that this woman suffered much from gastric trouble and that her emaciation was largely due to the mechanical difficulty caused by the tumor.

THE CAUSE OF SOME LARGE PARIETAL EMINENCES

It is usually stated that large parietal eminences are due to a local displacement outward of both laminae of the skull. In the great majority of cases this explanation holds but in case of

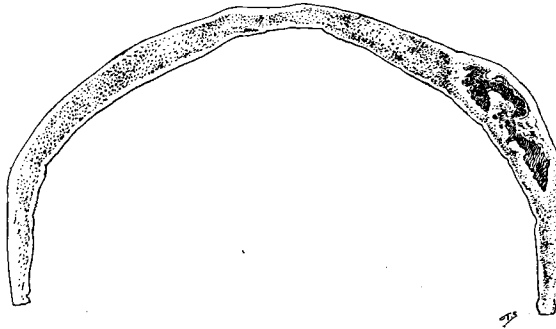


Fig. 20 Outline of a cross section of calvarium with a large parietal eminence

the calvarium outlined in figure 20 the large parietal eminence on the right plainly has a different origin. As the figure shows, the inner table of this skull has suffered no outward displacement whatever and the prominent eminence is due to a considerable thickening and a gradual deflection of the outer table. Sclerosis of the diploe is present and several areas of dense connective tissue and what looked like red marrow, are interpolated between the two tables the space between which is largely filled in by compact bone.

This calvarium which was taken from the body of a man 70 years old at time of death, is heavy partly because sclerosis is so complete in the frontal region and also because the calvarium

as a whole shows only slight evidence of absorption. Although the arterial sulci are only slightly deeper than normal, very evident thickening in the interior in the lateral frontal region is nevertheless present.

The greatest thickness of the right parietal eminence is 15.5 mm. and the thickness of the corresponding point in the left is 8.5 mm. The greatest thickness in the left lateral frontal region is 1.0 cm. and 0.9 cm. on the right. The thinnest point in this calvarium is in the right temporal region where the section measures only 2.5 mm. yet in spite of the thinning in this region the whole calvarium does not even remotely suggest senility. It is true that all the sutures are well obliterated and that the sagittal suture is marked by a very slight sulcus which extends over the metopic suture which can be recognized still. These things are, however, of but little moment. The right parietal foramen is still evident and there is no indication of concentric atrophy in that region.

The periosteum was not especially adherent over this bosse which measured 6 by 4 cm. in the sagittal and parietal planes respectively. Its surface is very smooth and it looks denser; that is whiter; than the rest of the calvarium but there is no good evidence of the presence of a pathological process and the rest of the skeleton was wholly normal.

EXTENDED FUSION OF THE SECOND AND THIRD RIBS

Although more or less extensive bifurcation of ribs is relatively common fusion is much rarer. In fact Bland-Sutton ('99) stated that fusion of the ribs resulting in the formation of bicipital ribs occurs only in connection with the cervical ribs or in relation to the first and second ribs. Disse ('96) made a similar statement. Dwight ('07) however, held that a bicipital rib may occur also by the fusion of the first thoracic with the second beyond the tubercles. Merkel ('99) in a fine summary, merely states that anomalies occur at the posterior ends in the region of the tubercles where the ribs may send processes toward each other and a similar statement is made by Nicolas ('11)

and Thompson ('14). In Rauber-Kopsch ('11) it is stated that now and then it is observed that the margins of two or more ribs may fuse for a greater or lesser distance. This statement was also made by Thompson ('13) who merely said that fusion of adjacent ribs may occur. In the second edition Thomson referred to Meckel.

Campbell ('69) reported a remarkable case of union of a number of ribs by cartilage and also by bone accompanied, however, by multiple exostoses and also by the formation of bone in the diaphragm and of cartilage in the right lung. The presence of so many exostoses and the occurrence of bone formation in the soft tissues makes it probable, however, that, in this case, the union of the ribs was due to a pathological rather than a developmental process.

Turner ('70-'71) referred to a case of fusion of the first and second ribs reported by Hunauld in 1740. Hunauld is also said to have possessed a fetal skeleton from the seventh month in which the upper five left ribs were united posteriorly and in which the sixth and seventh ribs were also partially united. In this article Turner pictured two specimens of fused ribs which from comparative anatomical considerations, he apparently declared to be fused cervical and first ribs. In a later article Turner ('82-'83) concluded that the two specimens in question were fused first and second ribs.

A fuller account than that contained in any of the above texts and handbooks is that given by Lane ('83). Lane gave several instances of fusion of a cervical with a first rib and of fusion of the first and second ribs. He found the common shaft formed by the union of the first and second ribs in one of his cases, $1\frac{1}{8}$ inches broad dorsally with a maximum width of $2\frac{1}{4}$ inches. The latter point was located $1\frac{1}{4}$ inches behind the termination of the lower rib. Unfortunately Lane did not give the length of the union but judging from his drawing this was as long as the breadth of the united ribs or $2\frac{1}{4}$ inches. Although the ribs in this specimen were said to be firmly united the "outer surface of the shafts still remained very prominent after fusion, being separated from one another by a deep groove. The inner surface of the com-

mon shaft was smooth, however, and presented no irregularity or ridge of any sort." Lane remarked that this specimen is peculiar in its great breadth and in the thinness and incurvation of its lower part.

Two similar cases were previously described by Turner, and Bryce ('15) stated that Valenti ('03) also described a case of fusion of the second and third vertebra accompanied by 'apparent' fusion of the second and third ribs for the greater part of their length.

The most comprehensive study of the occurrence of variations in ribs is that by Hrdlicka ('00) who examined over 1600 ribs

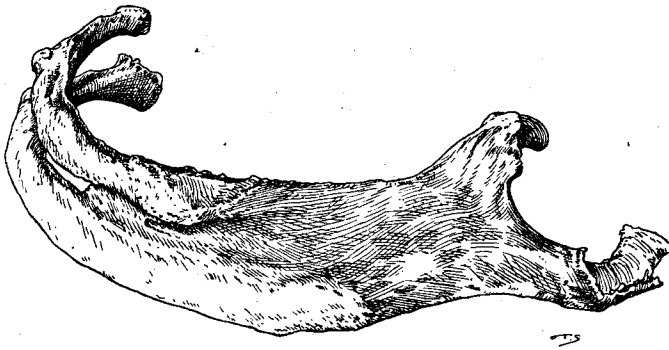


Fig. 21 Fused second and third ribs

and numerous Indian skeletons. In an examination of this large amount of material, Hrdlicka found only one case of junction of the third and fourth ribs but three cases of the much more common anomaly—fusion of the first and second ribs.

The specimen shown in figure 21 was taken from the cadaver of an old man, is composed of the second and third ribs. The rest of the skeleton was normal and the thorax was not unusually asymmetrical. Hence the anomaly was not very evident and my attention was called to it by Messrs. Supple and Tufts, two of our students. These two ribs which are of normal length were fused throughout three-fourths of their length. Nevertheless their relations were maintained exactly for they had independent cartilages and a short bifurcated medial extremity.

Unlike the specimens of fused first and second ribs described by Lane, the individual shafts are almost completely obliterated in the medial half of the fused portion, both within and without. This is true of a rhomboidal area lying within 8 cm. of the sternal extremity of the second and 7 cm. of the same extremity of the third rib. The intercostal groove is only very slightly preserved on the external surface of the lateral half of the fused portion. Since the fused portion extends to within 9 mm. of the medial extremities the appearance here is that of a bifurcated rib. The common shaft is 12.3 cm. long, the first rib 22.8 cm. and the second 26.5 cm. The width of the fused portion is 3.5 cm. laterally, and 4.3 cm. medially but the distance from the superior border of the first rib to the inferior border of the second rib at the medial extremities is 6.1 cm. This increase in width is due to the fact that the short non-fused medial extremities diverged rather markedly to meet the costal cartilages. The distance from the mid-point of the head of one rib to the midpoint of the head of the other is 2.1 cm. or normal.

In the lateral area of fusion the second rib is very definitely outlined for a distance of 4.3 cm. and the third for a distance 7.9 cm. Throughout this region of only partial obliteration of the shafts the intercostal region is marked by a broad deep sulcus and the outlines of the individual shafts are well preserved externally but not internally, where the intercostal region is marked by a decided ridge which gradually disappears toward the medial extremity. This rounded ridge looks not unlike the inner surface of a rib and gradually merges with the shaft of the first rib. The subcostal sulcus of the second rib is fairly well marked to a point of 2.5 cm. beyond where the fusion begins but that on the first rib extends 4.5 cm. beyond this point. The greater length of the sulcus on the first rib is due to the fact that it lies external to the bony union between the ribs for a distance of 4.3 cm. The intercostal nerves ran internal to the fused portion.

The superior margin of the flat, fused area is much thicker than the inferior, the two measuring 6 and 2.5 mm. respectively. The greater thickness of the superior margin is due to the better development of the bony area which would be comprised by the

second rib. In thickness, spacing and form where separate, and also in length where fused the ribs are entirely normal. The intercostal muscles are of course absent in most of the fused area which is covered by a strong intercostal membrane. The muscles are present, however, in the lateral portion of the fused area where the external portion of the bodies of the individual ribs are only partly unaffected by the fusion.²

BILATERAL ABSENCE OF THE EXTENSORES CARPIULNARES

Such a variation as the above is not mentioned by Le Double ('97) or in the larger handbooks such as those of Bardeleben and Poirier et Charpey. Neither do Quain nor any of the other German and English textbooks consulted speak of it. Gruber ('85) and Turner ('85), however, each reported a somewhat similar case. Gruber also says that he could not find anything like it in the literature.

Gruber observed the specimen reported by him in 1883, in the left arm of a young male 20 years old. It was the only specimen observed by Gruber in the course of the personal dissections of 600 arms! In this case the muscle was represented merely by a tendinous strand which extended, however, all the way from the external condyle to the fifth metacarsal. This strand which was fused with the fascia was 5 mm. wide above, 3 mm. wide and 1 mm. thick in the middle of the forearm and 4 mm. wide and 2 mm. thick at the point of insertion. The lower portion was supplied with a vaginal sheath and lay in an ulnar sulcus of normal dimensions. Other fairly common muscular variations were also present in this arm.

Turner who referred to Gruber said the case observed by him was wholly comparable to that of the former. In Turner's case also, the sulcus on the ulna was normal although the ten-

² Through the courtesy of Dr. Hrdlicka, it has since been my privilege to examine specimens of fused ribs in the Smithsonian Collection, and if I remember correctly, one of the specimens is very similar to what is here described. Through the courtesy of Dr. Lamb I was also enabled to examine a specimen of extended fused ribs in the museum of the surgeon-general, which belongs still lower down in the series of ribs.

dinous slip was only one-sixth the size of the normal tendon. Turner emphasized that such an anomaly was not mentioned by Macalister or Testut in their works on muscular anomalies, and that this case was the only one observed by him in thirty years' experience in the dissecting room.

A very careful examination of both upper extremities of this male subject by Messrs. Supple and Tufts who noted the absence early in their dissection, and by Professor Congdon and myself did not reveal a trace of these muscles. It seemed to me at first that a remnant of the tendon had fused with the internal lateral ligament of the wrist but a comparison showed that this ligament varies sufficiently in strength and distinctness to justify one in including those on these arms among the normal variations.

Although the extensores carpi ulnares muscles were completely absent in these arms the sulci on the dorsal surface of the distal extremities of the ulnae, in which they lie were nevertheless present and practically normal in size and depth. Hence these specimens again illustrate a certain independence in the formation of these and similar sulci, which nevertheless may be moulded by tendon pressure even if not primarily due to them. No other anomalies were found in this cadaver and no unusual strands or thickenings were present in the fasciae of these forearms. No modifications could be determined in the fifth metacarpals.

UNILATERAL ABSENCE OF THE TWELFTH RIB IN AN ORANG-OU-TANG

In a skeleton of an adult orang-ou-tang which seems to possess no other unusual characters the condition of the ribs deserves a word of comment. There are eleven pairs of ribs which look normal except for the development of a flat wedge-shaped square bony process one centimeter square on the anterior upper surface of the tenth rib. This process which is 3 mm. thick at the base arises from the superior costal border a few centimeters ventrally from the angle and must have come close to the inner surface of the superior rib although the latter bears no sign of such contact. Many of the ribs on both sides also bear triangular bony extensions along their inferior borders in the re-

gion of the angles a condition which may, however, for all I could learn, not be uncommon in the orang-ou-tang. The right transverse process of the nineteenth, or first lumbar, vertebra looked, practically like the corresponding process in human skeletons. The accessory and transverse processes were very well differentiated and were marked by a deep sulcus. The mammillary process though slender was well-developed and was separated by a broad deep sulcus from the inferior processes.

The left transverse process, on the other hand, had the typical form except that its extremity was pitted by a very definite articular cavity which received the head of the twelfth rib. The latter was 8.8 cm. long and the eleventh ribs 18.2 cm. It is particularly interesting that although the twelfth left rib did not articulate with the body of the vertebra but arose from the transverse process the right transverse process nevertheless showed no enlargement whatever and possessed a better differentiated accessory mammillary and transverse processes than most human vertebrae.

THE EFFECT ON THORACIC FORM OF COMPLETE DESTRUCTION OF ONE LUNG

Although the expression "One lung is gone" is not unfamiliar to medical students and to physicians who deal with large numbers of tubercular subjects it is necessary to recall that those words as customarily used by clinicians are not intended to be taken literally. Moreover, when one considers the great vessels in the root of the lung such a thing seems quite impossible. It would seem that death from hemorrhage must occur long before the great pulmonary vessels so near to the heart can be obliterated. Yet such a case recently came to my attention.

The cadaver was that of a man beyond middle age and nothing which could be identified with the naked eye as pulmonary tissue remained of the left lung. The remnant of the pleurae was roughened and thickened considerably and the remnant of the root of the lung, was represented merely by a short stub of dense connective tissue containing the sclerotic and wholly, or partially obliterated extremities of the bronchi, blood vessels and calcified lymph nodes. The left thoracic cavity contained

but very little coagulum and was otherwise completely empty. The left dome of the diaphragm was but slightly displaced. The fact that the mediastini and the contained viscera were displaced so slightly is likely explained by the thickening of the left parietal pleura long before the lung was completely destroyed.

I have not sufficient knowledge of either tuberculosis or pathology to venture a statement on the probable sequence of events in this case but the fact that the external form of the thorax was altered so slightly that it attracted no attention, does seem to indicate that not much tension could ever have been exerted on the thoracic wall as a result of an adhesive pleurisy. I recall that Hutchinson found that the long-expressed idea that tubercular individuals are flat-chested is erroneous but these findings do not imply that tuberculosis never affects thoracic form. Hutchinson found that the anterior posterior diameter in normal adult males between the ages of twenty to forty-four is 71 if the transverse diameter at the level of the nipple is taken as 100. This same diameter in 82 clinically tubercular subjects was found to be 79.5 and in 30 flat-chested individuals 80.

Instances in which the thoracic form has been profoundly changed especially in cadavers in which the ribs are markedly senile, are, of course, frequently seen in dissecting rooms where most of the material used is from the senile or tubercular or from the senile and the tubercular. But it is difficult to see how a lung can be completely destroyed by tuberculosis without an attendant pleurisy and consequent long-continued tension on the chest wall as a result of fibrosis. Nevertheless, the conditions were as here represented and there can be no doubt about the tubercular nature of the disease in this particular case.

OSSIFICATION IN THE ARACHNOID

The occurrence of small hardened areas in the spinal arachnoid is comparatively common in dissecting room cadavers. Because of this fact and also because these areas are usually very small I have in the past usually taken them for calcifications.

This assumption was based not only on their appearance but also on their physical properties. Some months since my attention was called to certain small areas of apparent fibrosis of the arachnoid and to other very much larger horny plaques. Mr. H. M. Winans and Miss Dorothy Wood, two of our medical students noticed these peculiar plaques in the lower dorsal region upon exposing the spinal cord. The largest of them has an area of 2.8 by 1.6 cm. and the next largest 2 by 1.4 cm. Both were less than 0.5 mm. thick, however, and were moulded so as to surround the dorsal portion of the cord in the region over which they lay. They were adherent neither to the pia nor dura. Both these large plaques and the smaller similar ones were very flexible and quite translucent.

In cutting off a portion for microscopic examination it was evident that these plaques both had the hardness of bone rather than of horn and that they lacked the friableness or at least the brittleness of calcified areas. Examination of paraffine sections showed that these areas were composed of lamellae laid parallel to the flat surfaces of the plaques. The lamella contained some rather atypical bone corpuscles and were penetrated at intervals by perforating or atypical Haversian canals which here and there opened upon the surface. Several small narrow cavities were also found and the internal surface also showed a narrow calcified layer. The outer portion, on the contrary, was formed by a single layer of investing cells. The body was that of an Irish woman of 75 who had died of arterio-sclerosis and in whom the porencephalic brain referred to on page 76 was found.

In view of the close relationship between fibrous tissue and osteogenetic processes, the mere presence of bone in the arachnoid is nothing particularly surprising. A discussion of this subject in man and animals with references to the literature and numerous interesting personal observations is given by Cushing and Weed ('15).

CUTANEOUS PIGMENT IN THE SPERMATIC FASCIA

Although small quantities of cutaneous pigment are found in the cutis of man I am not aware that the so-called superficial fascia has been found pigmented. It is true that Toldt ('13) found that the epidermis in the dark skin spots in *Macacus inuus* and *Cebus libidinosus* contained very little pigment and the deep layers of the corium much, but this pigment was intra and not intercellular for it was contained in large branched pigment cells. Toldt also emphasizes the relatively great pigmentation

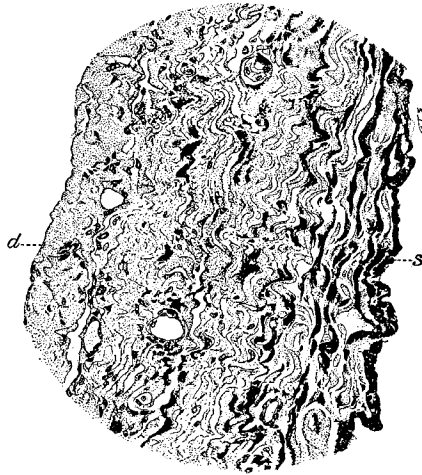


Fig. 22 Spermatic fascia from *Didelphys virginiana*

in the corium of these mammals as compared to the lower vertebrates. Adachi ('03) on the other hand concluded that there is a correlation between the intensity of epidermal and dermal pigmentation but found that the quantities of pigment contained in the cutis were relatively small. Breul ('96) and Frederic ('06) strangely enough found pigmented places in the corium most common in the relatively unpigmented regions.

In figure 22 a portion of the spermatic fascia of an opossum is shown. The surface marked *S* is the superficial one and that marked *D* the deep one. As shown in this figure large masses of pigment are scattered about in almost the whole of this fascia

the superficial layers of which contain thick layers of pigment. In addition to these larger masses pigment granules were also scattered about in the fascia but practically all of the pigment was extra-cellular. Although I am not here concerned with the finer questions relating to the origin and occurrence of normal skin pigment there can be little doubt that we are dealing with normal cutaneous pigment. The gross character of the overlying skin alone makes this certain.

The scrotum and the para-scrotal skin of this opossum was intensely bluish black. The color of this area made it look like 'tache bleuatre,' the peculiar shade being of course due to corium pigment. Since similar pigmented areas as found in the scrotal region of this opossum are relatively common in mammals and since other similar areas were found on this very animal the scrotal pigmentation attracted no special attention until the skin and some of the superficial fascia had been reflected, butcher-wise, and the testes were seen to be just as intensely bluish black. On incising the spermatic fascia and reflecting the parietal tunica vaginalis with it, the testes were seen to have the usual color.

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