AN ACCOUNT OF A FINBACK-WHALE (BALAENOPTERA SPEC.) WHICH WAS WASHED ASHORE ON THE SOUTH-COAST OF THE PREANGER REGENCIES IN DECEMBER 1916.

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Introduction.

Towards the end of December 1916 it was mentioned in several Batavia newspapers, how a whale of extraordinary dimensions had been washed ashore on the S.-coast of the Preanger, between Tjilauteureun and Tjikelet. This being an extremely unusual thing on Java, Mr. P. A. Ouwens, the Curator of the Zoölogical Museum of Buitenzorg, attended by a mantri-draughtsman and a native photographer, hastened to the place where the Cetacean had run aground, in order to determine to what extent this specimen might prove valuable to the forementioned museum.

A few photos were then taken and at the same time a number of measurements effected, the principal ones being:

1. the length of the body .... 27,28 M.
2. the girth of the body .... 15,12 „
3. the width of the tail-fin .... 4,50 „

As it had meanwhile been decided to get the skeleton of the stranded whale conveyed to Buitenzorg, I started for the S.-coast of the Preanger Regencies on January 6th. 1917, accompanied by two native preparators.

The operations necessary to obtaining the various parts of the skeleton were carried out there, and the transport to Garut provided for.

In spite of the many difficulties met with in the transport across the rough hilly country, owing to the absence of good roads and bridges, and notwithstanding the fact that the heavy fragments had to be carried across ridges 5000 ft. high, after 44 days everything arrived at destination in proper order and condition. [1])

[1]) Much appreciated assistance was received in the course of this work from Mr. J. A. van Oostersee and Mr. E. van Leeuwen, resp. overseer and forman of the Board of Public Works at Goenoeng Glap; also from Raden Soerialegawa, the wedana of Pameumpeuk and Raden Danoeatmadja, the assistant-wedana of Tjikelet.

In the course of 1917 the various bones were prepared here, and the skeleton also set up, which reconstruction was not completed till February 1918.

For this purpose a special shed was built, measuring 28 M. in length and 5 M. in width, erected between the two parts of the left-wing of the Zoölogical Museum.

The beached whale proved to be a *Balaenoptera*. The creature is bigger than any other representatives of this genus preserved in European or American musea. Also the numerous statements in True (6) as to the length of these animals as measured at different whaling-stations in America, make it evident that the specimen before us is an exceptionally huge one, being indeed unique and surpassing all measurements recorded.

Very little is known as yet about the various species of whales occurring in the Indian waters. The biggest whale, however, stated to occur in Indian seas, is said to be *Balaenoptera indica* Blyth.

It was therefore natural that in identifying the Buitenzorg skeleton attention was immediately directed to this species, adult specimens of which were saïd to attain a length of from 80 to 90 feet.

However, I have never been able to lay hands on the original description of this huge Indian fin-fish, made by Blyth in the Journal of the Asiatic Society of Bengal, vol XXVIII p. 488 (1859). It would, however, appear from Blanford (2) p. 567 and other works, that this *Balaenoptera indica* was described from a small number of bones preserved at the Indian Museum of Calcutta, viz. two mandibles (inferior maxillae), a rib, a righthand radius and 5 vertebrae.

Mention must further be made of a smaller finner-skeleton classed under the same name, kept in the Raffles Museum at Singapore. This skeleton is reproduced by a photograph in the catalogue of the zoölogical department of that museum.

From this photo, which displays numerous divergencies from the whale-skeleton at Buitenzorg, it clearly appears that, as far as this Java skeleton is concerned, we must be dealing with quite a different species.

As far as it can be ascertained the various characteristics of our great whale skeleton agree most nearly with those of *Balaenoptera musculus L.* (occasionally described as *Balaenoptera sibbaldii* G. O. Sars), which species is known as the biggest finback-whale, and hence also as the hugest of living creatures.

According to Weber (7) p. 575 this species is supposed to reach a maximum length of 26 M, whereas the specimen treated of here shows a length in horizontal projection of 27,28 M, that is measured from the centre of the line connecting the extremities of the caudal flukes to the bony front-side of the lower maxillary.

As, however, beside a great many points of resemblance with the last mentioned large species of whale, a good many differences can be pointed out, it is not an easy thing to settle whether the specimen under discussion should be termed an entirely new species or a variety of *Balaenoptera musculus* L. Our knowledge of the variation of *Balaenoptera musculus* L. is insufficient to help us out of this uncertainty. Meanwhile the characteristic features of this northern finner have been as far as possible compared with corresponding data derivable from the Buitenzorg specimen.

Balaenoptera musculus L. being moreover comparatively rare, and few reliable illustrations being therefore at my disposal, I have considered it expedient in describing the Buitenzorg specimen also to compare, wherever necessary, the illustrations of *Balaenoptera physalus* L. which latter species is nearly related to *Balaenoptera musculus* L.

As far as good illustrations were already available it will be sufficient for me to enumerate the points of difference these pictures show as compared with the bones of the Buitenzorg skeleton now under discussion.

Where, however, the parts of the Buitenzorg skeleton were quite dissimilar to the existing figures, a more detailed description has been given, sometimes of component parts when it was those portions that showed the divergences.

To this description has been added a large number of illustrations drawn by myself, in which it has been my endeavour to bring out both the shape and the typical characteristics of each part of the skeleton by a judicious distribution of light and shade. Also the special structure of the bone and the minor bends and peculiarities of the surface, which are invariably weakened by a photograph, I have made more distinct in the figures, in order to render these frequently characteristic features more conspicuous.

The outward shape.

When I first saw the stranded whale, the body already in decomposition was lying on its back and was entirely fallen in. The epidermis had to a great extent disappeared. With the exception of a few parts withered and shrivelled up by the sun, showing more dark against the layer of fat of a lighter brown which formed the greater part of the surface, it was only at the tail and on the pectoral flippers that a dark-grey epidermis was still present.

The abdominal layer of fat divided into longitudinal strips, which was turned upwards, still showed a variety of dull-yellow, white and brown, but the natural colour was no longer to be clearly made out. It also seemed to me that the abdominal furrows were broader and fewer in number, than are to be observed in fotographic representations of *Balaenoptera musculus* L.

On a first view the fusiform or spindleshaped outline was apparent, in spite of the collapsed parts; this shape is obviously an adaptation for the purpose of rapid unhampered locomotion through the water.

Next, the head was proboscidiform or snoutshaped and tapering to a point, as a result of which the resistance of the water in rapid forward movement through the element is a minimum.

Though the lower jaws had been pushed apart by the natives for the purpose of unfixing the baleenplates, and were therefore no longer in their natural positions, it was still clearly noticeable that they project some way in front of the upper- jaw.

A neck properly so called is not present. The aggregate length of the cervical vertebrae is accordingly but 92 c.M. or 3.4 % of the total length of the body; in addition the cranium also stretches backward for some distance beyond the atlas-vertebra. The head and trunk passed insensibly into each other, thus obviating irregularities of the shape of the neck such as would have increased friction in swimming.

The penis also, which in this case was 180 c.M. long, could be enclosed within the periphery of the body by a fold of the skin so as not to impede rapid movement either. But, as eventually happens in many whales that are washed ashore dead, also in our specimen the organ had been completely forced outward. The gases generated in the process of decomposition, which had filled the abdominal cavity and had caused the wall of the belly to be powerfully swelled out, had made the skin- plait normally containing the penis bulge out, so that even the muscular fascicles at the basal part of it were clearly visible, as is shown in the illustration (fig. 44).

The skin, what was left of it, was glabrous and showed no hairs. I did not even find any hairs at the front part of the head, whereas in other species of *Balaenoptera* the occurrence of a few sporadic bristles is mentioned. It is however not impossible that these hairs, like the whalebeards had been already removed by the native people.

Among the relatively small number of baleenblades that could be collected, there are six not of the largest, still connected together at the basal end. This group of six laminae, not aggregating 4 c.M. in thickness gives some idea of the very large number of beards that must have hung down to the right and left from the outer rim of the palate which is over 4½ M. long. In connection with this it is clear that the number of 400 baleenplates to each half of the upper- maxillary, which is occasionally mentioned as belonging to the big *Balaenoptera*- species, can be easily reached.

These triangular horny plates, the largest of which, inclusive of the fringe-like border, is not more than 105 c.M. long, are all black, and therefore agree in this respect with those of *Balaenoptera musculus L.*

The pectoral flipper measured from the ball-and-socket joint of the humerus-bone was 332 c.M. long, i.e. slightly less than ⅛ of the entire length of the body; it must be taken into consideration that a small part of the damaged distal end of the breast-flipper was missing.

The dorsal fin, embedded in the sand, was altogether soft and fatty, and was approximately situated on the last quarter of the body. The small dimensions of the back-fin yield some further resemblance with *Balaenoptera musculus L.*

The immense caudal flipper was 450 c.M. broad, consisting as regards the extremities and margins of a strong stiff connective tissue, and was marked by a convex roundness in front, the back-rim being the shape of an accolade or brace.

The Skeleton.

The bone was generally speaking soft and spongy. It was permeated by a great quantity of fat and, in spite of its being very light owing to its porous structure, the entire skeleton still weighed 6390 K.G. and that after 42 days transport, during which time it was frequently exposed to the fierce sunrays.

In the caudal vertebrae and a large part of the lumbar vertebrae the ossification (ostosis) was evidently complete, at least the epiphyses had become entirely anchylosed with the centra or bodies.

Another part of the lumbar vertebrae and also the dorsal vertebrae, likewise the ulna and radius however still show a suture or seam, sometimes even loose epiphyses, occuring at the end of the bones in question as separate plates, clearly showing that the process of total ostosis was not yet accomplished.

We may safely assume, therefore, that the specimen under investigation is certainly not a very old one; at the same time the immense length of 27,28 M., hitherto unsurpassed by anything recorded, establishes a presumption that we are dealing with an adult male, fully developed to its maximum length.

As mentioned before, the bone also is somewhat soft, and of course softer in proportion as it contains more cartilage. Those softer parts are in the nature of things also more liable to shrinkage when drying than the parts already ossified; and this is why the parts of the skeleton still containing cartilage, such as for instance the upper-rim of the shoulderblade (scapula), after desiccation present a fretted or corroded appearance, as this is rendered in the illustration (fig. 39 and 40).

It may be supposed that the younger bone still containing a good deal of cartilage would probably no longer show the exact original shape after desiccation. This would appear to me to account for the fact, that in many illustrations especially of smaller bones the thin and pinched character of these bones was often striking in comparison with the corresponding parts of the skeleton dealt with here.

The skull (cranium). The illustration (fig. 1) gives a side-view of the skull; views from above and from below could not be made. It offers most similarity to that made after *Balaenoptera musculus* L. by Reinhardt (5) on p. 188 and also some, though less striking, resemblance with that made from *Balaenoptera physalus* L., of which creature True (6) reproduces several good photos. These latter, however, since they have reference to an allied species, are utilised exclusively because the sideview of the skull of the first- mentioned whale is not known to me either from an illustration or from any description.

The breadth of the skull amounts to 48½ % of its length, this proportion being 49 % in the illustration by Reinhardt, and according to True (6) p.

184 for the Ocean City whale (*Balaenoptera musculus* L.) 49½ %, so that in the matter of this proportion we find no appreciable difference.

With regard to Reinhardt's upper aspect of the skull of *Balaenoptera musculus* L. we observe as characteristic points of resemblance: the broad nasalia and the likewise broad maxillaria.

The space between the intermaxillaria is however considerably narrower in our skeleton, especially at the front. The intermaxillaria in the Buitenzorg skeleton are moreover somewhat differently shaped, in so far that in the smaller hind part of those bones the vertical dimension is predominant, whereas towards the front the bone- surface so to say turns or revolves, and becomes flattened in a horizontal direction.

This horizontal flattening of the bone is attended with a more pronounced broadening of the bone than in the Reinhardt skeleton, as a consequence of which, except a very narrow median strip that remains open, an upper over-arching of the vomer is formed, which vomer frontally tapers to a very pointed apex.

Again, the back-rim of the os frontale reaches further backward than in the illustration of the Reinhardt-skull; other possible divergences are not to be deduced from the latter picture by itself, since the lower and top view are lacking.

Now on comparing the side-view of the skull with the corresponding illustrations in True (6) after *Balaenoptera physalus* L., we notice how in our figure the temporal fossa i.e. the concavity for the musculus temporalis is greater and stretches more forward, through which also the thickened outer part of the maxillary directed towards the orbit, is conspicuously lengthened.

A further point to be noticed is that the exterior and posterior part of the skull (squamosum) has more of a *rearward* direction, whereas this part of the skull has an earlier and more directly downward bend in *Balaenoptera physalus* L.

All things considered, however, the remaining resemblance to the structure of the skull of *Balaenoptera physalus* L. is so great, that a reference to the descriptions already existing of the latter species will be sufficient, whilst a separate discussion follows for the more deviating parts of the skeleton, accompanied by illustrations tending to show as clearly as possible the typical shape.

In conclusion I subjoin a few measurements relating to the skull, so far as these have not been recorded in the preceding discussion.

(the measurements are taken in projection):

length of skull	612 c.M.
breadth of skull (squamosum behind zygomatic arch)	296 „
breadth (quite at the back)	255 „
height of skull	108 „
protrusion of lower before upper jaw	52 „
total length of the head (612 + 52 c.M.)	664 „
breadth of upper-jaw in the middle	189 „
length of intermaxillaries, (measured along the bone)	498 „
diameter of eye-socket (length-	35 „
occipital condyles (aggregate width)	44 „
height of inferior maxillary in the middle	45 „
breadth of blowhole	44 „

The nasalia (fig. 5) correspond with those of *Balaenoptera musculus* L. in so far that they are remarkably broad. In most other respects their shape differs entirely from the drawing given by Reinhardt (5) p. 186 and by True (6) plate 7 fig. 10.

These nasal bones are extraordinarily light and porous; the two front surfaces combined in vertical projection yield a figure that can be most closely comprised within an isosceles trapezoid, 44 c.M. high and whose upper parallel and basis are 20 and $33\frac{1}{2}$ c.M. resp..

The front and lower surfaces of the nasalia are smooth and slightly concave; they contribute to the formation of the wall of the blow-hole which in our skeleton is broader behind than in the illustration by Reinhardt to which reference has been made before.

The front of the nasalia combined possesses at the upper half a prominent median part, which projects most before the plane of the bone just above the centre of the anterior surface in question.

The combined under-surface, narrowing towards the back, shows a depression in the median part just before the middle and behind it a prominent bony ridge or keel extending to the posterior end of the nasalia and most prominent there. The more or less rough lateral surfaces are articulated with the posterior and interior parts of the intermaxillaria. At the front side may be seen, as indicated in the figure, a flat bony rim; the illustraticn also clearly demonstrates the peculiar form of one of the lateral surfaces.

The posterior surface is concave and possesses especially at the top a great number of narrow, flat bony frames, closely fitting into the rising grooves or ruts that mark the central fore-part of the os frontale.

The inner surface, in conclusion, by which the two nasalia are adpressed together, is even and, save a few unimportant irregularities, they do not display any special features.

The zygomaticum (fig. 2 and 3) is missing in many whale-skeletons and is very rarely reproduced or even included in the illustrations as a part of the skull; in the latter case the peculiar forms are not sufficiently emphasised, owing to the reproduction being on too small a scale.

The zygomaticum of our Buitenzorg skeleton however, appears to me to be dissimilar in structure when compared with that of other *Balaenoptera-skeletons* it is therefore that the following description has been supplemented with two illustrations clearly picturing the under- and the upper surface of the zygomaticum (jugal arch). It is a curved bone of 54½ c.M. in length, forming the bony lower wall of the orbit which narrows down funnel-shaped towards the interior. At the back it shows a more or less rounded part, small in proportion to the whole length of the bone, serving to effect the articulation with the tapering outer extremity of the squamosum which is produced forward. Anteriorly it possesses a heavier and broadened part with rough bone- surfaces which for the purpose of articulation are inserted between the backwardly produced outer prominence if the upper maxillary and the angular part of the os frontale which is directed outwards and forwards.

This anterior part of the zygomatic arch is however nothing else but the os lacrymale coalescent with the zygomaticum.

The tympanicum (fig. 4) is a more or less rounded bone measuring 13 c.M. in length. It displays a very peculiar structure and consists of a very hard compact mass of bone, so that unlike the rest of the skeleton it is exceptionally heavy.

The peculiar plicae and curves in the surface of the bone are hard to describe but are sufficiently marked in the figure representing the left ear-bone viewed from the side turned to the os temporale. This side shows an elongated aperture and a very thin, interrupted bony rim by which the tympanicum is attached to the rest of the skull. Owing to his very slender attachment the bullate tympanic bones easily break off, which explains why they are often missing from skeletons. (In the figure the surface of the fissur is clearly discernible).

The lower jaw (fig. 6, 7 & 8).

The mandibula is an elongated piece of bone with an outward arching, measuring a length of 6.20 M. The two mandibles approach each other in front and are there connected by a firm ligamentous tissue.

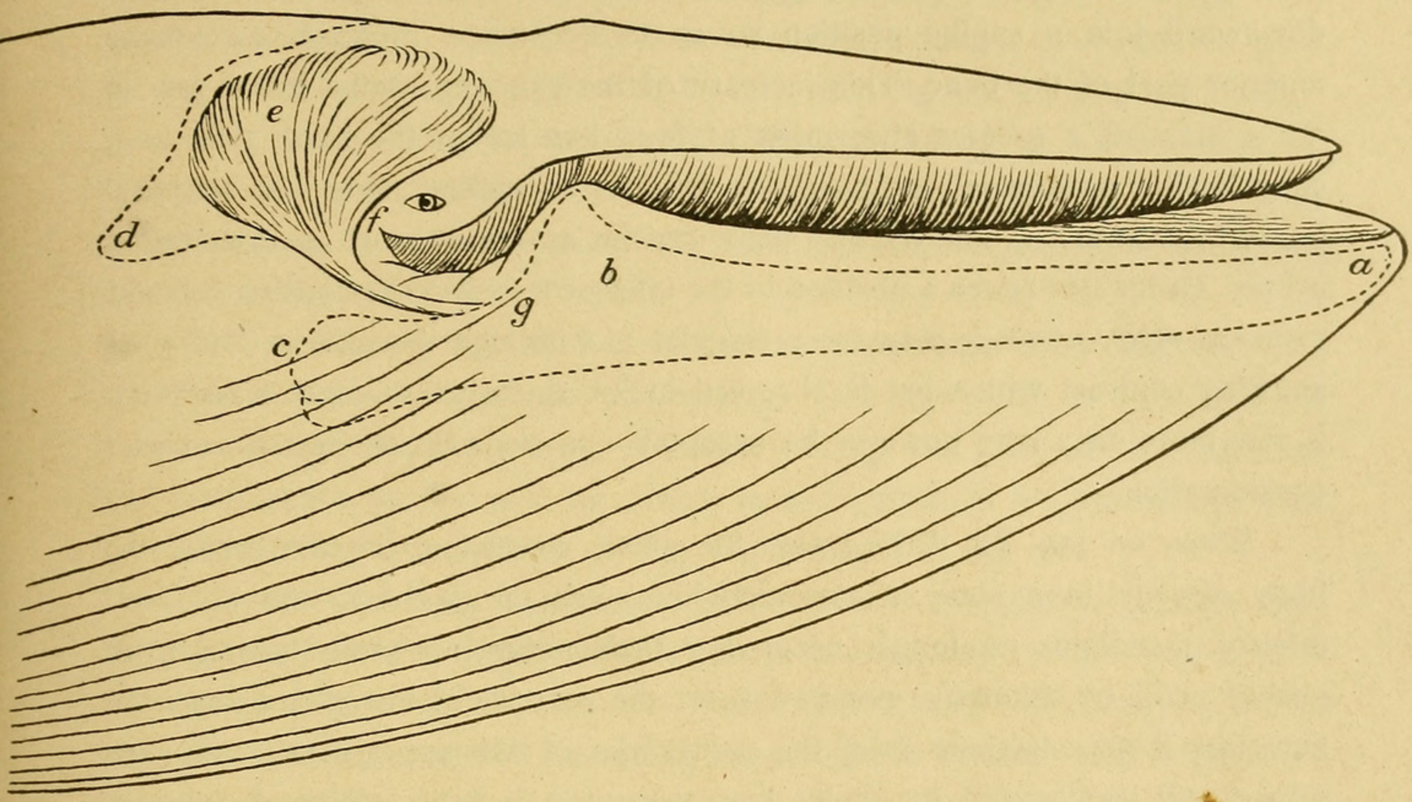
On the hindmost quarter of the mandibular bone we perceive the big crown-shaped process (processus coronoideus) whose apex is 83 c.M. distant from the lower margin of the jaw-bone. Quite at the rear-end here is the articulation-process of the mandibula.

The part of the jaw-bone corresponding with the rising ramus in other mammals, hardly deserves this name here, because this branch is here mainly directed backwards so as to prolong the anterior half of the jaw-bone in the same line, and is even directed a little downwards.

In connection with this circumstance the articulating condyle of the jaw-bone does not rest in an articular-socket of the squamosum, but remains quite a long distance away from it, separated from it by a thick layer of a partly filamentous partly cartilaginous tissue. This articulation process is divided by a horizontal groove into a bigger upper-part and a smaller lower-part. Midway between the articulation condyle and the coronoid process, at the upper interior surface of the bone, there is a pointed prominence of slight elevation and directed backwards, which conceals an orifice giving access to an interior channel running the whole lenght of the jaw- bone (fig. 7). This canal in its turn communicates with a series of 6 openings elongated in the longitudinal direction of the jaw and situated on the outer and upper edge of this bone. Moreover the interior upper edge of the mandibular bone displays a large number of shallow furrows.

The lower jaw protrudes quite a long way in front of the intermaxillaria, how far exactly it was not possible to determine by the dead animal, since when found the two halves of the mandibles were no longer in their normal situation.

I beg leave to insert here a brief discussion relative to the correct position of the mandibles. After the setting up of the Buitenzorg *Balaenoptera* skeleton



Sketch of the head, showing the position of the lower jaw relative to the skull.

doubts were raised on different sides as to the correctness of the position in which the mandibles had been fixed relative to the rest of the skull.

It may be mentioned sub limine that there was no literature dealing with this matter available to me. In the second place the various illustrations of finner-skeletons of divers musea show too little agreement to enable the question to be solved by means of them. Let it be borne in mind that since nearly all mammalia chew their food, the mandibles of those animals must have a fixed fulcrum which is found in the articular condylus of the lower jaw fitting into an articular cavity at the base of the squamose portion of the temporal bone. Seeing that mastication is out of the question in the case of *Balaenoptera* the necessity for this articulation does not exist here.

Again, it must be clearly understood that just in the case of these furrowed whales to a greater extent than with the smooth, furrowless representatives of the group, the mandibular- and throat part of the body is extraordinarily developed, while the throat pleatings make it possible to increase the capacity of the lower jaw even considerably more. In connection with this the so-called ascending ramus of the lower jaw-bone has inclined downward into a supine position so as to become a prolongation of the anterior part of the bone. This increase of the capacity of the lower jaw in the interest of a greater absorption of food has led at the same time to a considerable removal of the posterior articulation process from the temporal bone, from which it follows that there can be no question of an articulation proper. Hence has arisen a position of the inferior maxilla entirely disconnected from the skull, which appears very singular at first sight because it is in such startling contrast with what is observed in the skulls of all other mammalia. A few more data may however be acceptable to clear up the question under consideration.

When on Jan. 8th 1917 I saw the whale washed up by the ocean, the body already in a state of decomposition was on its back, the upturned inferior mandibles no longer occupying their natural position having been pushed aside by the native population for the purpose of wrenching loose the numerous baleen-laminae from the cuther rim of the upper maxilla. It was indeed still visible that the lower jaw protruded in front of the upper one, but how far was no longer to be measured with accuracy.

The protrusion of lower jaw before the upper one is however discernible in *Balaenoptera musculus* L. in True (6) plate 13 fig. 3, plate 15 fig. 1 and 2, and plate 48 fig. 2; and for *Balaenoptera physalus* L. in True (6) plate 10 fig. 1, 2 and 3, plate 12 fig. 1, 3 and 4, and plate 37 fig. 3. Further in Flower: Proc. Zoöl. Soc. London 1869, plate XLVII fig. 1 for *Physalus antiquorum* = *Balaenoptera physalus* L.; whilst the protrusion of the lower jaw has also been made allowance for in setting up the skeleton of *Megaptera nodosa* Bntr. reproduced in True (6) plate 36 fig. 1.

In conclusion it may be mentioned that according to True's account (6) p. 116 the length of the protruding section is 2,1% of the total length in *Balaenoptera physalus* L., which applied to our Balaenoptera would work out to 2,1% × 2728 c.M.=57.3 c.M.. Flower (Proc. 1869) states for this in *Balaenoptera physalus* L. nearly 2½ %, which in our case would yield 2½ %×2728 c.M. = 68.2 c.M. In the skeleton now set up at Buitenzorg the lower jaw only protrudes 52 c.M. before the upper one. How far the thickness of the skin and flesh on the upper and the nether jaw may be a factor in this question is here left out of account. In this position of the inferior maxilla the processus coronoideus is situated more forward than the eye. In connection with this the fleshy lower jaw in this place occasionally shows a slight, faintly marked swelling, as is rendered in True (6) plate 37 fig. 3 for *Megaptera nodosa* Bntr., and on plate 12 fig. 3 for *Balaenoptera physalus* L. (see also our sketch on page 108).

That this swelling is mostly not visible, is owing to the circumstance that the processus coronoideus does not rise much above the upper bony ridge flanking it, and a thick layer of flesh also contributes to the weakening or total extinction of this elevation.

But immediately behind this processus coronoideus there follows a depression of the bone (see our sketch, page 108), by which in that place the external form of the fleshy lower jaw clearly brings out the posterior outline of this excrescence, so that now all doubts as to its position are solved. See True (6) plate 10 fig. 1 and 2; pl. 15 fig. 1 and 2; pl. 37 fig. 1.

In several of these illustrations it looks as if the inferior maxilla ends immediately behind this excrescence; also in our skeleton viewed from in front (taking up a position about 4 feet beside the centre) this seems to be the case, because the so-called ascending ramus curves inwards and is therefore invisible from the point of view indicated above: the flutings of the skin in that place accordingly make it evident that the surface layer is free from bone, for the very reason that the posterior branch of the lower maxillary there deviates from the periphery of the body.

Then also the angle of the mouth presents a slit in a backward and downward direction, as is clearly visible in most of the illustrations afore mentioned. This slit of the lips would obviously not slant in this way if the processus coronoideus were in a more anterior position. Moreover the outward appearance of the corner of the mouth demonstrates the absence of an interior hard bony substructure, which is brought out in the sketch. In True (6) pl. 38 fig. 2 we see besides the outline of the lower jaw making itself felt owing to the circumstance that the mass of flesh has subsided from flaccidity.

Concerning the breadth of the two lower maxillae together, it is obviously greatest just in front of the eye, which is clearly discernible in True (6) pl. 15 fig. 1, 2 and 4 and in pl. 14 fig. 7.

In fig. 2 and 7 the head is couched on the left side, the right hand jaw uppermost, so that the rising back part of the lower mandible, which is bound to sag downwards through its own weight, in spite of this lowering, still shows with clearness how great the distance between the two inferior maxillae must be.

In True (6) pl. 41 fig. 1, 2, 3 and 4 we can further see in the case of *Megaptera versabilis* Cope (at any rate also a fin-whale) the extraordinary width of the lower jaw, the two bony posterior extremities of which arch considerably outwards, a thing which would of course be impossible if these extremities were restrained by a strong articular ligament. An articulation capsule is not present here, so that we can no longer speak of an articulation.

In the description of *Balaenoptera rostrata* Fabr. in Carte and Macalister (3) it is stated with reference to the joint of the inferior maxilla (p. 212) that Hunter found no synovial bursa but that a double synovial bursa was demonstrated in *Balaena mysticetus* L. by Eschricht and Reichhardt; but this creature is not a fin-fish but a right (unfluted) whale, whose posterior extremity of the lower jaw is quite differently shaped from what it is in *Balaenopteridae*. This double synovial capsule is apparently meant to serve as an argument for presuming the existence of a lower-jaw joint in *Balaenoptera*. Meanwhile the position and relation of the lower maxilla to the skull is now perfectly determined, since we know the length of the part that is produced before the upper jaw and also the width of the lower jaws, whilst the falling away of the lip near the corner of the mouth marks the place of the processus coronoideus.

The sketch on page 108 shows how far removed is the so-called articular process of the inferior maxilla *(c)* from the lower extremity of the skull (squamosum, *d)*.

This squamosum in the Buitenzorg *Balaenoptera* having a strong backward deviation, unlike the downward direction in other species, it follows that the distance must here be greater than in other representatives of the group.

Some photographic reproductions of *Balaenoptera musculus* L. *and Balaenoptera physalus* L. show however, that in some cases the loweh jaw is little, if at all, produced forward. See True pl. 15 fig. 3 and other illustrations.

From the preceeding we must conclude that the lower jaw possesses a great mobility in the forward-backward (horizontal) direction, for originally we calculated the length of the part of the lower jaw that can be produced before the upper one, to be 68.2 c.M.

We find therefore that the lower jaw can certainly be moved forwards and backwards for a distance of at least ½ M, and as the condyles of the jaw can consequently also be displaced more than ½ M, it is not possible to assume an articulation properly so called.

But in connection with this mobility there is quite a different matter that must now be pointed out.

On examining the flutings or furrows (plicae) running through the layer of blubber on the throat and ventral side, it will strike the observer that they occur precisely in those places beneath which there are no bones but cavities; these cavities can be compressed thus diminishing the volume of the body through the increased pressure of the water when the animal dives to a great depth.

This diminution of the volume is in the nature of things attended by an increase of the creature's specific gravity thereby of course facilitating the diving. The same purpose is also served by the contraction of the tongue, by which the voluminous mass of the throat is raised and the flutings of the throat are narrowed and closed.

In both these cases we therefore see a diminution of the volume of the body as a factor of some value in diving, and there are moreover grounds for surmising that a third cause of a diminution of volume is found in the mobility of the lower jaw through contraction of the musculus temporalis.

The temporalis is a very big muscle completely filling up the temporal fossa and even causing a slight swelling of the flesh. The converging fascicles of the muscle follow the back of the protruding part of the orbit formed by the os frontale, in a downward and forward direction, and terminate in a very strong tendon, which according to Carte and Macalister (3) p. 222 attaches itself to the processus coronoideus. (This latter detail appears to me slightly incorrect: the attachment is probably effected at the basal part of the processus coronoideus postero-interioly, where the bone is clearly very rough for a powerful attachment of a tendon. Besides, if the processus coronoideus served for this attachment its rear-edge would of course be indistinguishable from the outside).

The sketch reproduces the musculus temporalis at *e*, from which it may be gathered how according as the muscle contracts the inferior maxilla is first drawn backwards, whilst the posterior end of the jaw- bone will also move towards the interior. The diminution of volume conducive to ease in diving can therefore, be it only to a slight extent, be emphasised by the movement of the lower jaw.

Let us now consider the question whether the lower jaw can be withdrawn so far that the processus coronoideus enters the temporal fossa, i.e. behind the orbital part of the os frontale, which position is by some supposed to be the normal one. This can not be brought about by the action of the muscle, since as appears from the sketch, in that case the place of attachment, *g*, would have to be withdrawn further backwards, (behind *f*, the posterior part of the orbit), than is possible.

This would be possible only in case the attachment of the muscle were located a long way anterior to the processus coronoideus.

On placing the lower jaw all the same in such a position that the processus coronoideus is couched in the temporal fossa behind the orbital part of the frontale, we obtain the singular result that the condyles of the inferior maxillae reach some way behind any part of the skull, whilst in front the upper jaw would stick out, so that the space between the lower jaws would become too small for the down-hanging baleen-plates.

To occupy this position the inferior maxillae of the Buitenzorg Balaenopter would have to be moved backwards at least 95 c.M., whereas we have previously found that they might safely have been produced forward a little more than in the existing reconstruction without causing unnatural proportions.

As a matter of fact I have never seen a position similar to that advocated by my critics in any picture representing the reconstruction of a whale skeleton, although indeed the differences in the reconstructions are many. The sketch shows how on the basis of all the facts and arguments adduced in the preceeding paragraphs, I conjecture the true position of the lower jaw relative to the skull; which position was accordingly given to it in the construction of the Buitenzorg skeleton.

Furthermore this reconstruction agrees substantially with the somewhat vague illustration, referred to before from True (6) pl. 36 fig. 1, reproducing the skull of *Megaptera nodosa* Bntr, a Balaenopter from the Niagara-Falls Museum in New-York, described in the index to the plates as: „Skull from the type-skeleton". The lower jaw in this instance is placed in a slightly more advanced and lowered position than in our case.

The tongue-bone (hyoid bone) (fig. 9) presents a strong resemblance to that of *Balaenoptera musculus* L. according to the illustration in Reinhardt (5) p. 189, with the only difference that in the Buitenzorg skeleton the great posterior horns of that bone are somewhat heavier and less constricted in girth towards the basal end.

The whole bone presents, besides the excrescences marked in the illustration, a convex frontal surface, and a concave back-surface; the maximum length, measured along the front-surface of the bone amounts to 168 c.M., whilst the distance between the extremities of the big cornua is not more than 140 c.M., in consequence of the fact that these cornua have a back- and downward direction. These horns are not quite round but somewhat compressed in the antero-posterior direction. Like the upturned lesser cornua they display rough extremities for the attachment of cartilage.

The styloidean or styloid process (fig. 10) is a small separate bone, curved and flat, measuring 72 c.M. in length and 23 c.M. in breadth. Both ends are rough for the attachment of cartilage, by means of which it is connected below with the ascending small cornua of the hyoides, and above to that part of the cranium corresponding to the processus mastoideus, or nippleshaped process of the temporale. To what extent this bone of the Buitenzorg skeleton is congruous to that of *Balaenoptera musculus* L., which in contradistinction to the other European *Balaenopteridae* is also described as flat, can not here be stated, seeing that I have no drawing of the processus styloideus of *Balaenoptera musculus* L. However a similar bone, described as „stylo-hyal" is reproduced by Flower (4) p. 406, from a Java finner, *Balaenoptera schlegelii*. The latter bone is however shorter and broader than that of the Buitenzorg skeleton.

The vertebrae fig. 11 — 32. The vertebrae consist of light spongy bone, more so than is the case with the other parts of the skeleton. They moreover show in various places apertures for the egress of bloodvessels in which the spongy material of the vertebral body is very rich. The surface of the body serves for the attachment of ligaments and accordingly presents a rough, porous structure; the ligaments are indeed astonishingly strong, except in the cervical part of the spine, where they seemed to me less powerful.

The greater part of the osseous anterior and posterior epiphyses are not completely incorporated with the bodies or centra, but exist frequently as separate plates of bone.

The total number of vertebrae amounts to 65, distributed as follows:

cervical vertebrae	7
dorsal vertebrae	16
lumbar vertebrae	15
caudal vertebrae	27

This vertebral-formula tallies exactly with that of a foetus of *Bal. musculus* L., obtained in 1901 off Newfoundland, and referred to by True (6) p. 182. It should however be borne in mind that many other vertebral-formulae mentioned, all deviate more or less from the figures given here.

Side by side with the great similarity however the vertebrae also display characters proper to each separate group, though the typical features characteristic of each group are not equally pronounced in all the representatives of each of those groups. The central vertebrae of each group do indeed display distinctly the characteristic features, but as we pass from one group to another we find transitions.

This regards both the different processes and the shape and size of the bodies or centra. Only the atlas and the axis, the first two cervical vertebrae, bear their special features.

Vertebrae colli, fig. 11 — 19.

The first vertebra (atlas) (fig. 11 and 12) clearly shows all the characteristic features of this bone as occuring in the genus *Balaenoptera.* For the shape and dimensions of this the student may conveniently be referred to fig. 11 and 12.

It is, however, worth noting that in Flower (4) there is a description of a finback-whale washed ashore on the N. W. coast of Java *(Balaenoptera schlegelii)* whose head bears the general character of *Balaenoptera sibbaldii* Gray. From this description to which a.o. several illustrations of cervical vertebrae are added, it may be distinctly gathered that this Balaenopter represents quite a different species from the one to which the specimen in the Buitenzorg Museum belongs. On these grounds the points of difference from Flower's description will be mentioned in the treatment of the vertebrae colli.

In the atlas (fig. 11 and 12) the articular facets in combination with the occipital condyles assume a vertical position and the neural foramen is a vertical perforation of equal breadth throughout; the spinous process is somewhat larger and more pointed, and the transverse process situated a little higher than in the case illustrated by Flower. The two anterior articular sockets are very smooth in agreement with the occipital condyles resting on them and extending some way behind. Both the two articular cups combined and the two occipital condyles considered as one whole, are parts of a spherical surface, so that the articulation in question is a ball-and-socket joint, which differs from the usual formation of this joint in other mammals. The posterior aspect of the neural aperture shows a noticeable expansion.

The second vertebra, epistropheus or axis (fig. 13 and 14) fits so closely against the posterior surface of the atlas as to render movement between these two vertebrae hardly possible. An odontoid pivot of the epistropheus on which the revolving of the atlas in most mammals takes place is not present either, unless a granular emergence at the centre of the anterior cup of the epistropheus may be looked upon as a rudiment of this organ (fig. 13).

In comparison with *Balaenoptera schlegelii* Flower there are left for me to point out the following differences:

The articular surface towards the atlas does not consist of two parts but of one continuous surface. The spinous process is larger and, especially when compared with those of the other cervical vertebrae, it forms a strikingly ponderous mass. The lateral processes are more rectangular, and are directed backward but not downward at all, the apertures occurring in these are proportionally smaller.

If we except the first two vertebrae, we find that the general type of the cervical vertebrae is best represented by the middle one of those remaining, i.e. the 5th vertebra (fig. 17).

As typical characters we find: the centrum is flat and rectangular, more or less rounded at the corners; the vertebral foramen large and triangular. The spinous process, formed by two bone-plates meeting roofwise, is low and little developed, the articular prominences are small, but the articular facets of these processus articulares of the successive vertebrae still meet, and lateral processes form great plane arches.

In the 5th vertebra the plane of these lateral processes is perpendicular to the axis of the body, whereas the three previous and the two succeeding cervical vertebrae suggest that they are compressed towards the centre of the group of vertebrae colli (the 5th). In the third and fourth vertebrae (fig. 15 and 16) the spinous process is not closed at the top, but consists of two very thin lamina of bone, whilst not much more remains of the articular processes than the articular facets. In the 5th vertebra (fig. 17) these latter processes are of a more pronounced character.

In the 6th vertebra (fig. 18) the transverse process does not form a closed arch, the latter being interrupted just below the middle, so that the two parts genetically produced by two distinct ossifications, are seperately discernible. The seventh vertebra colli (fig. 19) conforms exactly to the type of the 6th of *Balaenoptera schlegelii* Flower (4) p. 405 fig. 14 and 15.

The dorsal vertebrae (vertebrae thoracis) (fig. 20 — 24) are generally speaking much heavier than the cervical ones. The type is best rendered by the 6th dorsal vertebra (fig. 22) which displays the features following:

The centrum is stout, cylindrical with more or less round articular surfaces which are either separated by a seam from the body proper or represent bony epiphyses not yet incorporated with the main bone but in the nature of loose, bony inter-vertebral discs.

The large neural foramen has no longer so clearly the triangular shape as in the cervical vertebrae but is more rounded. The spinous process is long, flat and with right angles, slightly expanded at the top and slanted backward; the lower and posterior basal end displays two divergent bony plates, each of which possesses no more than a faintly developed knobby prominence still representing the posterior articular process which, however, hardly acts as such any longer.

The anterior articular prominences on the contrary are strongly developed.

The transverse processes are big, produced horizontally at right angles with the longitudinal axis of the body and growing broader and stouter towards the distal end. They also possess an articular facet directed exteriorly and somewhat posteriorly for the costal capitulum. The body of the first dorsal vertebra (fig. 20) is not much bigger than that of the last neck-vertebra. In the next three dorsal vertebrae the dimension increases fairly rapidly, after which the increase up to the last dorsal vertebra is slight though regularly continuous. The neural canal remains practically constant for the whole length of this section of the spine. The spinous processes, beginning rather small immediately behind the last of the neck-vertebrae and having at first a vertical direction, gradually increase towards the rear of the spinal column, the position also assuming a more backward slope.

The lateral process of the first dorsal vertebra shows to a marked degree the compression in a cranio-caudal sense of the 7th neck-vertebra; in the 2nd. dorsal vertebra this flattening is much less; it has disappeared entirely in the 3rd (fig. 23), the processus being more roundish.

Henceforward, beginning at the 4th dorsal vertebra we see the beginning of quite a different compression, namely in the dorso-ventral sense, which then continues in the succeeding dorsal vertebrae (fig. 21, 22 & 24). The position of these lateral processes, initially with a somewhat forward inclination, gradually passes into that of the 9th dorsal vertebra where it is perpendicular to the axis of the body and remains so down to the end.

The processus articulares first appear between the 2nd and 3rd cervical vertebra, being there represented by nothing more than articular facets in a more or less horizontal plane, the real processus first commencing in the more posterior vertebrae.

Likewise in the first few dorsal vertebrae the articular processes in continuation of those of the cervical vertebrae are of a very unimportant development qua processes, whereas the articular facets are clearly discernible and accordingly function well. These are directed upwards in the anterior articular processes, and downward in the posterior articular processes. However, these positions are gradually modified, so that in the 4th vertebra thoracis the posterior processus articularis extends already outwardly and in connection with this the articular process of the 5th vertebra thoracis fitting together with it is turned inward (fig. 23).

Furthermore the articular facets of the processus articulares become gradually smaller towards the rear so as to practically vanish from the 9th vertebra thoracis onward; the posterior articular processes diminishing proportionally also untill they to eventually vanish.

The case of the anterior articular processes is on the contrary quite different, for as becomes apparent on comparing fig. 21 — 30 incl., these, contrarily, become more massive, notwithstanding the circumstance that their articular function gradually decreases to nihil. At the same time they become subservient to another purpose, in as much as these rearwardly increasing anterior articular processes of the dorsal region with their rough surfaces serve for the attachment of tendons for the separate interiorly directed muscular fascicles of the musculus longissimus dorsi.

The vertebrae lumbales are 15 in number and form the most massive part of the vertebral column. The separate vertebrae of this region present a very uniform appearance, so that it is not necessary to take the central one as the type or the lumbar section. The illustration (fig. 25) shows the third lumbar vertebra, clearly displaying the different parts presenting the typical characteristics of this region of the spine.

The bodies of the lumbar vertebrae are colossal and even increase in bulk somewhat to the rear. The osseous epiphyses are here generally more firmly united with the centrum than in the dorsal region, though there are a few that are not quite incorporated, but fit against the centrum of the vertebra by means of a granulated surface.

The neural-foramen diminishes towards the rear. The spinous processes are mostly somewhat longer than in the dorsal vertebrae but towards the rear end they again diminish in length. The transverse processes are conspicuously flat, those of the 1st lumbar vertebra only having retained some of the knobby expansion occuring in the dorsal vertebrae. Towards the rear those processes at first increase slightly in size, so as to reach a length somewhat superior to those of the dorsal vertebrae. Further to the rear however they become much shorter untill for the hindmost lumbar vertebrae they are shortened by nearly one half.

The anterior articular processes serving similarly to those in the last vertebrae thoracis exclusively for the attachment of tendons belonging to the interior fascicles of the longissimus dorsi, have the peculiar square appearance brought out in the illustration and become a little smaller only quite at the back.

The vertebrae caudales (fig. 26 — 32) are in other Vertebrata posterior to the sacrum. It being however impossible to speak of a sacrum in *Cetacea,* the criterion to mark the beginning of the caudal series must be the first attachment under a vertebra of a chevron-bone formed by the haemapophyses.

According to this criterion there are 27 caudal vertebrae bringing the total number of vertebrae to 65, a maximum for various species of *Balaenopteridae.* A type of the caudal vertebra proper is not to be indicated, seeing that the anterior ones are quite similar in shape to the latter lumbar vertebrae, whereas the various processes become gradually smaller towards the rear, pass to rudimentary conditions and finally vanish altogether, so that the last nine or ten vertebrae caudales present no more processes whatever. The bodies of the vertebrae caudales at first diminish very slowly in volume, and it is only with the 12th that a rapied diminution of the bulk sets in. The foramina of the vertebrae however diminish rapidly in width of the bore and even disapper altogether, as is visible in the illustration (see below).

The spinous process, which in the first few vertebrae caudales still bears the character of those in the lumbar region, soon assumes a more distinct shape as shown in the illustration of the 5th vertebra caudalis (fig. 26), and is then distinguished by a crest-like broadening upward and a protuberance situated posterioıly a little below the middle. Furthermore in the 7th and 8th vertebra caudalis the spinous processus immediately becomes much smaller (fig. 27). in the ninth the position becomes horizontal and more to the rear the entire process vanishes. The 17th and 18th vertebra caudalis (fig. 31) show nothing but an insignificant rudiment of the spinous process. The size of the anterior articular process at first diminishes relatively little towards the rear (see fig. 28, the illustration of the 10th and 11th vertebra caudalis); on the 16th and 17th vertebra caudalis (fig. 31) they have however dwindled away so as to be hardly visible.

The transverse process in the first few vertebrae caudales again conform entirely with those of the adjoining vertebrae lumbales; it stands to reason that also these processes gradually dwindle to a smaller sizé. On the 5th vertebra caudalis (fig. 26) the lateral processes have already shrunk to a roundish part on the side of the vertebral centrum and, unlike the transverse processes in caudal vertebrae in general, are located not anteriorly but in a more posterior position on the body of the vertebra. More to the rear of the column the position of the dwindling transverse processes shifts more and more towards the forepart of the vertebral body, so that in the 11th vertebra caudalis (as shown in the figure 28) it protrudes slightly before the plane of the bone and coalesces with this posteriorly. The succeeding vertebra however presents this aspect only in a slight measure.

In the 8th to 12th vertebra caudalis it is seen that the foot of the transverse process is perforated so as to yield passage to nerves and blood-vessels (fig. 28 & 29). This perforation, however, only commences on the right hand side in the 8th vertebra caudalis; only with the 9th vertebra caudalis does the perforation appear symmetrically on both the right and the left.

More to the rear, i.e. between the 12th and 16th vertebra caudalis, there is on the lateral surface of the vertebral body a groove ending below in a hole yielding access the subvertebral caudal canal, a broad longitudinal depression that receives the main caudal bloodvessels (fig. 29 & 30).

In these last 9 to 10 vertebrae (fig. 32) all processes have vanished, also the lateral groove is no longer there, the only thing that remains clearly visible down to the very last vertebra being the hole to which the groove leads.

The 51st vertebra, marked in the illustration of the end of the tail by a little cross, has been reproduced separately in the upper-right hand corner, with the front-surface directed upwards, so as to give relief to the small round articular surface which was consolidated with the corresponding articular facet of the preceding vertebra by cartilage.

The remaining exterior margin of the bone of the front-surface is furthermore enclosed with an extremely tough connective tissue, so that, also as a consequence of relative smallness of these contact surfaces and the comparative bigness of the inter-vertebral cartilage, the mobility of the tail end is considerable augmented.

The chevron-bones (haemapophyses) (fig. 33) have the shape of a V, and are attached, to the number of 19, to the lower end of the first 19 vertebrae caudales. In order to show how the connection with the lower ends of the vertebral bodies is made, the 10th and 11th vertebra caudalis, reproduced in the lateral aspect in fig. 28, have been once more copied in fig. 29, in the lower aspect, so that it is now clearly show that the vertebral centrum possesses two larger posterior and two smaller anterior articular facets, with which the upper ends of the chevron-bones are articulated above.

Furthermore, in fig. 29 we see the bony margins attached to the nether-side of the vertebral bodies and forming the caudal canal aforementioned which extends a long way back and is bridged or arched over each time between two vertebral bodies by chevron-bones. This longitudinal sub-spinal groove becomes naturally less pronounced towards the end of the caudal canal, until on the last few caudal vertebrae (also the one marked with †) there is nothing left but a shallow depression, displaying right and left two perforations, which features persist down to the hindmost vertebra of the tail.

The chevron-bone occuring in fig. 29 bottom, between the 10th and 11th vertebra caudalis has been furthermore reproduced in three different positions (fig. 33) in order to bring out the character of this bone clearly. The lower articular facets on the vertebral centra, which, as the illustration fig. 29 shows, are larger behind than at the front, become more equal towards the tail, and consequently the chevron-bones are there suspended more nearly from the middle.

The first chevron-bone still consists of two bony plates converging downwards but not yet coalescent there. The caudal canal is broadest here and the distance between the bony plates forming the haemapophyses is largest.

This horizontal dimension does not decrease so rapidly towards the rear as the vertical extent of the same bones; consequently, behind the 10th chevron bone, here given as the type (these bones being sometimes designated as the inferior spinous processes), they assume a broader and more thickset build, whereas more to the front, where the vertical dimension is more considerable, the tall or slender character is more pronounced.

The first five chevron-bones show gradually increasing lengths, the 5th and 6th being longest of all, and attaining a height of 41 c.M.. The 7th and 8th have nearly the same measurement, the gradual diminution setting in after this. The last three chevron-bones consist of no more than two truncated and rounded bony protuberances, present a stunted appearance, being nothing more in the 19th chevron-bone than a païr of roundish pieces of bone measuring 4 c.M. in diameter.

The ribs (costae); fig. 34, 35 & 36. The number of ribs amounts to 16 pairs; this number, according to True (6) is also stated by Gervais for *Balaenoptera musculus* L., varying according to the former author in European specimens of *Balaenoptera physalus* L. between 14 and 16 pairs, and in American specimens from 15 to 16 pairs.

Only the foremost pair of ribs is artïculated with the sternum and therefore represents the only pair of true ribs, whereas the other ribs are free at the ventral end, like so-called false or floating ribs (asternal ribs).

The following is a table of the lengths of the successive ribs on the left side, measured along the outer arching of the bone:

1st rib 185 c.M.	9th rib 314 c.M.
2nd rib 223 c.M.	10th rib 301 c.M.
3rd rib 288 c.M.	11th rib 287 c.M.
4th rib 307 c.M.	12th rib 271 c.M.
5th rib 326 c.M.	13th rib 259 c.M.
6th rib 328 c.M.	14th rib 238 c.M.
7th rib 329 c.M.	15th rib 220 c.M.
8th rib 325 c.M.	16th rib 227 c.M.

We see from this that the increase in length is very rapid in the first 5 ribs, viz. from 185 c.M. to 326 c.M.; the maximum length being attained in the 7th rib. Then follows a gradual decrease down to 220 c.M., being the length of the 15th rib, whereas the very last rib is again slightly longer (227 c.M.): a fact by which the Buitenzorg skeleton deviates surprisingly from the *Balaenoptera* with whose descriptions I am familiar, in which if present at all, the 16th pair of ribs is merely rudimentary.

As compared with the ribs of *Balaenoptera physalus* L. the illustrations given present a good many deviations.

The first pair of ribs is faintly arched, consisting of a flattened, elongated and rounded upper end which is rough for the attachment of ligamentous bands and hardly makes the impression of a separate capitulum and which is articulated laterally between the bodies of the last cervical and the first dorsal vertebra: this first rib, unlike all other costae, does not rest against a lateral process. The lateral process of the first vertebra thoracis, it is to be noted, is still very flat and is very abruptly curved downward, as a result of which it approaches the exterior of the capitulum of the rib with a rough edge, being connected with it by ligamentous tissue. The lower or ventral end of the first rib is not much broader than the dorsal end, which according to illustration is the case with most other varieties of *Balaenoptera.* Neither is the first rib, as usually stated, the broadest; the greatest breadth is met with in the 3rd, 4th and 5th costae, amounting to as much as 19 c.M.. The lower end of the first rib displays a rough surface for the attachment of cartilage and connective tissue by which it is joined on to the sternum. A little way upwards a rough part of the lower end of the first ribs shows a second place of attachment. The front surface of the rib is flat, the middle showing a broader and thicker part furnished with several grooves and rough ridges which continue on the exterior part of the equally flat posterior surface. This points to the attachment of a very powerful muscle, namely the exterior head of the oblique neck-muscle, sterno-mastoideus. The first pair of ribs consolidated with the breastbone and with the vertebral column forms with these a firm bone ring, which in the nature of the case can resist the action of muscles better than the asternal ribs following immediately behind. The sterno-mastoideus being the most powerful muscle joining the head and trunk, it is intelligible that for the attachment of its tendons such a large and exceptionally scabrous surface is required on this more firmly fixed first rib.

The second rib has, like the first, a rough elliptical capitulum, articulated laterally to the first two vertebral centra and approaching from below the transverse process of the second vertebra, from which it still remains a little way distant, so that the connection is not formed by an articular surface, but by connective tissue.

The third and fourth ribs conform more to the normal type of a rib, and besides the arched lath of bone, display a more pronounced capitulum, a costal neck and angle and a rough knobby part for the articulation with the transverse process of the corresponding vertebra. Besides the shape also the insertion of these ribs conforms more nearly to that in other mammals, in as much as the knobby part of the costal angle is produced higher so as to rest against the termination of the transverse process of the corresponding vertebra.

According to True (6) p. 185, in *Balaenoptera musculus* L. (the Ocean-City Whale) a capitular process also occurs on the 2nd, 3rd and 4th ribs, therefore unlike what is found in our case, also on the 2nd rib.

The capitulum of the third dexter rib presents a somewhat atrophied character, this capitulum being already more removed from the vertebral body in the 4th. Both these features form a transition to the 5th rib, where as the picture shows, the capitulum is altogether missing; at the neck of the rib the apex terminates in a point, leans on nothing and indeed remains a good way removed from the vertebral centrum. The upper extremity of this 5th rib is so noteworthy, because by comparison with the previous and subsequent ribs it brings out so clearly, how the articulation of this termination of the rib passes from the centrum of the vertebra to the extremity of the transverse processes, (this latter being the typical connection in the *Cetacea,* in contradistinction to the double connection that is the normal one in Mammalia).

This looser fitting of the ribs makes it easier for them to recede inwardly, which capacity for yielding is required in diving to great depths, owing to the immense pressure then brought to bear upon the body.

In the 6th and subsequent ribs the upper articular extremity retains not a trace of a capitulum or neck and is accordingly articulated only with the apices of the transverse processes for which purpose articular surfaces cushioned with cartilage are clearly available. The articular surface at the end of these lateral processes then has an externo-posterior direction.

As the ilustrations show the rib-end now bears a more or less rounded character, sligtly suggesting to the observer the capitulum, though this organ had already vanished in the 5th rib. Herewith we have arrived at the normal type of a *Balaenoptera*-rib, which a.o. has two smooth surfaces, (anterior and posterior), a firmly rounded exterior margin and an edge-like inner rim passing towards the lowest quarter part into a more broadened bony rim. More to the rear the upper knobby costal extremity becomes smaller, the width of the rib narrower, and the cross-section of the rib more circular.

In the last three ribs, to end with, we see a double curvature,faintly marked in the 14th and most strongly pronounced in the 16th. In consequence of this additional curve the distal rib end becomes gradually bent more backwards.

The sternum (fig. 37 & 38) is a flat, rather small bone, somewhat asymmetrical, broad 62 c.M., high 51 c.M.. It possesses a descending odontoid process and two wings. Its shape presents an unmistakable similarity to that described of some specimens of *Balaenoptera physalus* L.. Generally speaking, however, the sternum in *Balaenoptera physalus* does not adhere rigidly to one type but varies rather considerably; vide numerous illustrations in True (6).

The junction of the sternum with the first pair of ribs has been schematically represented in fig. 38, which illustration is a free rendering of one by Struthers, to be found in the often quoted work of True (6), p. 141, fig. 27.

The scapula (fig. 39 & 40) is a broad, flat, very large, yet light bone of a more or less fan-like shape. The upper margin is curved evenly and very rough for the attachment of cartilage, which spreads forward and rearward in large plates prolonging the plane of the bone and extending it considerably.

The blade-bone itself measuring a length of 165 c.M. and a height of 107 c.M. presents an exterior surface, consisting, as brought out in the illustration, of four parts, slightly concave here and there. The interior side resting againt the ribs shows a number of more or less clearly rising bony ridges. The big acromion, so characteristic of *Balaenoptera musculus* L., is also enormously developed here, into a somewhat flat process curved anteriorly; it displays a broadened, very rough front edge for the attachment of cartilage.

The glenoid fossa of the scapula in which the head of the humerus articulates, is rather shallow, covered with a tegument of cartilage and thus very smooth; the rim of the articular fossa is scabrous for the attachment of cartilage, by which the articular surface is considerably increased. The neck of the shoulderblade at the top of this, shows as may be seen in the illustration, a more pronounced character than is met with in most illustrations from *Balaenoptera physalus* and *Balaenoptera musculus;* also the caracoid process is well-developed.

The pectoral flipper (fig. 41 & 42) from the shoulder-joint to the tip of the 2nd digit, has a length of 332 c.M., i.e. 12 % of the total length of the body, which is rather short for fin-whales in general.

The measurements of the various bones is as follows:

Length of Humerus .... 69 c.M.
Length of Radius .... 121 „
Length of Ulna .... 126 „

The length of the metacarpalia taken in the order from the radius to the ulna is:

1st metacarpal .... 28 c.M.
2nd metacarpal .... 35 „
3rd metacarpal .... 29 „
4th metacarpal .... 18 „

Since the illustration of the skeleton of the anterior extremity shows the forms more clearly than could be done by means of a description, a few remarks only are subjoined here.

In the place where the humerus, radius and ulna come together, the epiphyses are firmly consolidated with the bones, so that it is hardly possible to recognize seams or sutures. The very compact articulation here joining the bones, is still strengthened by connective tissue, so that not only is the junction between those three big bones sufficiently guaranteed, but even the idea of coalescence is suggested.

The lower epiphyses of the ulna and radius have not yet coalesced but exist as disconnected more or less cartilaginous pieces. The great width of the radius and curve of the ulna are both features that also belong to *Balaenoptera musculus* L. Of the proximal part of the ulna the end that points backward when the flipper hangs down shows a rough excrescence, continued by a large cartilaginous part running to a point and having a rearward and downward direction; in the illustration it is shaded a little darker.

The carpus consists of a number of little bones enclosed in a mass of connective tissue which is liable to strong shrinking in desiccation, thereby necessarily modifyng the relative positions of the carpalia. In view of this the sketch of this carpus was made immediately after removing the flesh of this pectoral flipper, so that the figure shows the correct position of the little bones.

As the illustration shows, 7 bony nuclei are distinguishable from the outside but a closer examination of the interior of the flipper-skeleton evokes the idea that immediately on the radial side of the two inferior carpalia, there exist two more separate little bones, bringing up the total to 9.

The metacarpalia do not deviate from the type of the phalanges, being merely somewhat larger.

The digits show a very regular construction as regards the shape of the phalanges. These are firmer and sturdier on the radial side, becoming more flattened on the ulnar side; this then corresponds with the heavier front edge of the breastflipper and the rearward attenuation of this extremity. According to the illustration the formula for the phalanges would be: 4,5,4,4. But it must be taken into account that the terminations of both flippers were damaged, so that very likely one or more terminal phalanges are missing.

The pelvic rudiments (coxae) consist of two symmetrically shaped bones only 45 c.M. long which are accurately each other's specular images and can therefore not be in the least irregular, though this is mostly stated. The picture (fig. 43) represents the interior- and exterior aspect of the dexter pelvic bone. The flat and pointed part of this (upright in the drawing, but whose natural position is forward sligtly tilted upwards) represents the ilium, whilst the thicker lower end represents the ischium and the median knobby and somewhat outwardly arched part stands for the pubis.

On comparing this figure with the corresponding illustration from *Balaenoptera musculus* L., in Weber (7) p. 559, fig. 415 no. 3, showing a great similarity to the pictures after *Balaenoptera physalus* L., given in fig. 1 and 12 p. 150; and fig. 16 and 17, p. 154, in Abel (1), we notice distinctly how the pelvic rudiments in the latter illustrations bear a more elongated character than in the case studied by us. In the Buitenzorg skeleton the pelvis is somewhat heavier and broader, especially because the ilium part is considerably shorter, the termination of the ischium being also rounder and more thickened than in the illustrations referred to.

POSTSCRIPTUM.

After this publication had been completed in December 1918, except the reproduction of the illustrations which proved a tedious process, I recently received for perusal the „Memoirs of the American Museum of Natural History", New Series, Vol. I Part VI, March 1916.

This publication contains two monographs on *Balaenoptera borealis* Lesser by Mr. Roy Chapman Andrews, and Mr. H. von W. Schulte, the latter author treating of the anatomy of a foetus.

It being a young foetus it has to be born in mind that many characters observed in this embryo may be far more primitive and less specialised than the corresponding traits in the adult animal.

Considering that the dentate *Zeuglodon* Owen, an extinct Cetacean, is generally looked upon as one of the ascendants of the living species of Cetaceans, there is no matter for surprise in the fact that teeth are still found in baleen-whales in embryonic stages.

In connection with the fact that the maxillary-articulation was originally designed for mastication, it is quite to be expected that in the embryonal phases the articular processes of the lower jaw, should approximate more closely to the prototype of the whale than is the case in the adult creature.

In the *Balaenoptera*-skeleton at Buitenzorg the length of the inferior maxilla measured externally amounts to 620 c.M., whereas the declining articular extremity is comparatively small.

On page 483 of the Memoirs of the American Museum of Natural History just quoted, the length of the lower-jaw measured externally is stated to be 7,5 c.M., against an height of 1.35 c.M. for the articular extremity. This latter measurement is very great in proportion to the length of the lower-jaw. Moreover the condyle of the processus articularis inclines upwards, and as a result the whole organ approaches more nearly to the primitive maxillary articulation.

From the following words of the author (H. von W. Schulte) it appears however, that a normally functioning articulation is out of the question;

„I could make out no synovial cavities, but the tissue adjacent to the bones was loose and easily stripped off".

The monographs by Messrs. Andrews and Schulte being of a more recent date than the rest of the literature I was in a position to consult, and this carefully edited publication supplying a wealth of materials for demonstration in the shape of numerous photos, it appears to me desirable to point out the following few things in connection with my reflections on the position of the lower maxillary.

The protrusion of the lower-jaw before the upper-maxilla in *Balaenoptera borealis* Lesser, is still clearly perceptible in plate XXXII, figs. 1, 2, 4, 5; and in plate XXXIII figs. 4 & 6, whereas from several illustrations the conclusion is readily derivable, that the depression behind the processus coronoideus is located *before* the eye. Also the great width of the lower-jaw is sufficiently apparent from a few photos.

Attention may also be called to Brehm's own statement, that on the mouth being closed the entire upper-jaw can be contained in the lower-jaw.

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   Memoirs of the American Museum of Natural History. New Series. Volume I, Part VI.

EXPLANATORY INDEX TO ILLUSTRATIONS.

Fig. 1. Lateral and slightly lower aspect of Cranium.

Length .... 612 c.M.
Breadth .... 296 „
Height .... 108 „

2. Dexter zygomaticum (lower surface).

3. Dexter zygomaticum (upper surface).

Length .... 54½ c.M.

4. Sinister tympanicum, showing the side turned towards the os temporale.

Length .... 13 c.M.

5. Nasalia, front aspect.

Length .... 51 c.M.
Breadth .... 33½ c.M. (together, viewed in front).
Breadth 18½ c.M. (together, posterior aspect).
Height .... 43 c.M.

6. Mandibula dextra, lateral view of exterior.

7. Mandibula dextra, lateral view of interior.

Length 620 c.M., measured along the surface of the bone.
Height in the middle 45 c.M.
Apex of the processus coronoideus 83 c.M. from lower edge.

8. Mandibula dextra, viewed from behind and above; the slight curve of the bone is accentuated by the foreshortening.

9. Hyoides, front view.

Length .... 168 c.M. along surface of bone.
Length .... 141 „ in projection.
Height .... 47 „

10. Styloideus, front and back views.

Length .... 71 c.M.
Breadth .... 23 „

11. Atlas or first cervical vertebra; front-view showing articular cups for articulation with occipital condyles.

Breadth .... 83 c.M.
Height .... 51 „

Fig. 12. Atlas, back-view. The expansion of the neural foramen is conspicuous.

13. Epistropheus or axis (2nd cervical vertebra); front view, showing articular surface for articulation with atlas.

Breadth .... 132 c.M.
Height .... 60 „

14. Epistropheus, back view; showing basal end of processus spinosus and the first pair of the so called posterior processus articulares of which only the articular surfaces are developed.

15. Vertebra colli tertia, back view.

Breadth .... 122 c.M.
Height .... 55 „

16. Vertebra colli quarta; back view.

Breadth .... 127 c.M.
Height .... 51 „

17. Vertebra colli quinta; back view.

Breadth .... 122 c.M.
Height .... 55 „

18. Vertebra colli sexta; back view.

Breadth .... 119 c.M.
Height .... 60 „

19. Vertebra colli septima; front view.

Breadth .... 113 c.M.
Height .... 56 „

20. Vertebra thoracis prima, showing the upturned frontal surface of the vertebral centrum. This vertebral body is already more bulky and the articular surfaces before and behind are already more elliptical than in the neck-vertebrae.

Breadth .... 120 c.M.
Height .... 67 „

21. Vertebra thoracis quinta; with the front-surface of the vertebral centrum turned upwards.

Breadth .... 102 c.M.
Height .... 85 „

Fig. 22. Vertebra thoracis nona; with the front-surface of the vertebral centrum turned upwards.

Breadth	124 c.M.	
Height	97 c.M.	
Thick	27 „	

23. Vertebra thoracis tertia, showing the front and the dexter lateral surface of the vertebral body. The front surface of the vertebral body, turned backward in the illustration, is scabrous for the articulation with the epiphysis which was not yet consolidated with it, and being quite loose, has been removed.

Breadth	113 c.M.
Height	67 „

24. Quarta-decima et quinta-decima vertebrae thoracis.

14a	Breadth	134 c.M.	15a	Breadth	135 c.M.
	Height	107 „		Height	109 „
	Thickness	29 „		Thickness	29½ „

25. Vertebra lumbalis tertia, the front surface of the body turned to the left.

Breadth	141 c.M.
Height	122 „
Thickness of body	38 „

26. Vertebra caudalis quinta, the front-surface of the body turned to the left.

Breadth	81 c.M.
Height	108 „
Thickness of body	35 „

27. Vertebrae caudales septima et octava.

7a	Breadth	75 c.M.	8a	Breadth	66 c.M.
	Height	88 „		Height	78 „
	Thickness	34½ „		Thickness	33 „

28. Vertebrae caudales decima et undecima.

10a	Breadth	59 c.M.	11a	Breadth	54 c.M.
	Height	65 „		Height	59 „
	Thickness	32½ „		Thickness	31 „

Fig. 29. Vertebrae caudales decima et undecima, viewed from below, where there are visible the caudal canal, the haemapophyses and the articular facets connecting these bones with the under-side of the vertebral centrum.

30. Vertebrae caudales quarta-decima et quinta-decima.

14a	Breadth	42 c.M.	15a	Breadth	39 c.M.
	Height	47 „		Height	46 „
	Thickness	28 „		Thickness.........	27 „

31. Vertebrae caudales sexta decima, septima decima et duodevicesima;

16a	Breadth..	35 c.M.	17a	Breadth...	31 c.M.	18a Breadth...	30 c.M.
	Height ..	43 „		Height....	39 „	Height....	32 „
	Thickness	21 „		Thickness	16 „	Thickness	13 „

32. Vertebrae caudales undevicesima — vicesima-septima.

	19a	20a	21a	22a	23a	24a	25a	26a	27a
Breadth	26	23	20	18	16	14	11	8	6 c.M.
Height	26	23	21	19	16	14	10	7	5 „
Thickness	12	11	11	10	9	8	7	6	4 „

The 22nd caudal vertebra marked × has been drawn again in the right-hand top corner, so as to bring out the front and inferior surfaces.

33. Haemapophyses decimae.

1. side aspect, showing the somewhat anteriorly curved distal end.
2. rear aspect, showing the arch bridging the caudal canal.
3. seen partly from above, showing the articular processes for articulation with the vertebral body.

34-36. Costae sinistrae no. 1, 2, 3, 5, 7, 11, 13, 14 and 16: exterior surface. The lengths measured along the bone-suface are resp:

1st	185 c.M.	9th	314 c.M.
2nd	223 „	10th	301 „
3nd	288 „	11th	287 „
4th	307 „	12th	271 „
5th	326 „	13th	259 „
6th	328 „	14th	238 „
7th	329 „	15th	220 „
8th	325 „	16th	227 „

Fig. 37. Sternum, front aspect.

Breadth .... 62 c.M.
Height .... 51 „

38. Schematic representation of the connection between the sternum and the lower extremities of the first pair of ribs; freely rendered after Struthers.

39. Scapula sinistra; lateral aspect showing the exterior surface.

Breadth .... 165 c.M.
Height .... 107 „

40. Scapula sinistra, showing the interior surface reposing against the ribs.

41. Upper part of breast-flipper; lateral view, showing the exterior surface.

Humerus length .... 69 c.M.
Radius length .... 121 „
Ulna length .... 126 „

42. Lower part of breast flipper, exterior view; metacarpalia:

1st metacarpal .... 28 c.M.
2nd metacarpal .... 35 „
3rd metacarpal .... 29 „
4th metacarpal .... 18 „

Length of 2nd digit + 2nd metacarpal = 128 c.M.

43. Rudiment of dexter half of pelvis; lateral view showing exterior and interior surfaces.

Length .... 45 c.M.

44. Penis.

Length .... 180 c.M.
Girth round basis ... 40 „

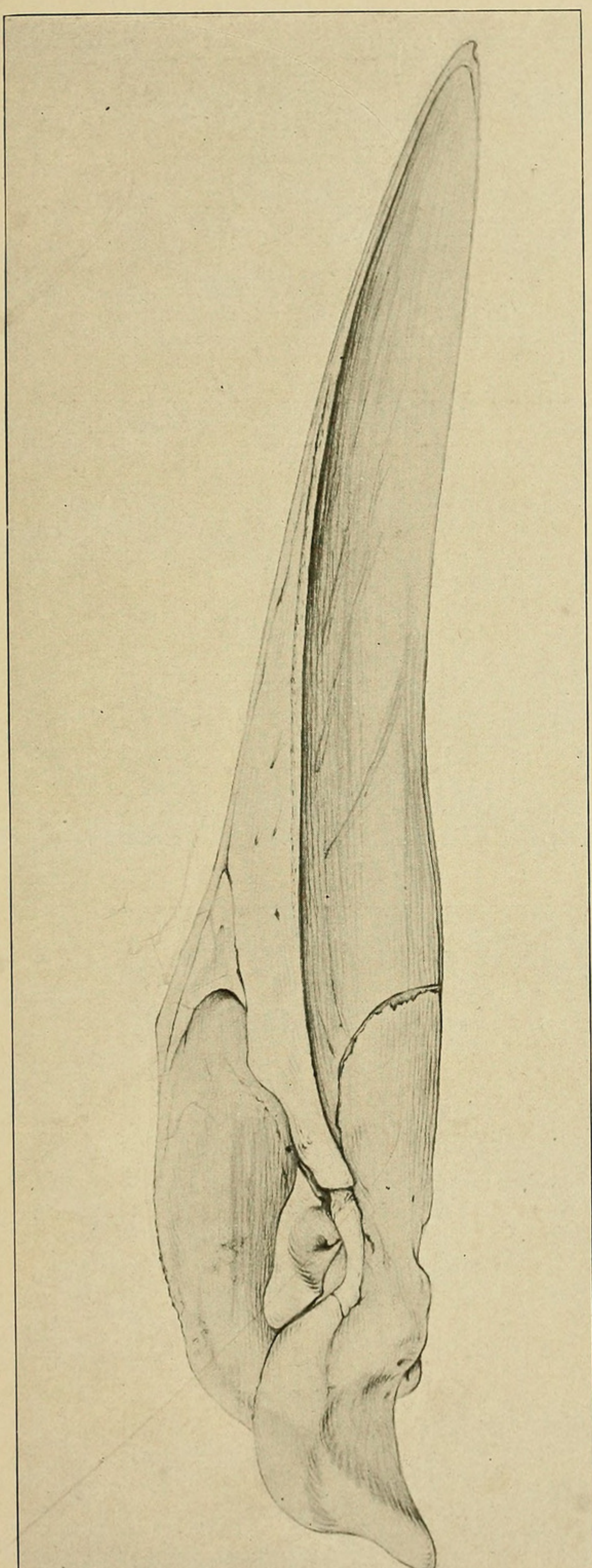
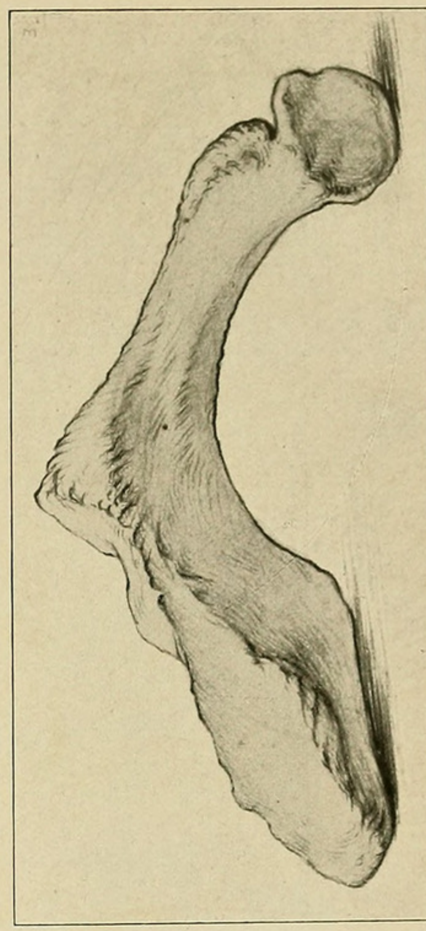


Fig. 1.



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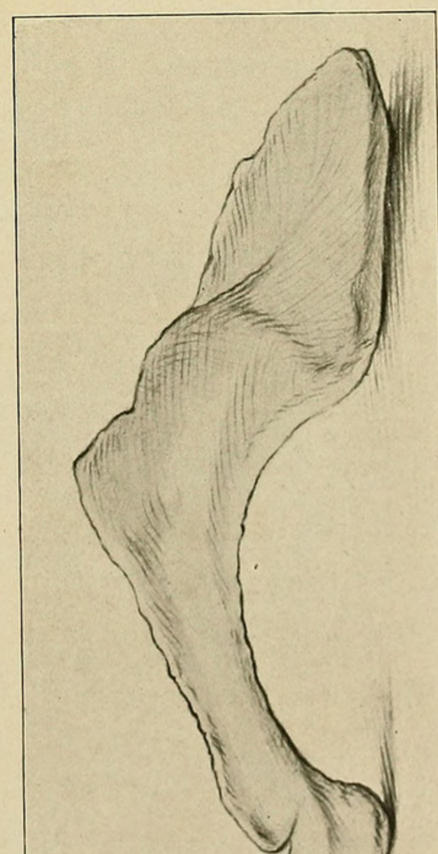

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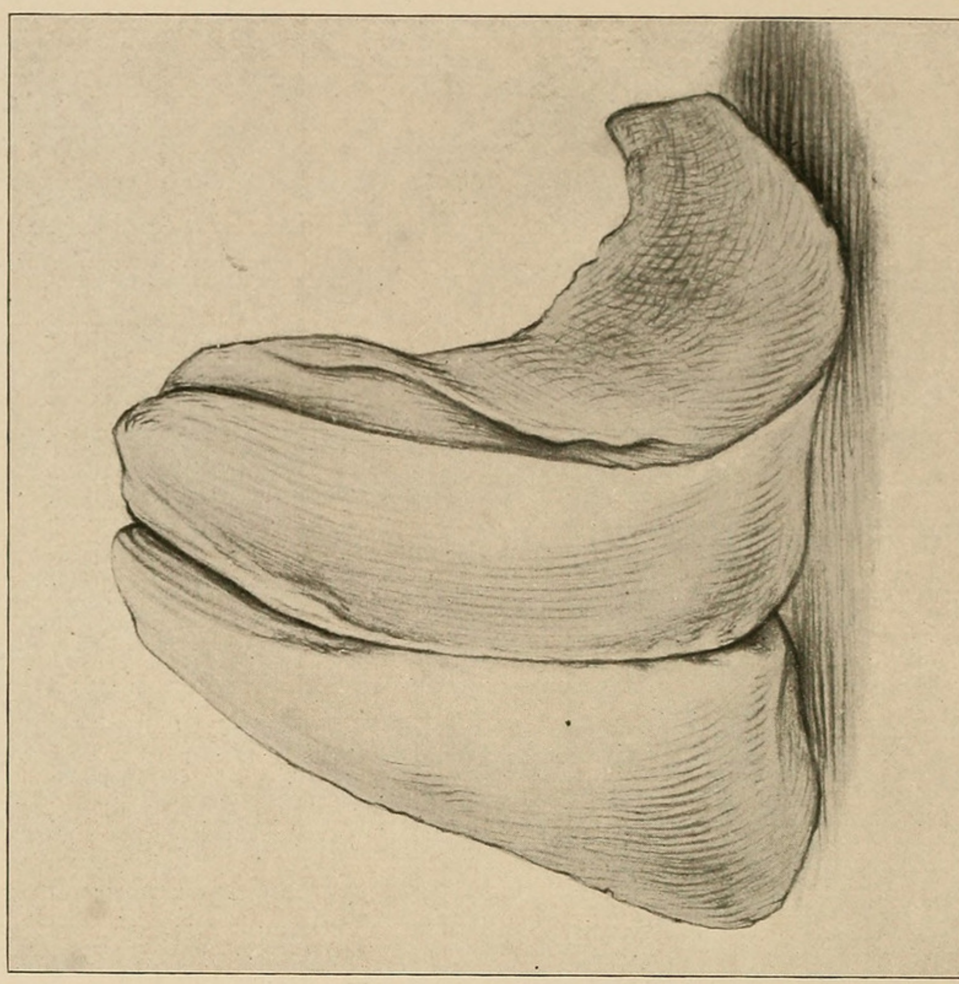

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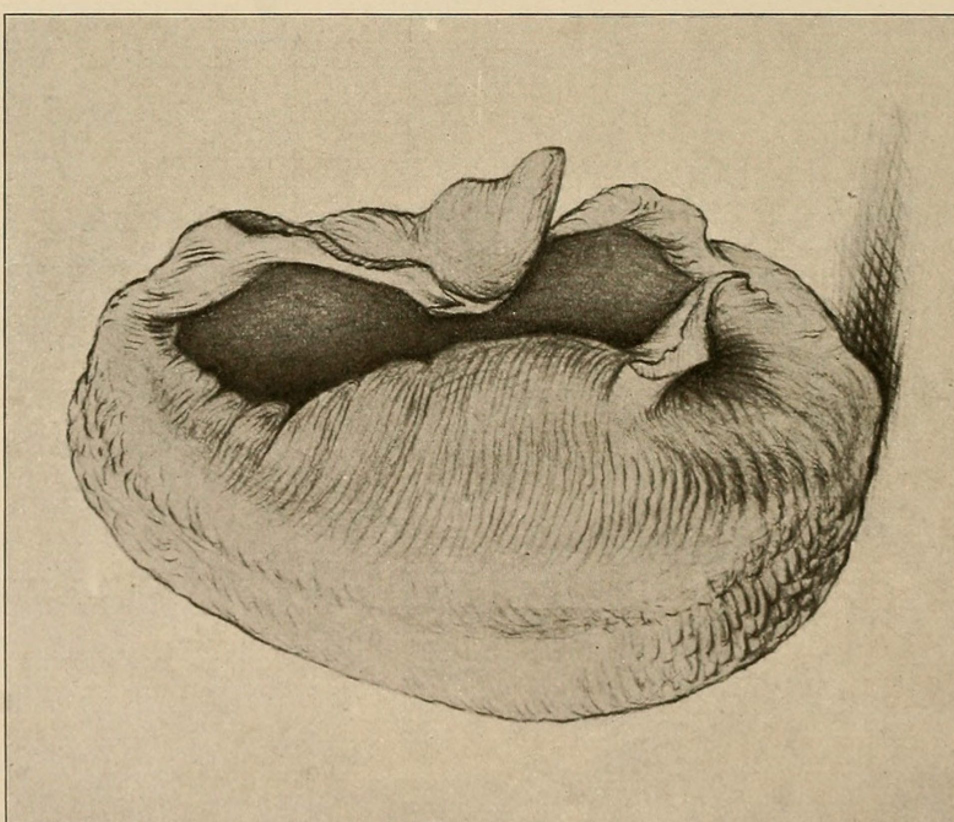

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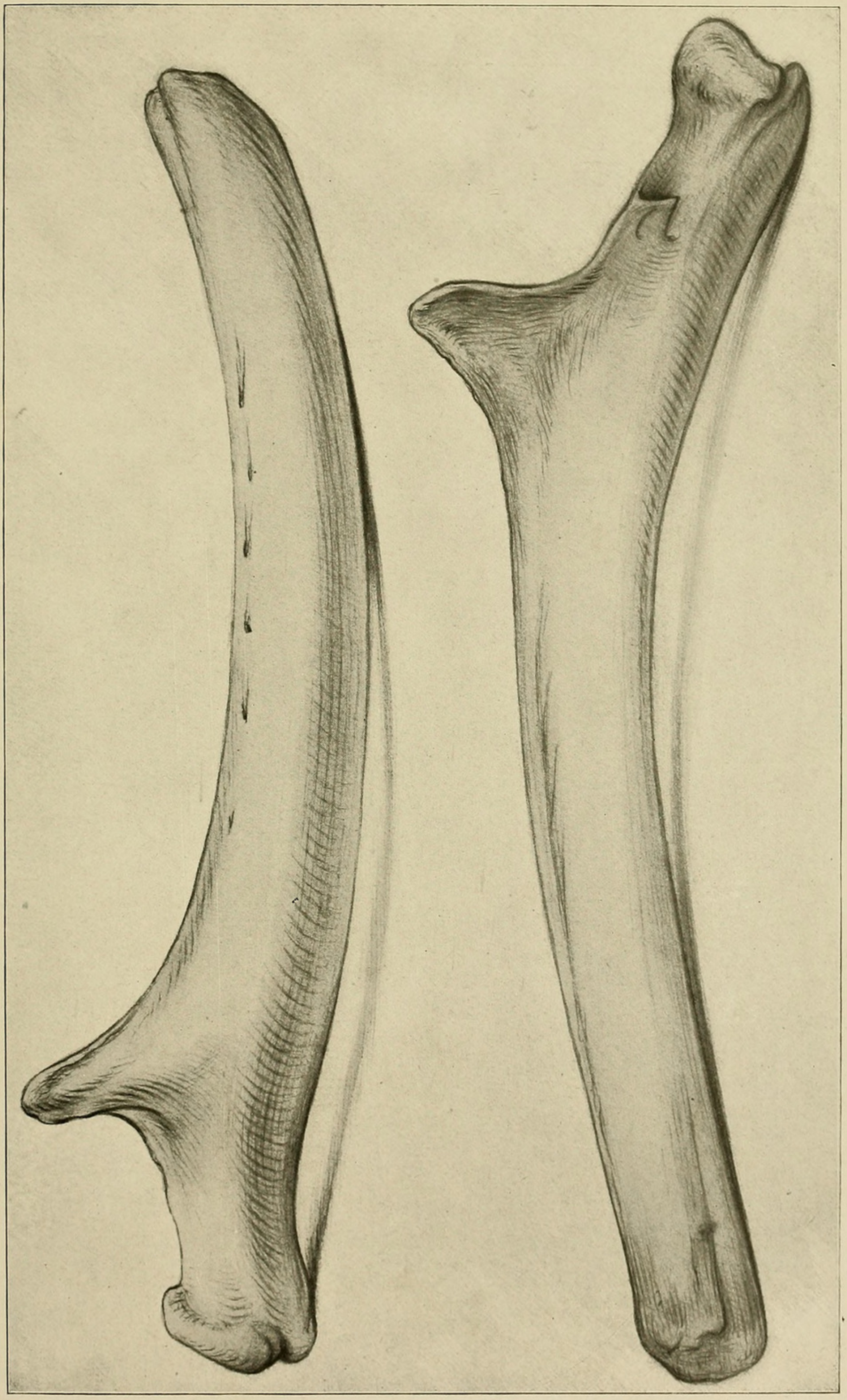

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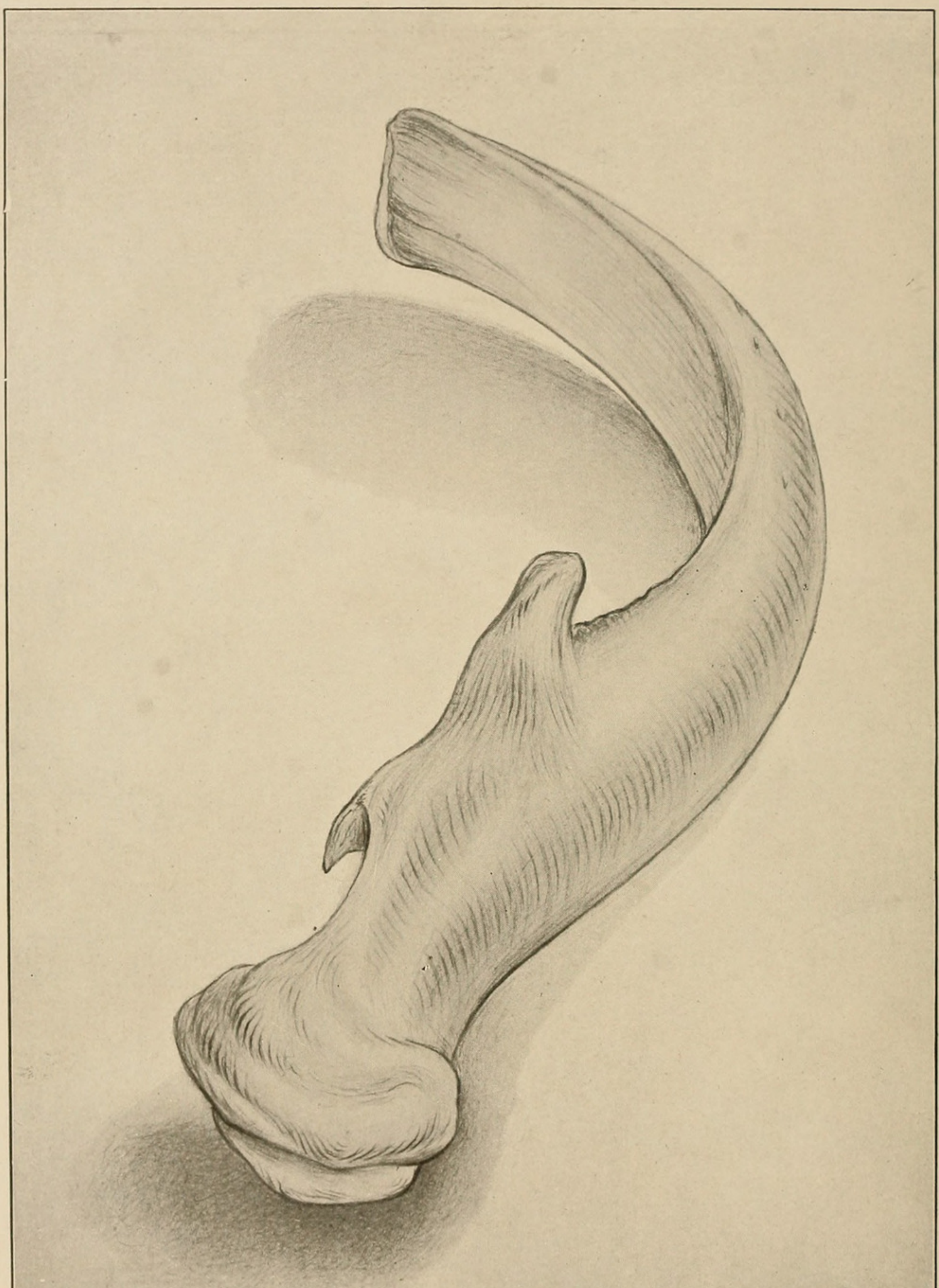

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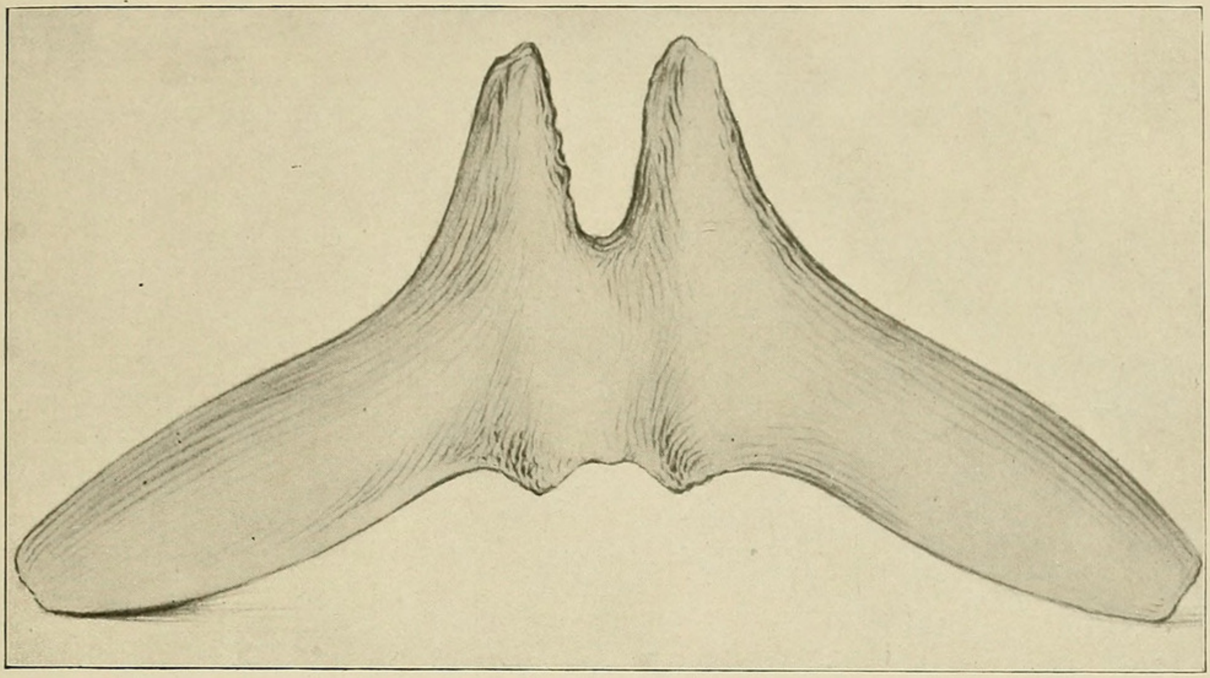

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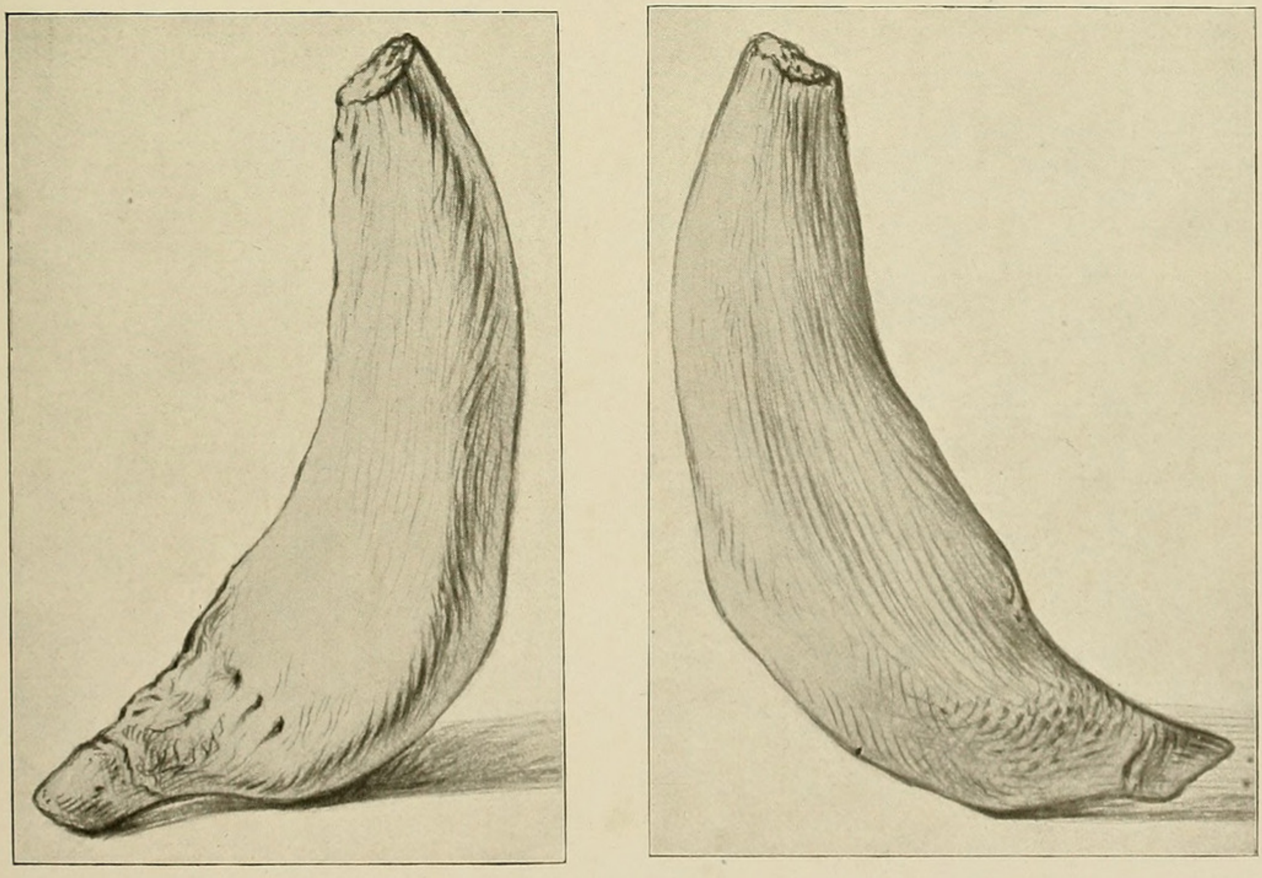

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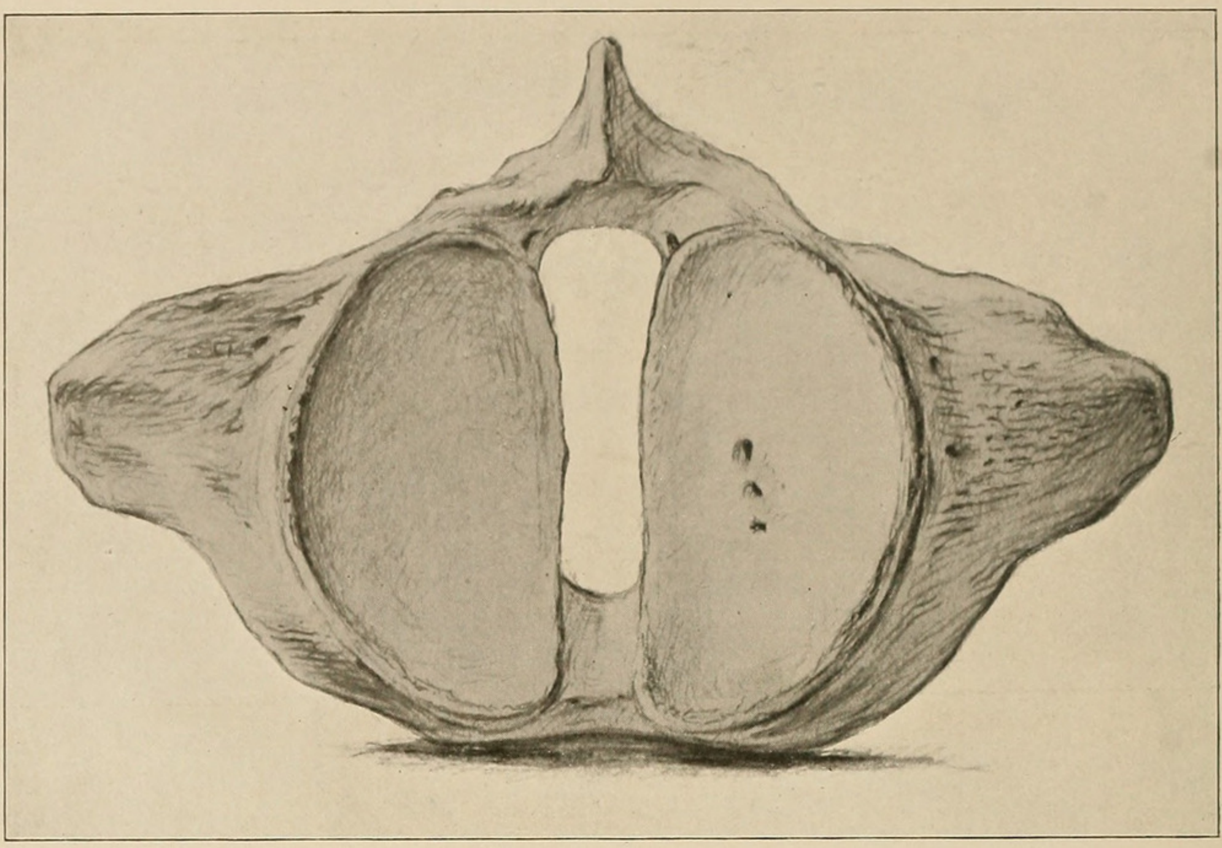

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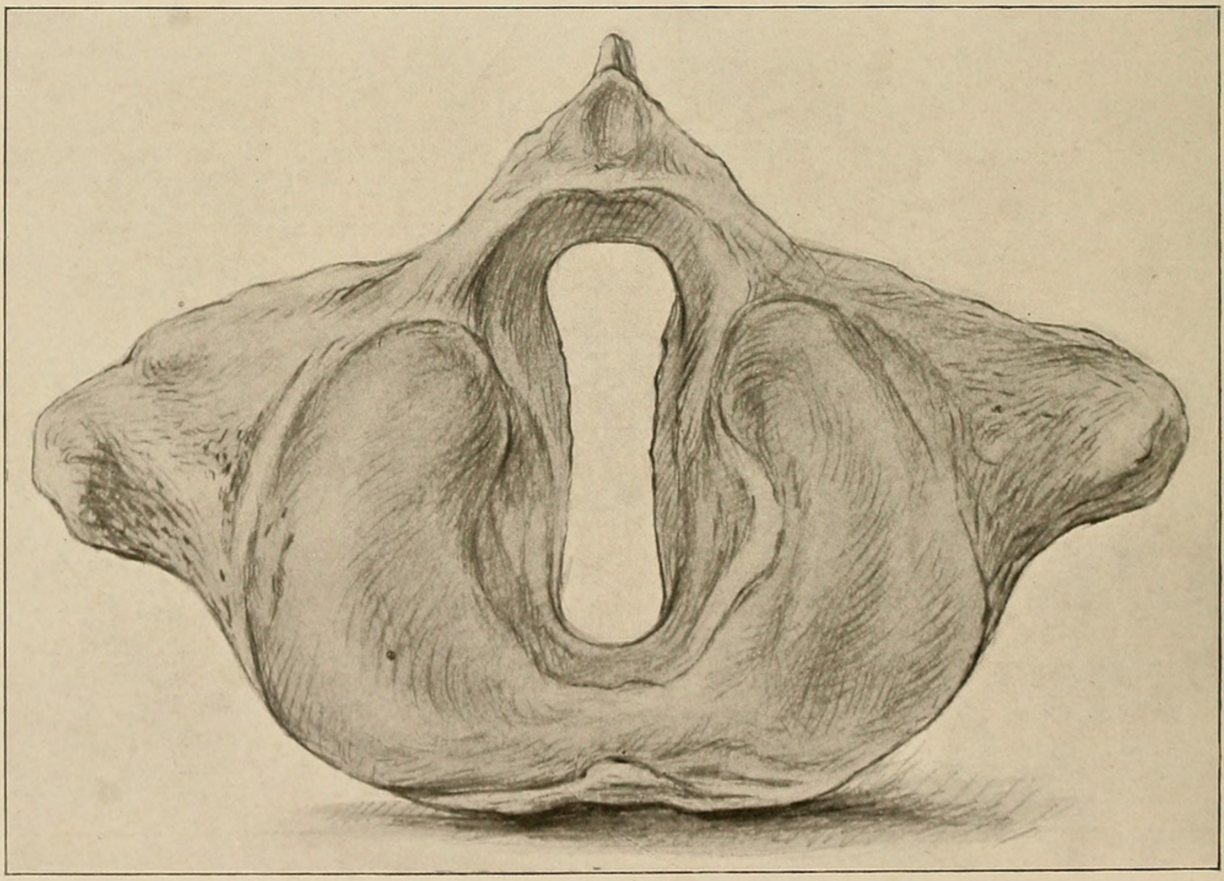
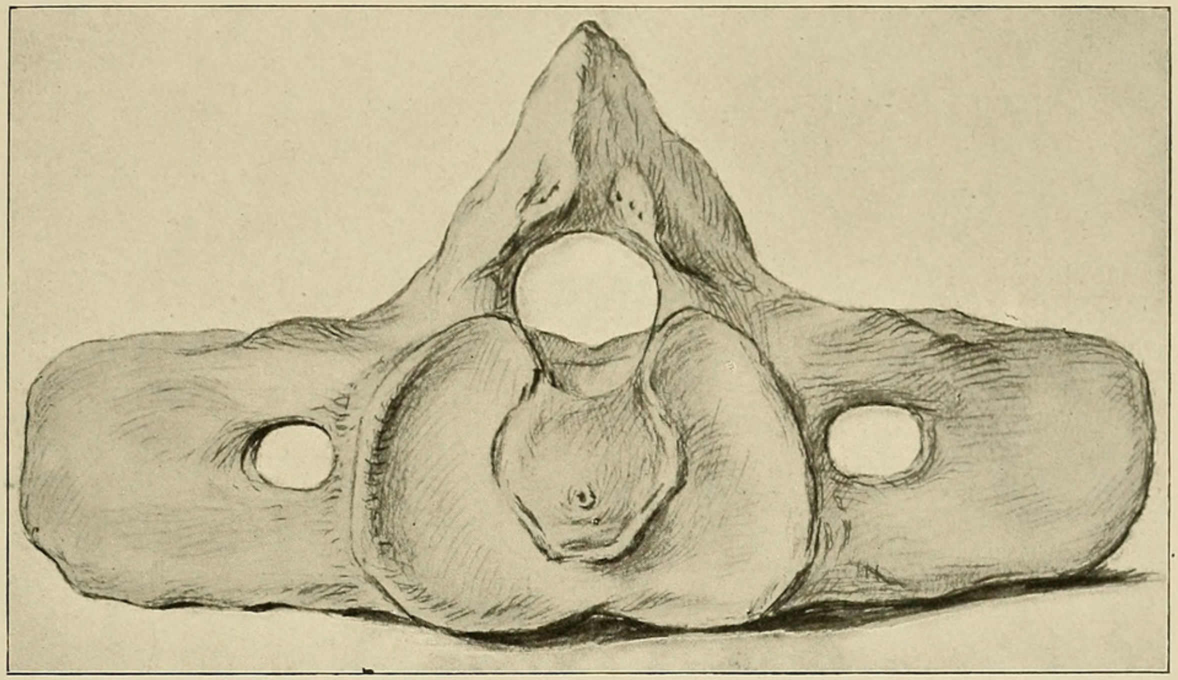


Fig. 12.



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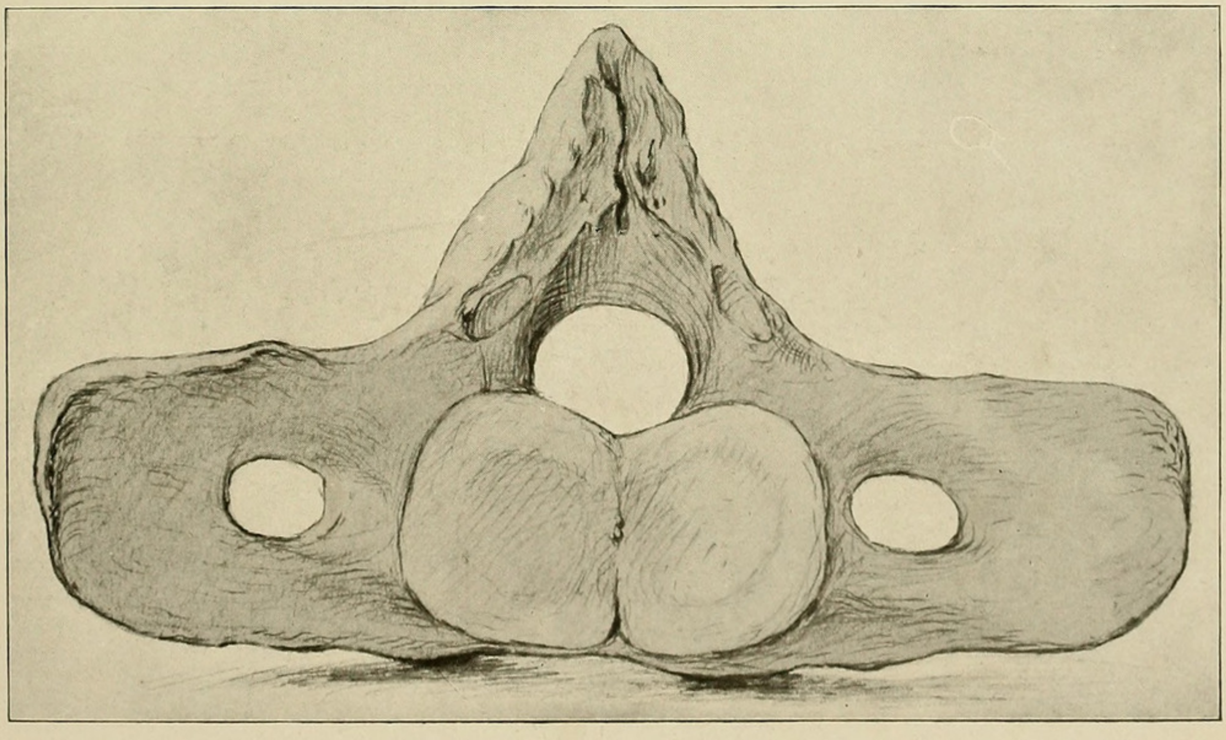

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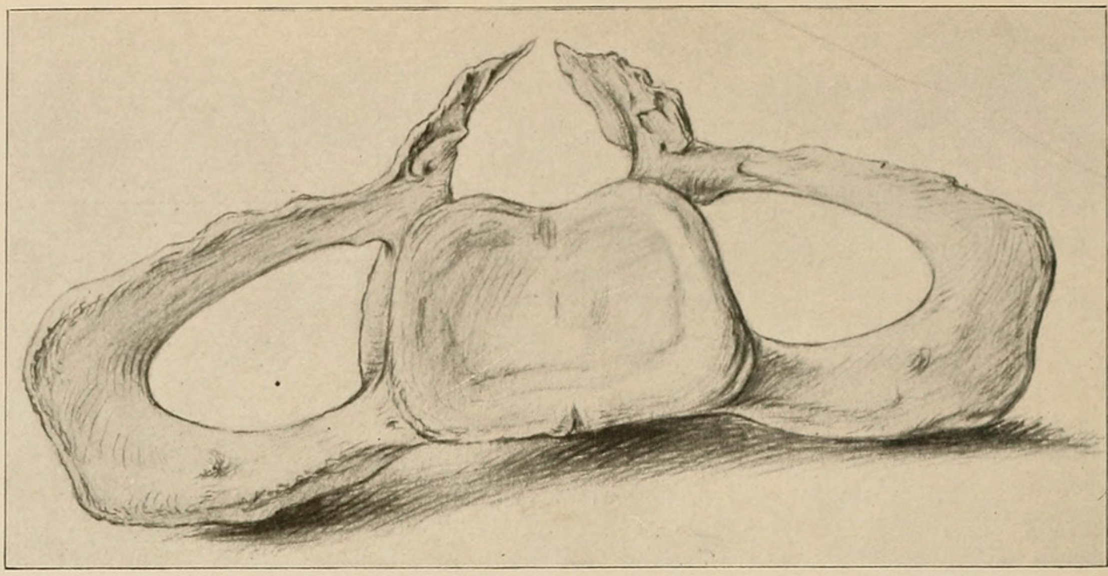

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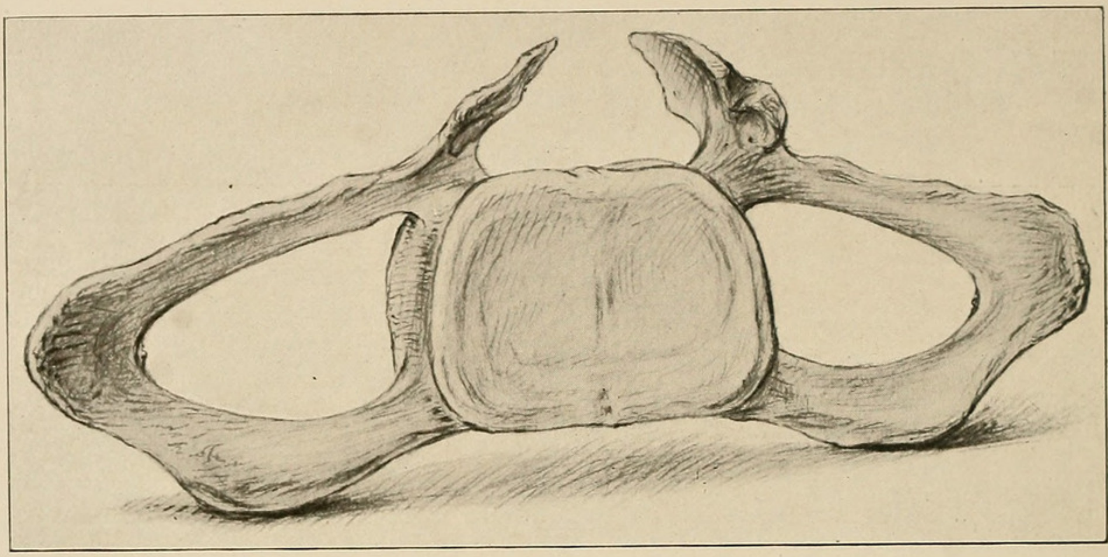

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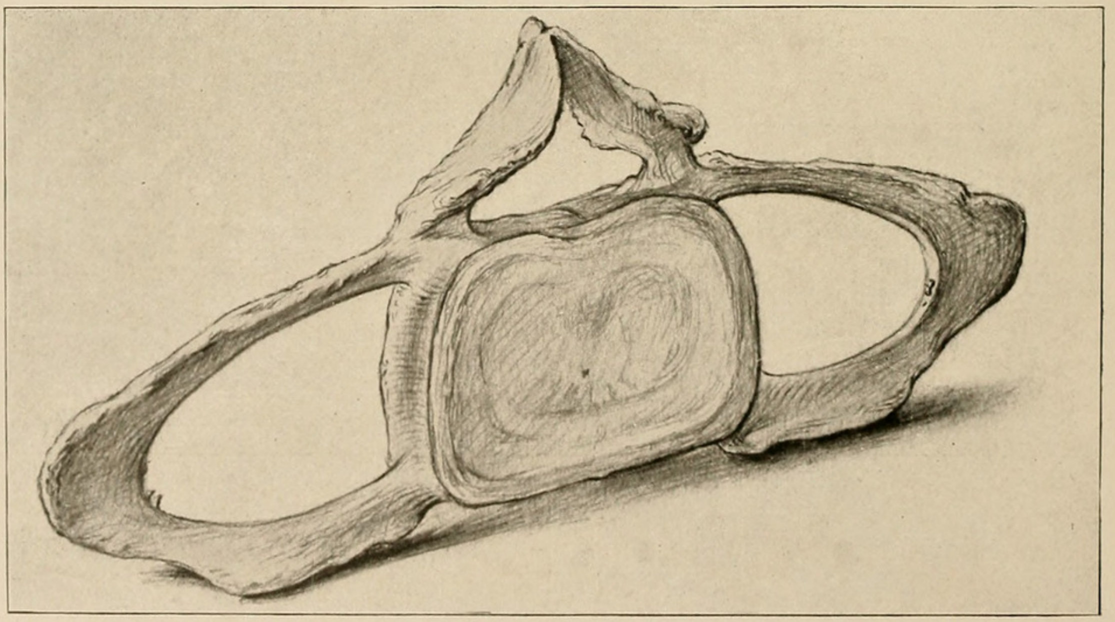

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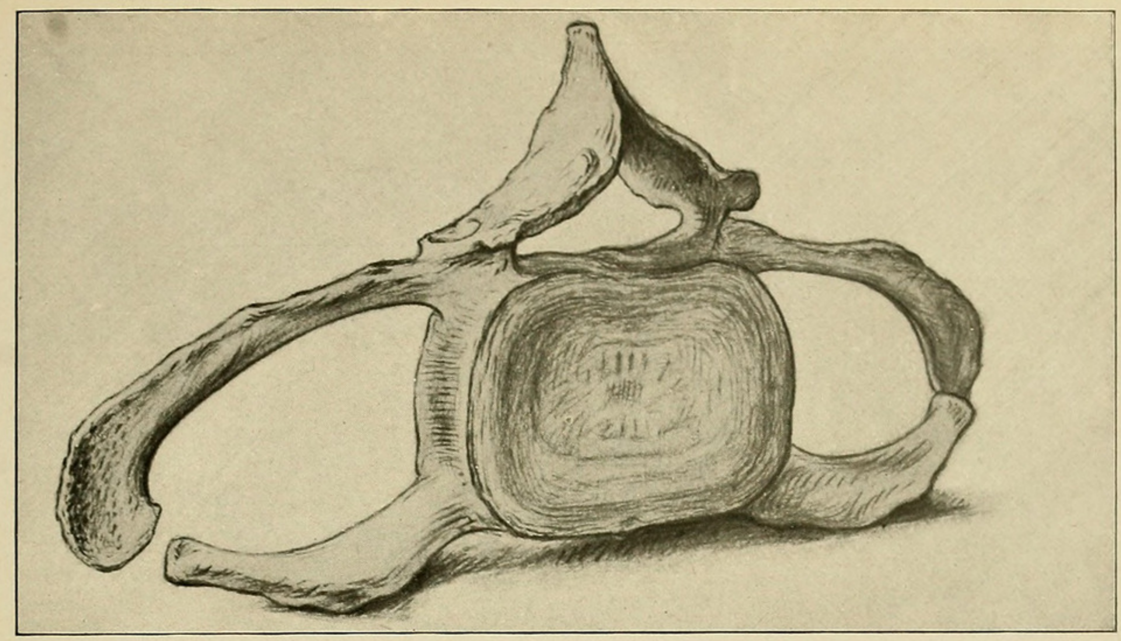

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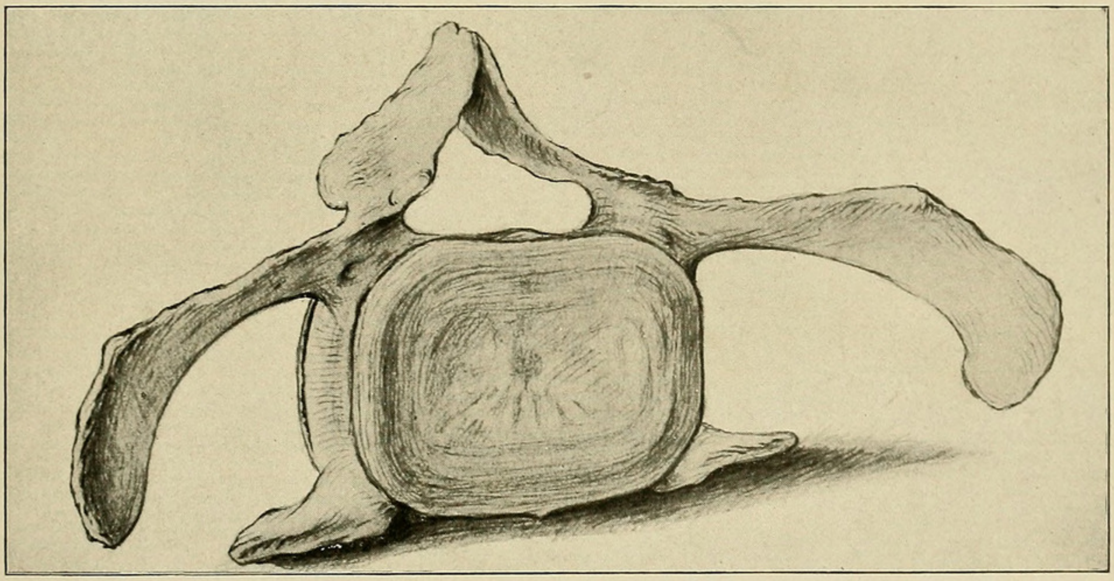

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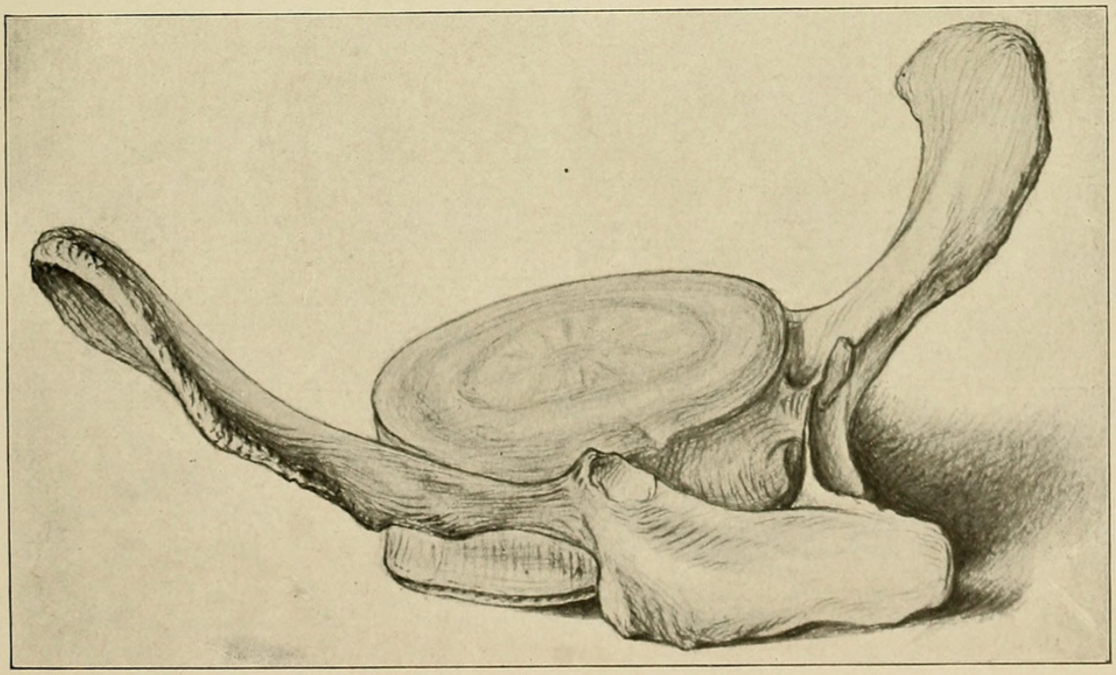

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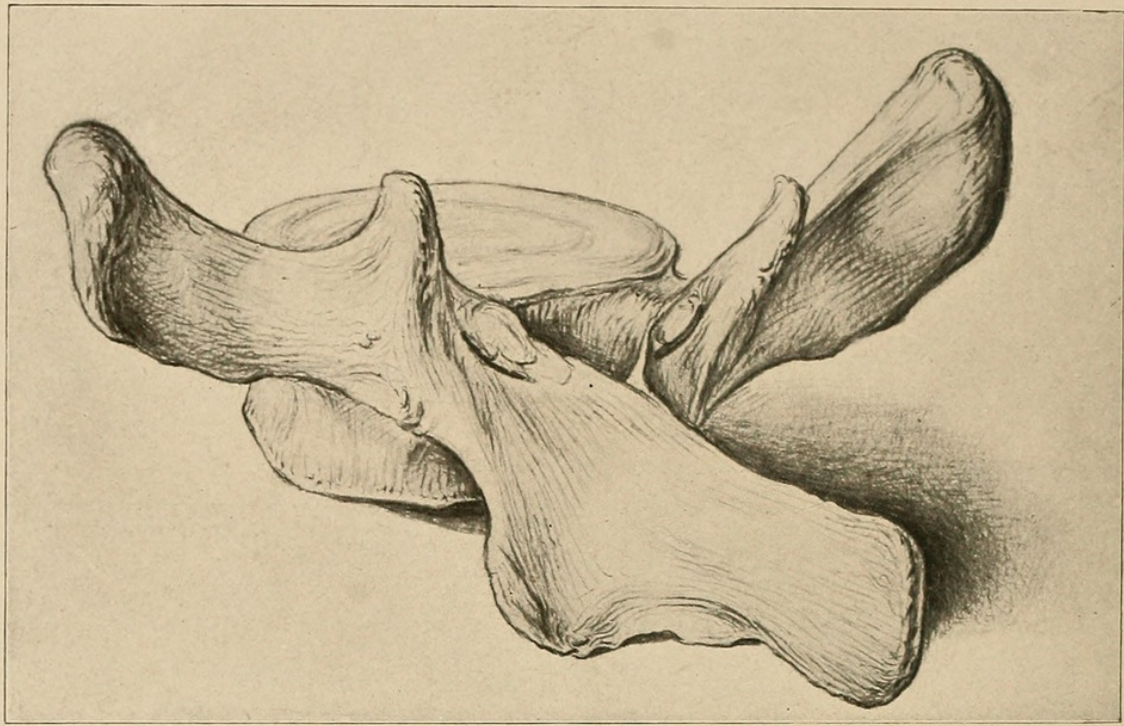

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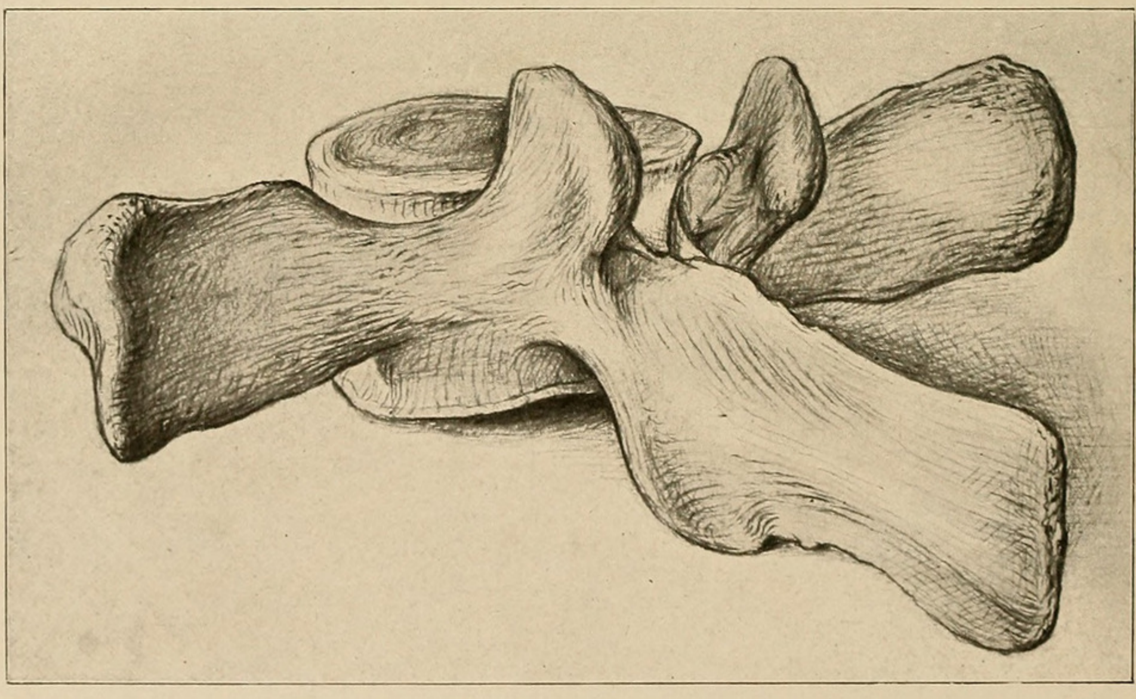

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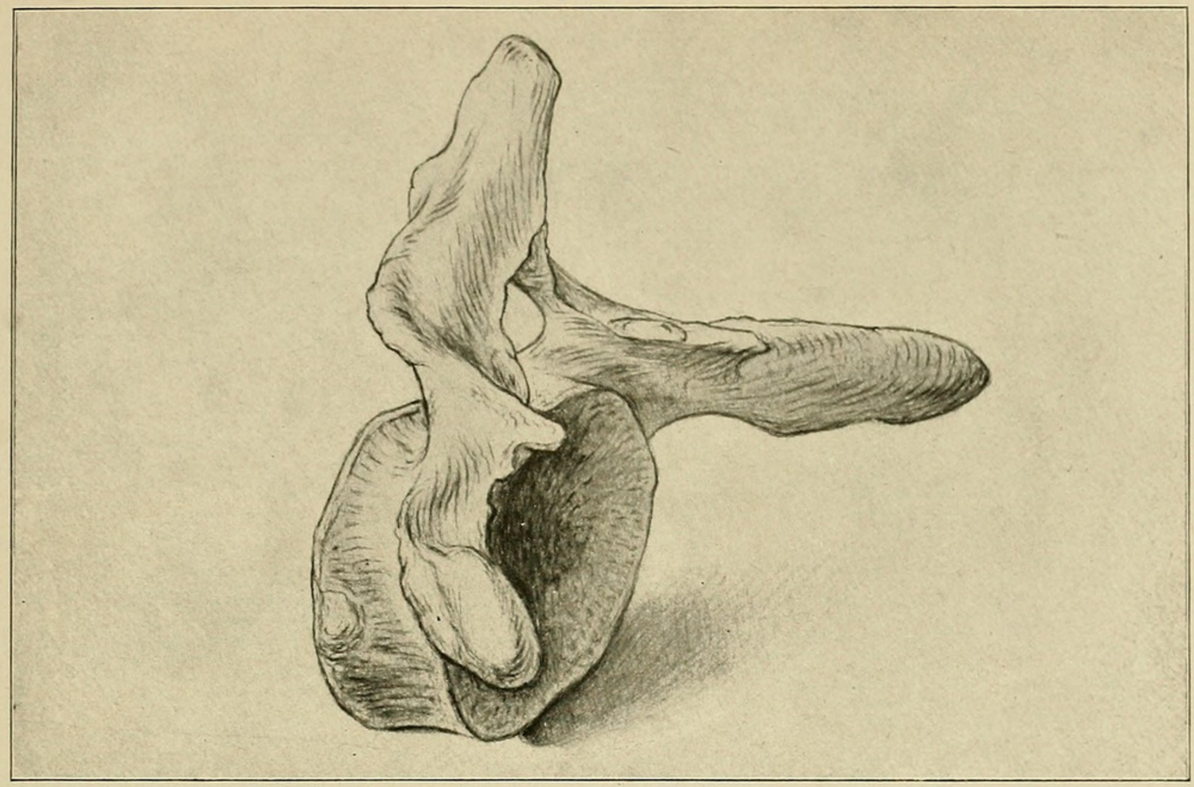

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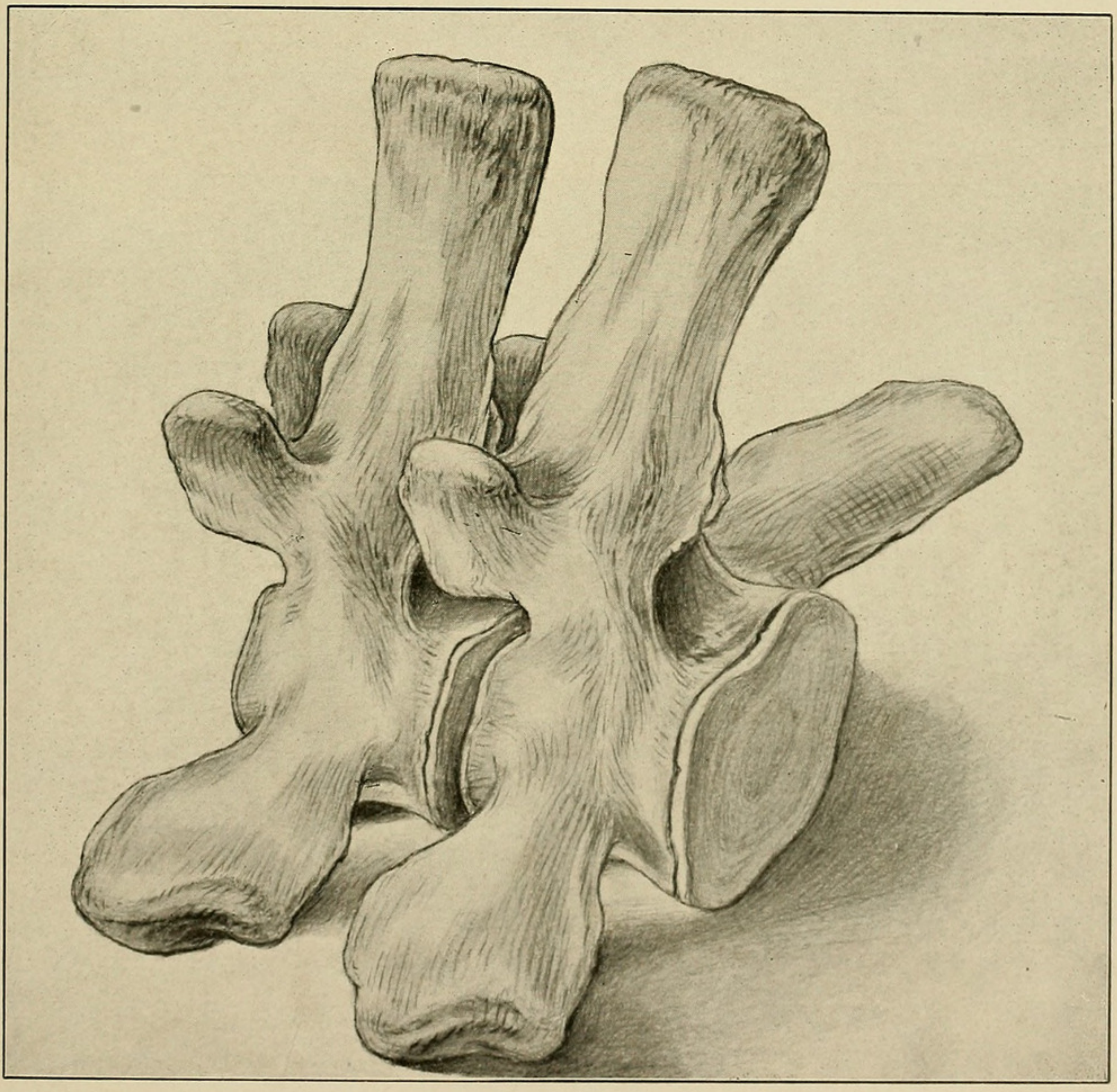

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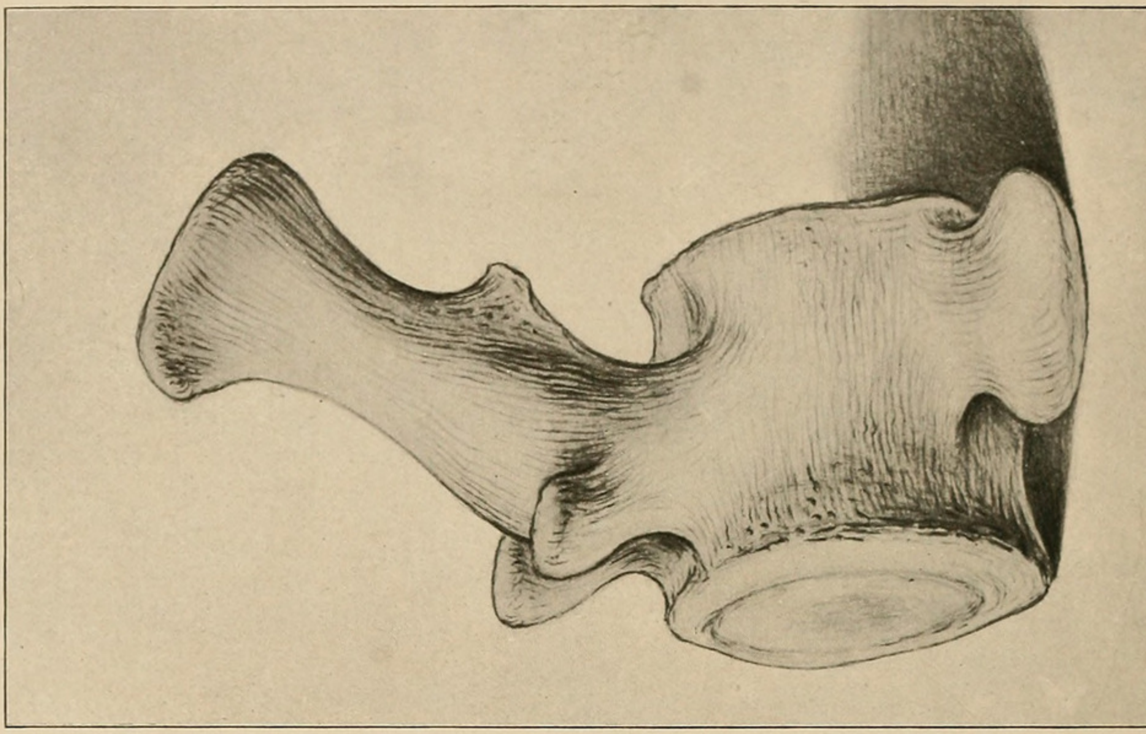

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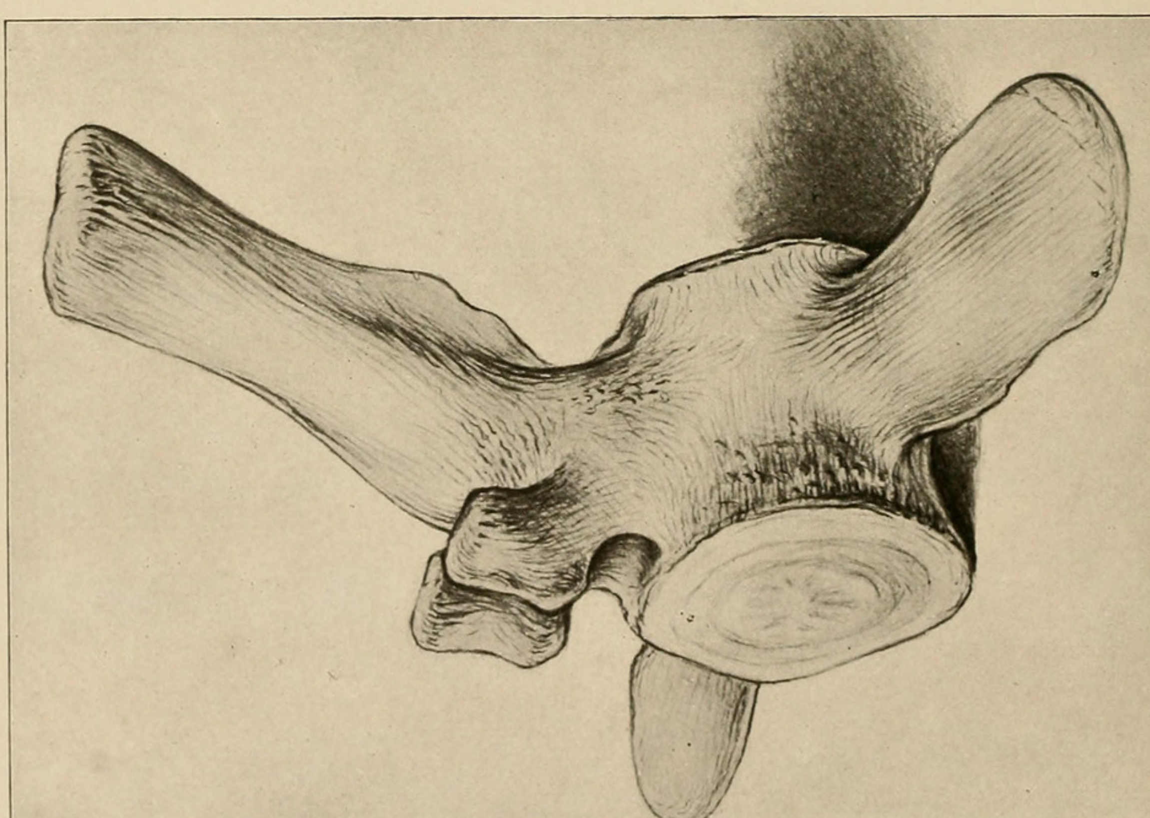

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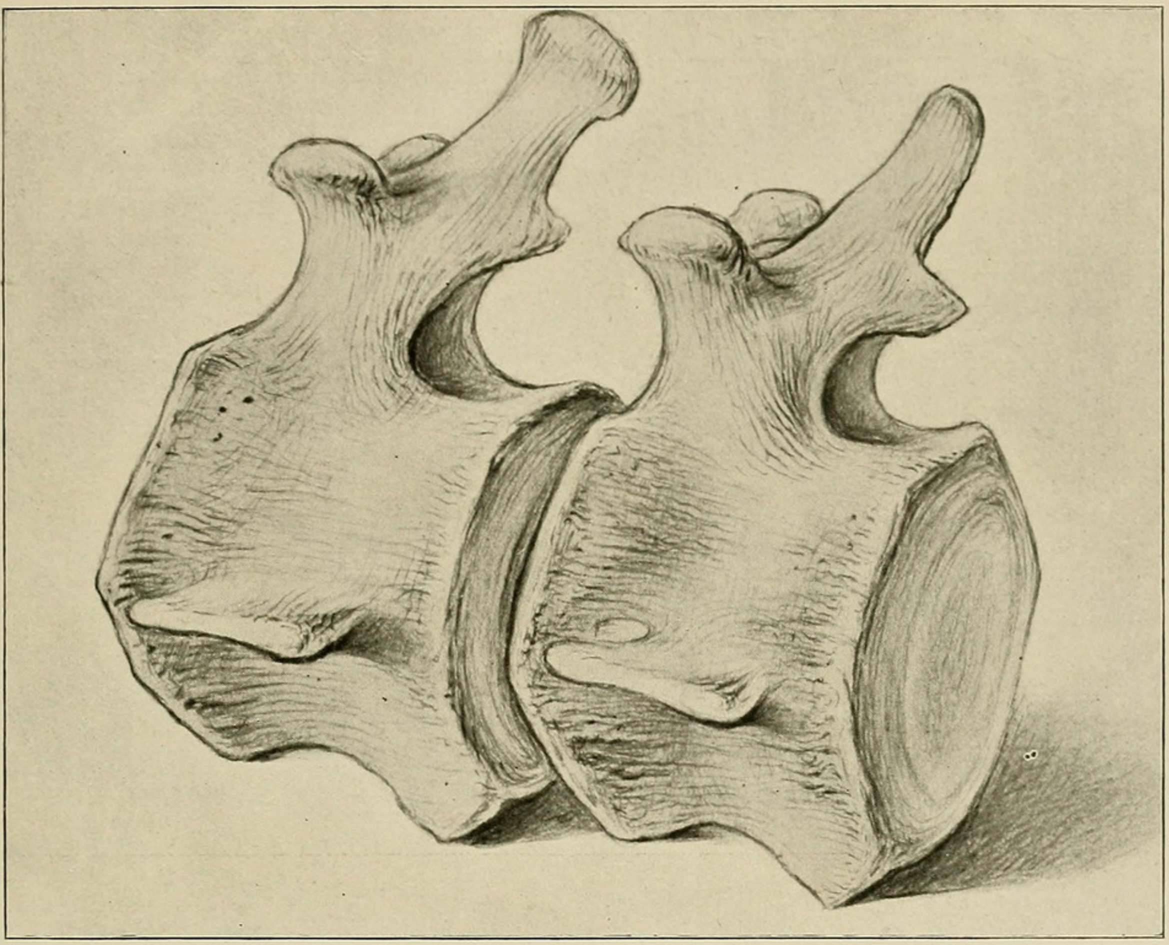

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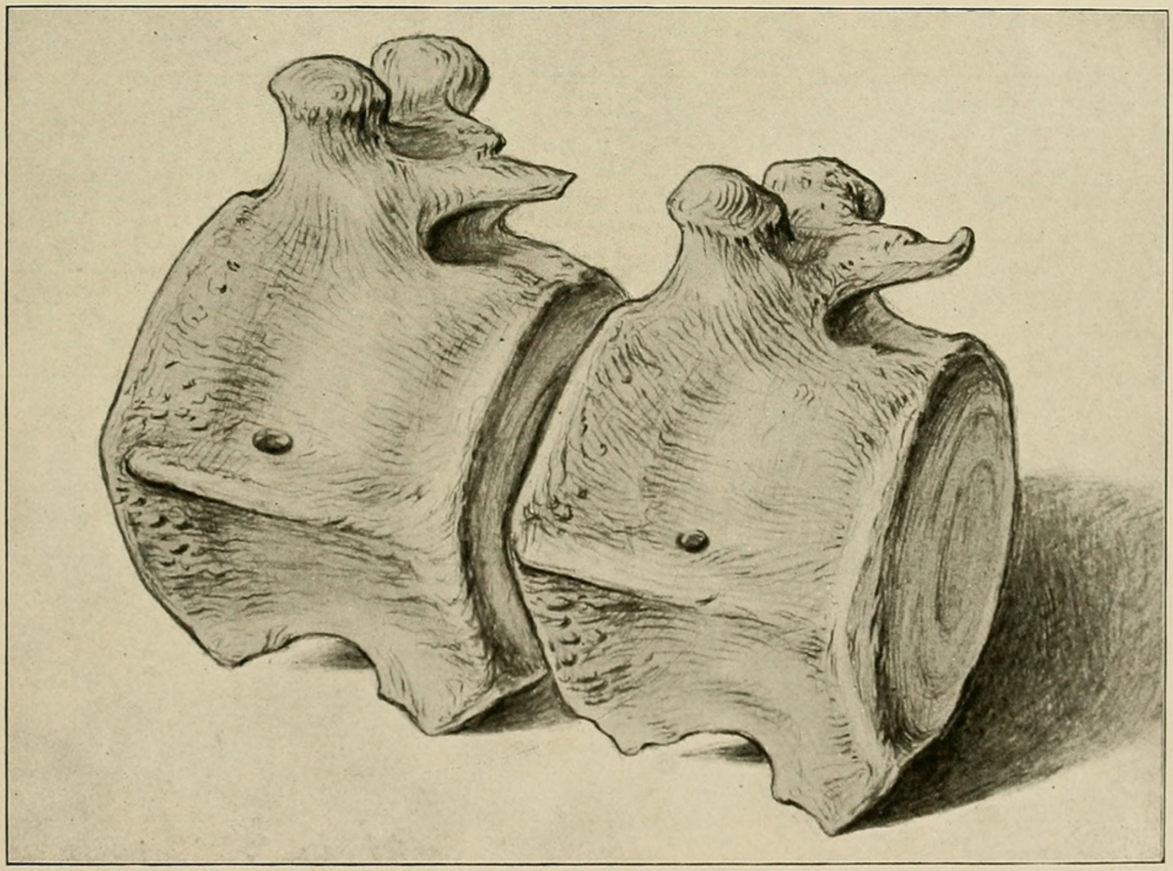

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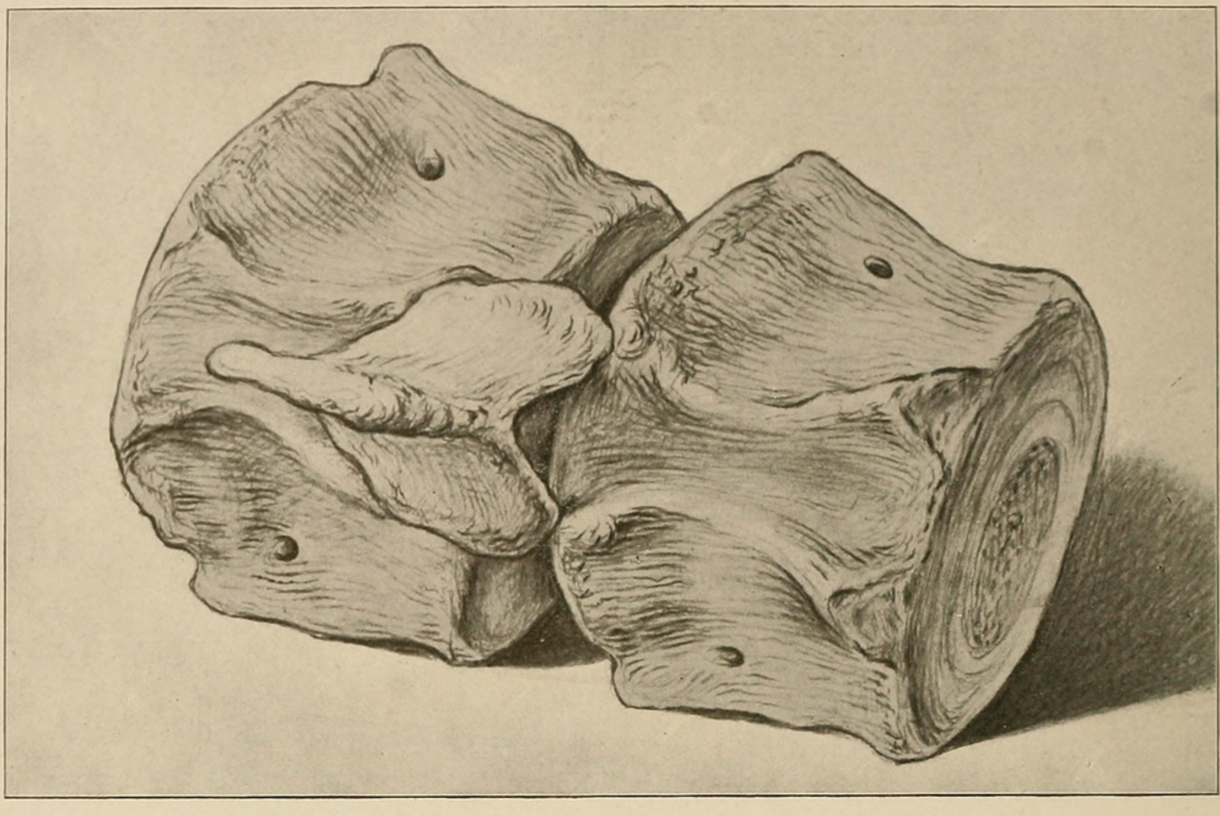

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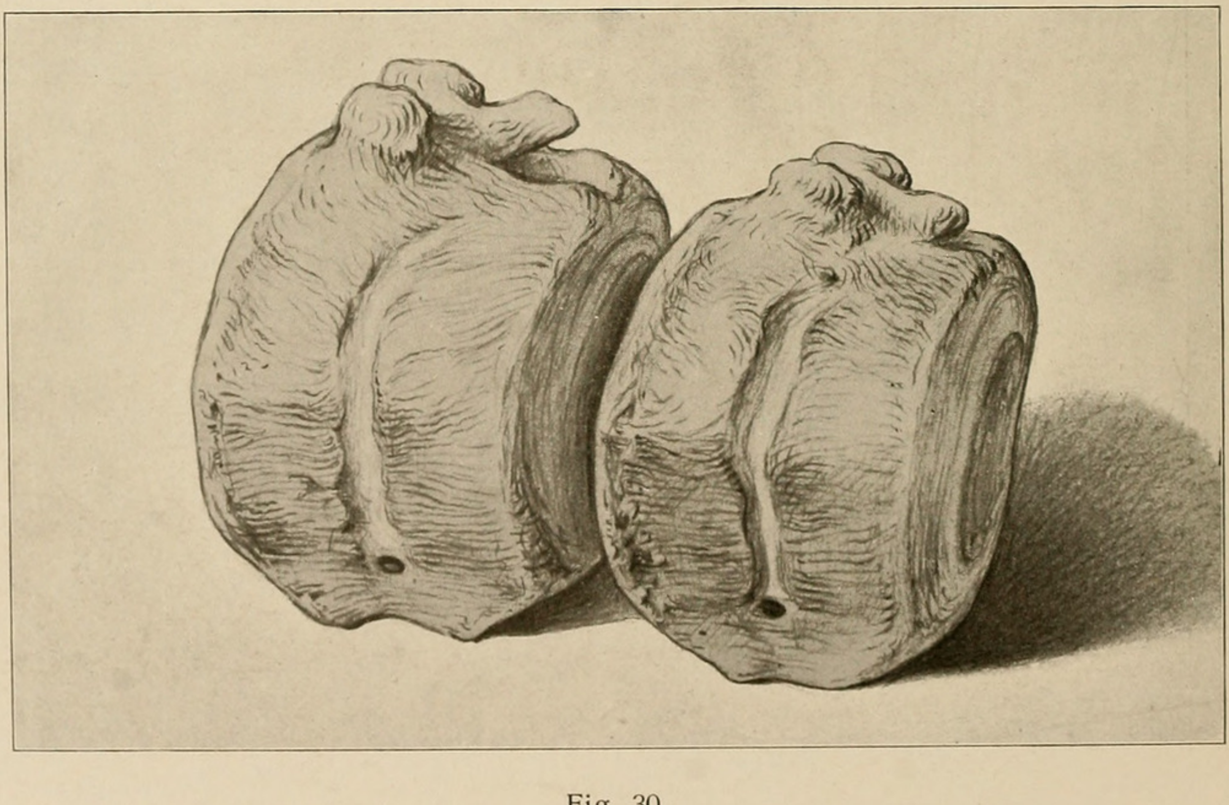

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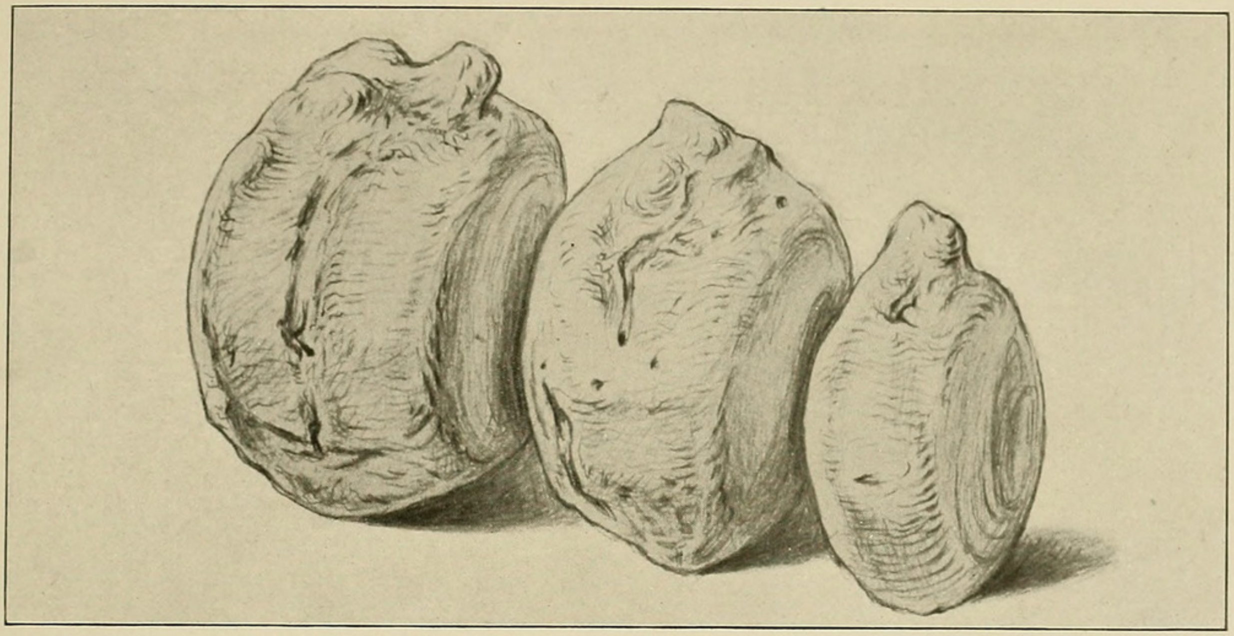

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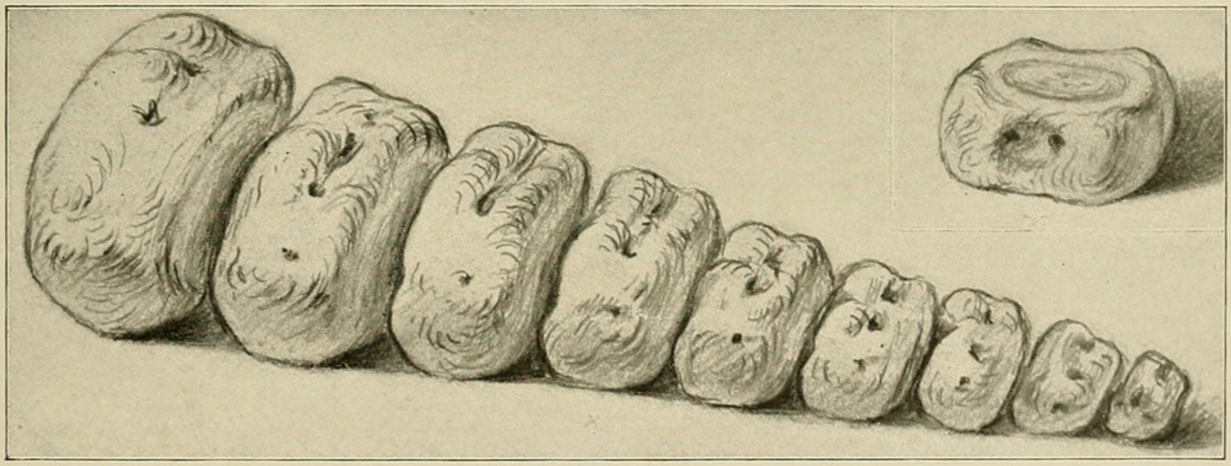

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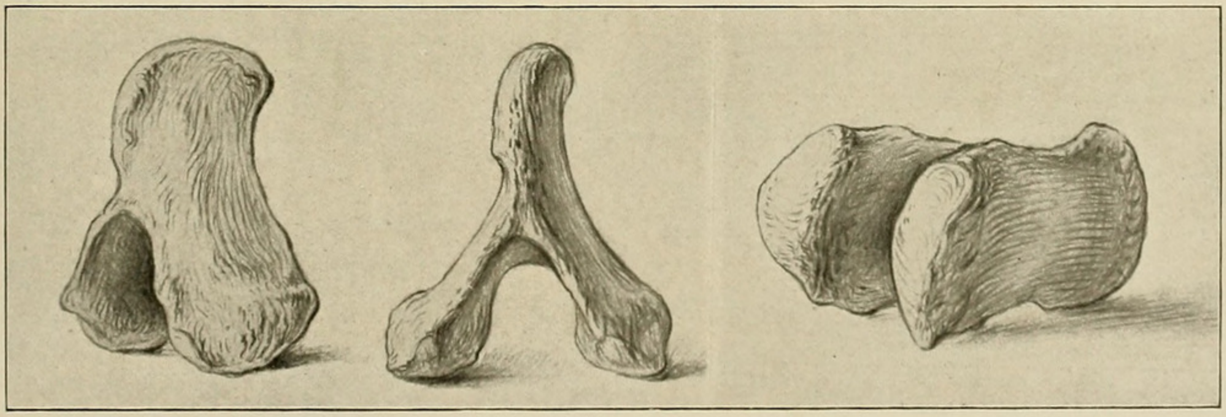

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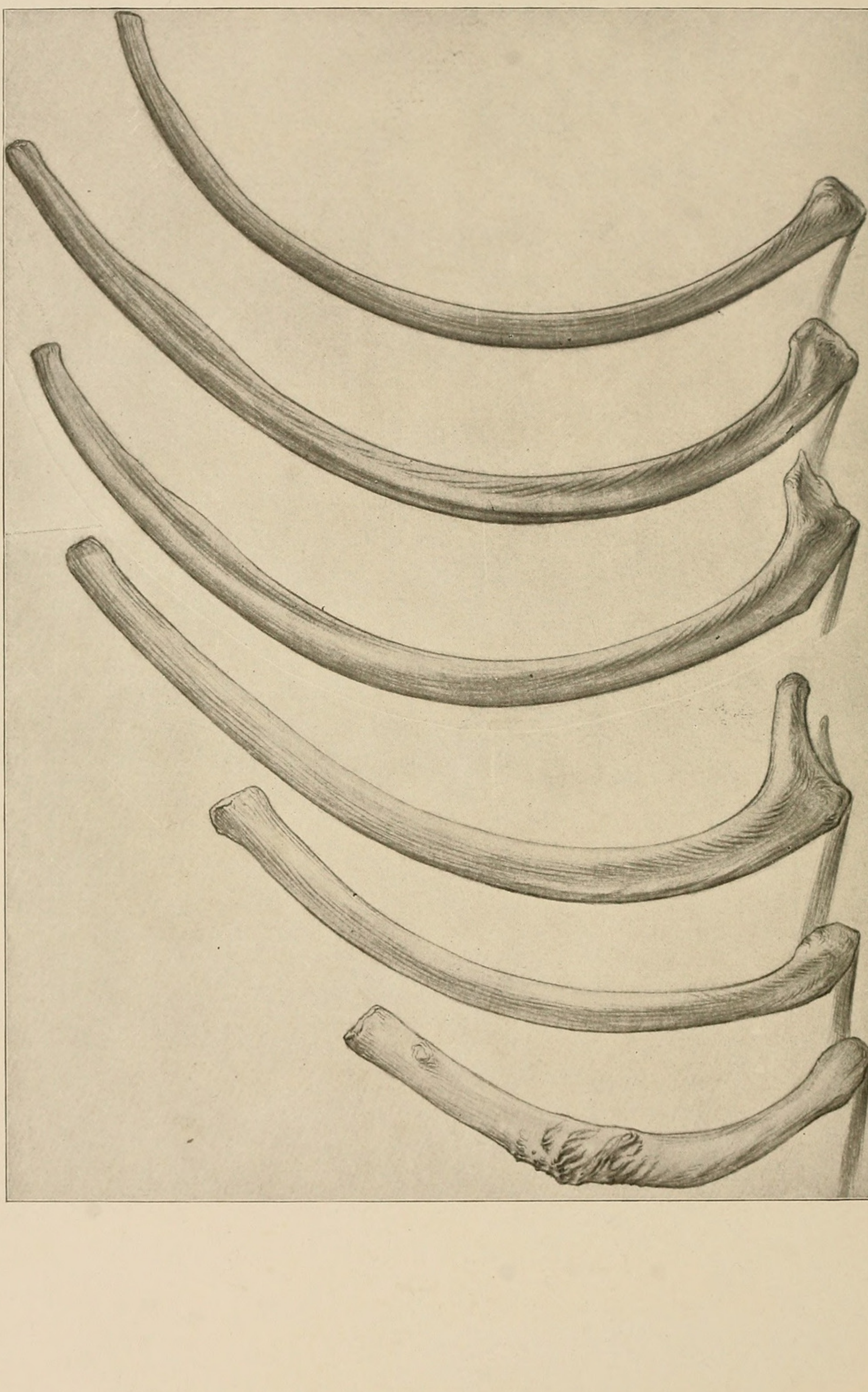

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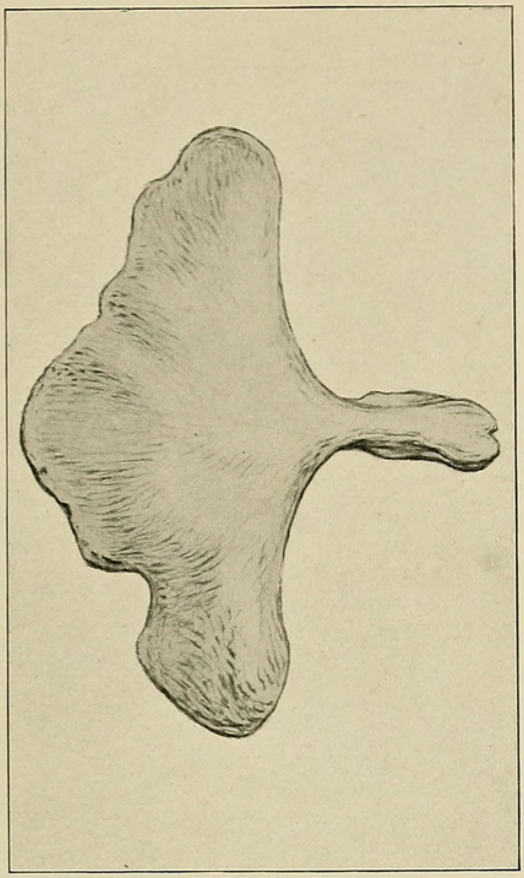
Fig. 34. Fig. 35.



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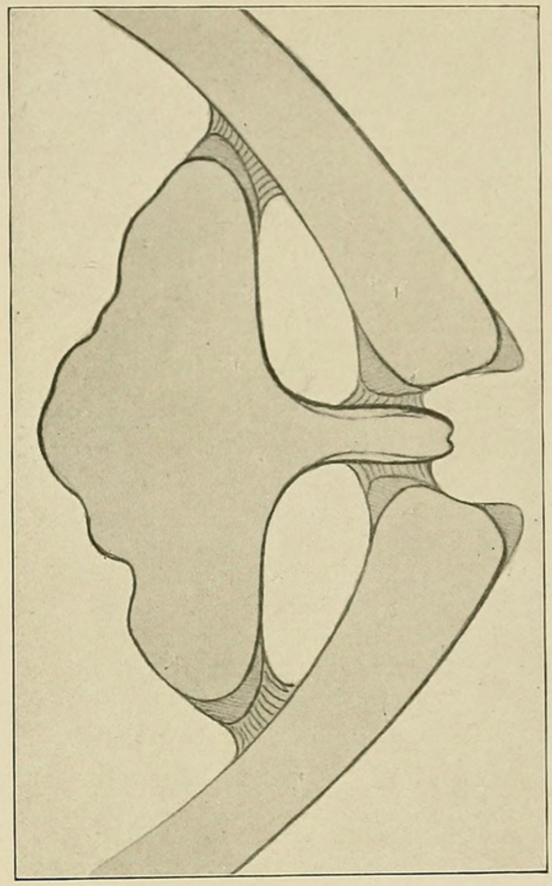

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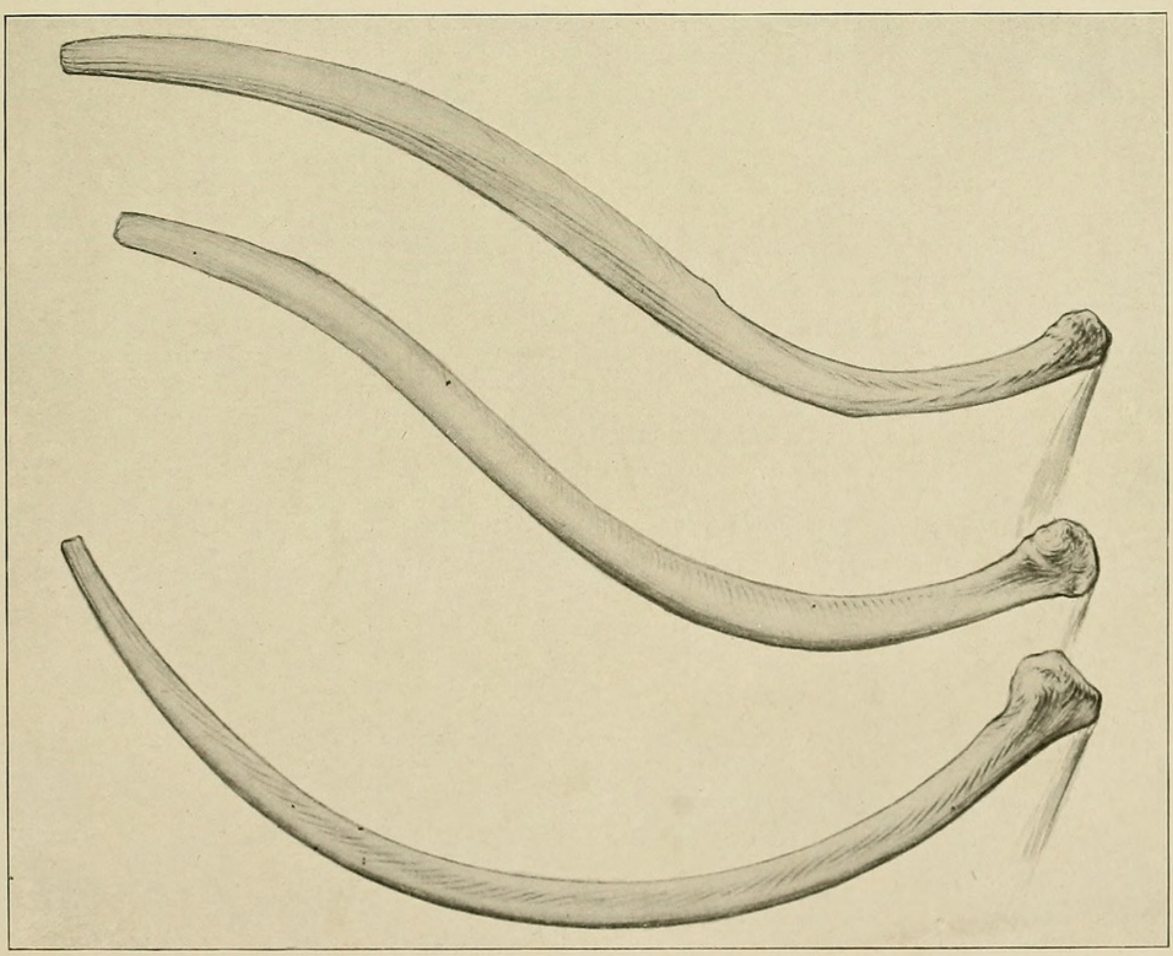

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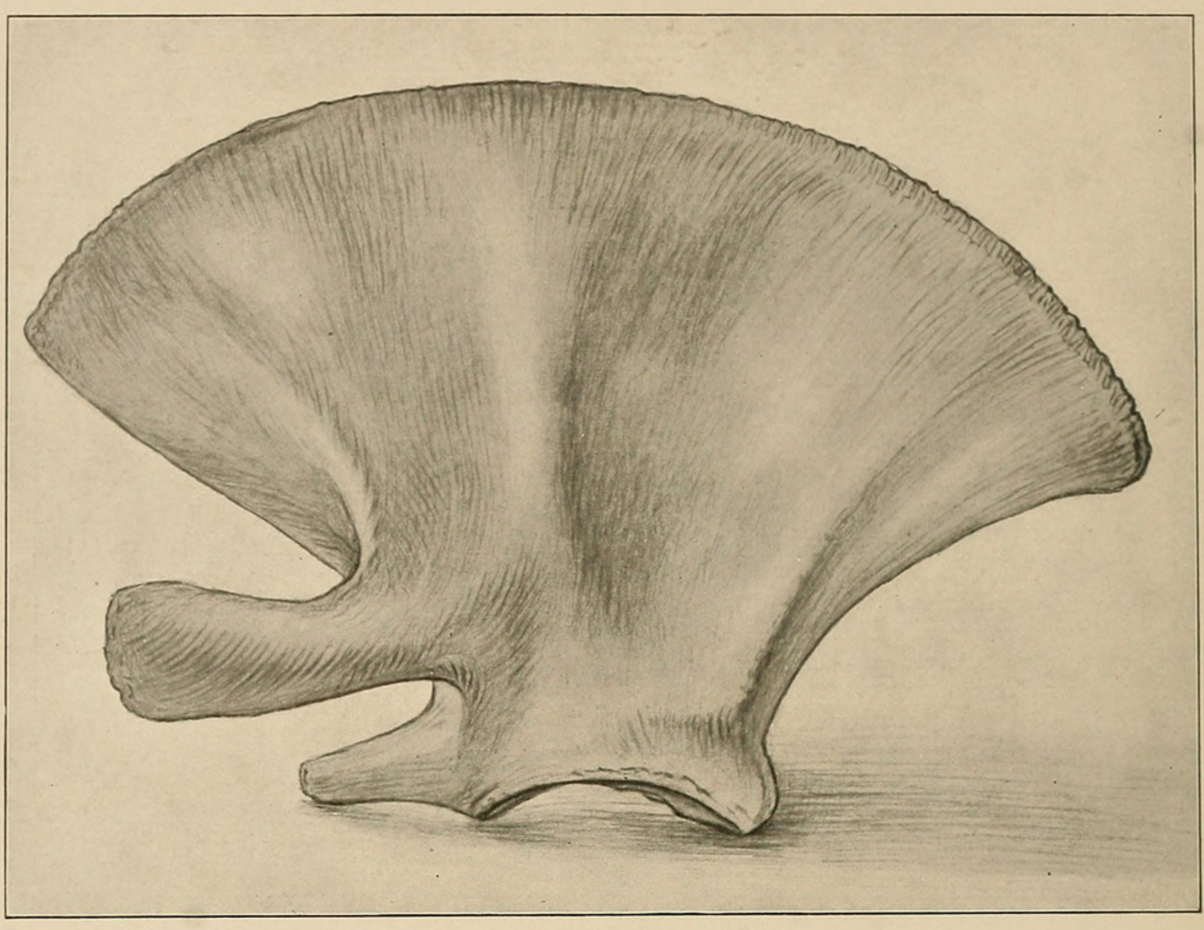

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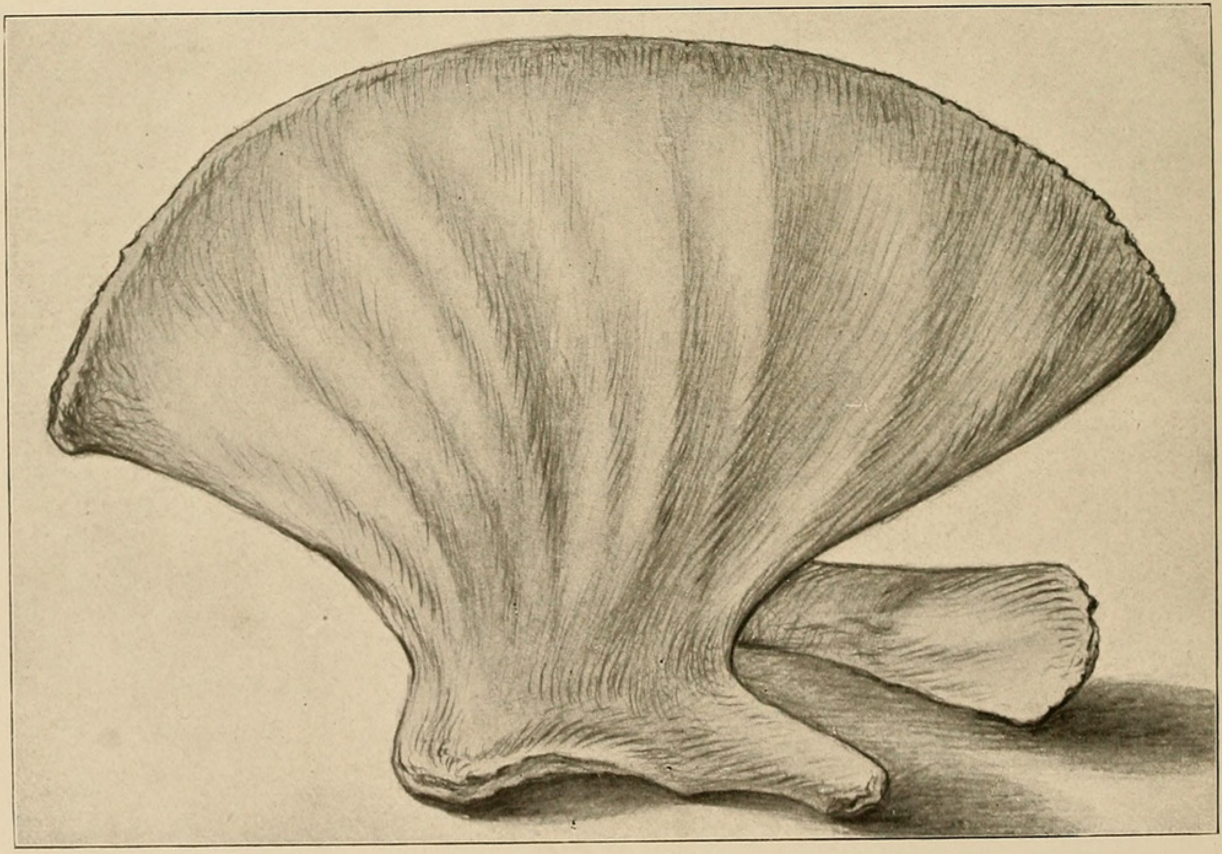


Fig. 40.

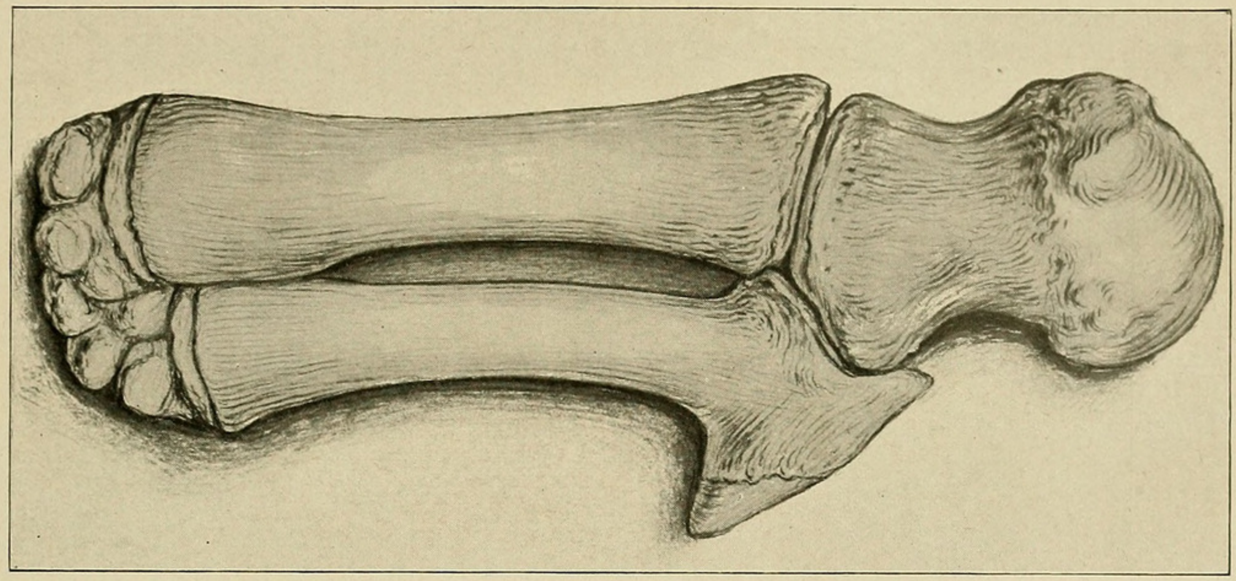


Fig. 41.

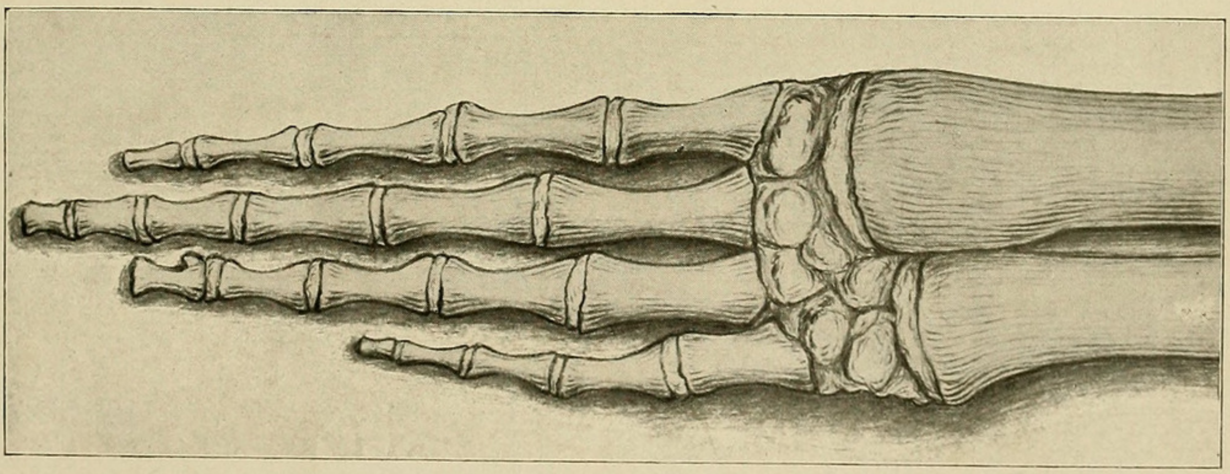


Fig. 42.

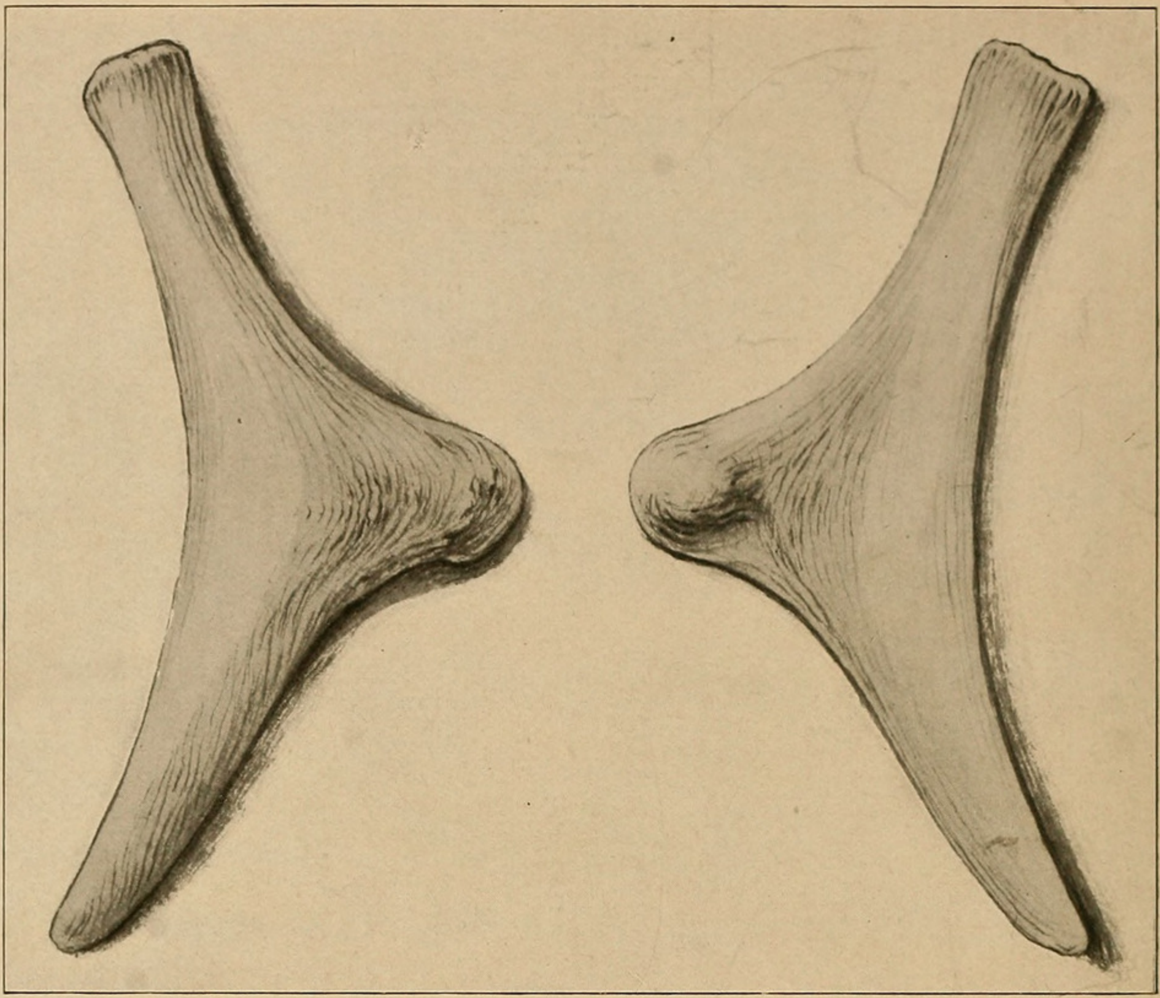


Fig. 43.

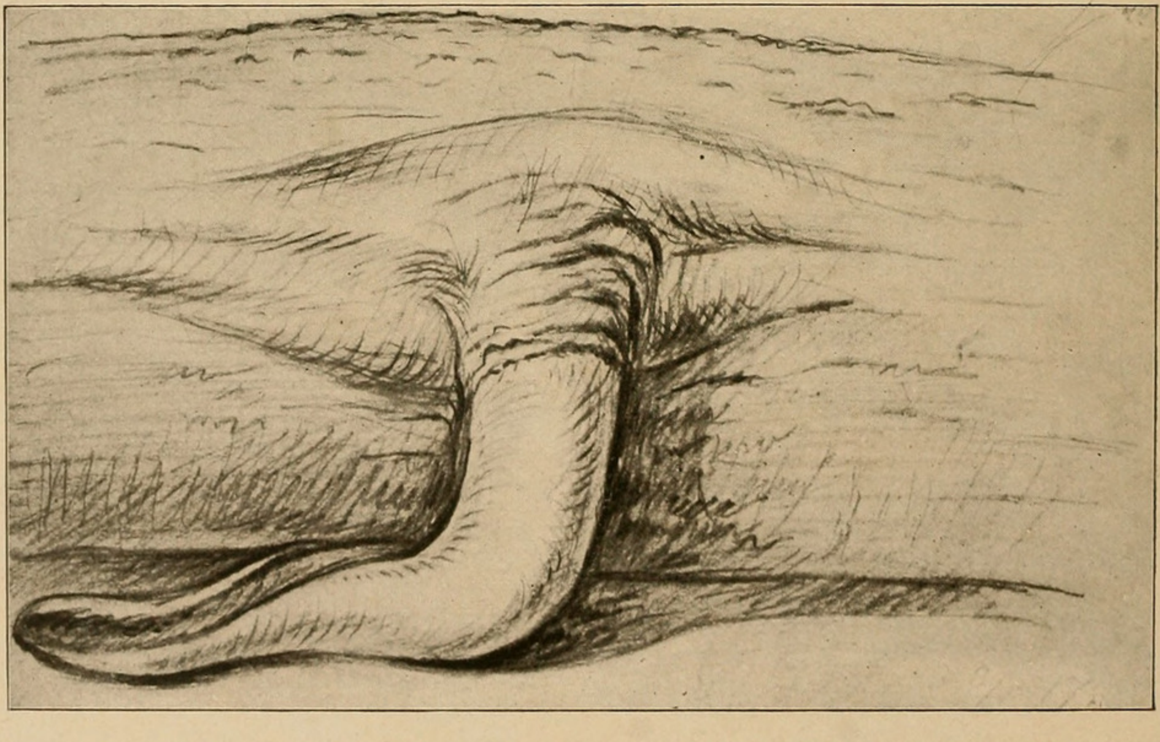
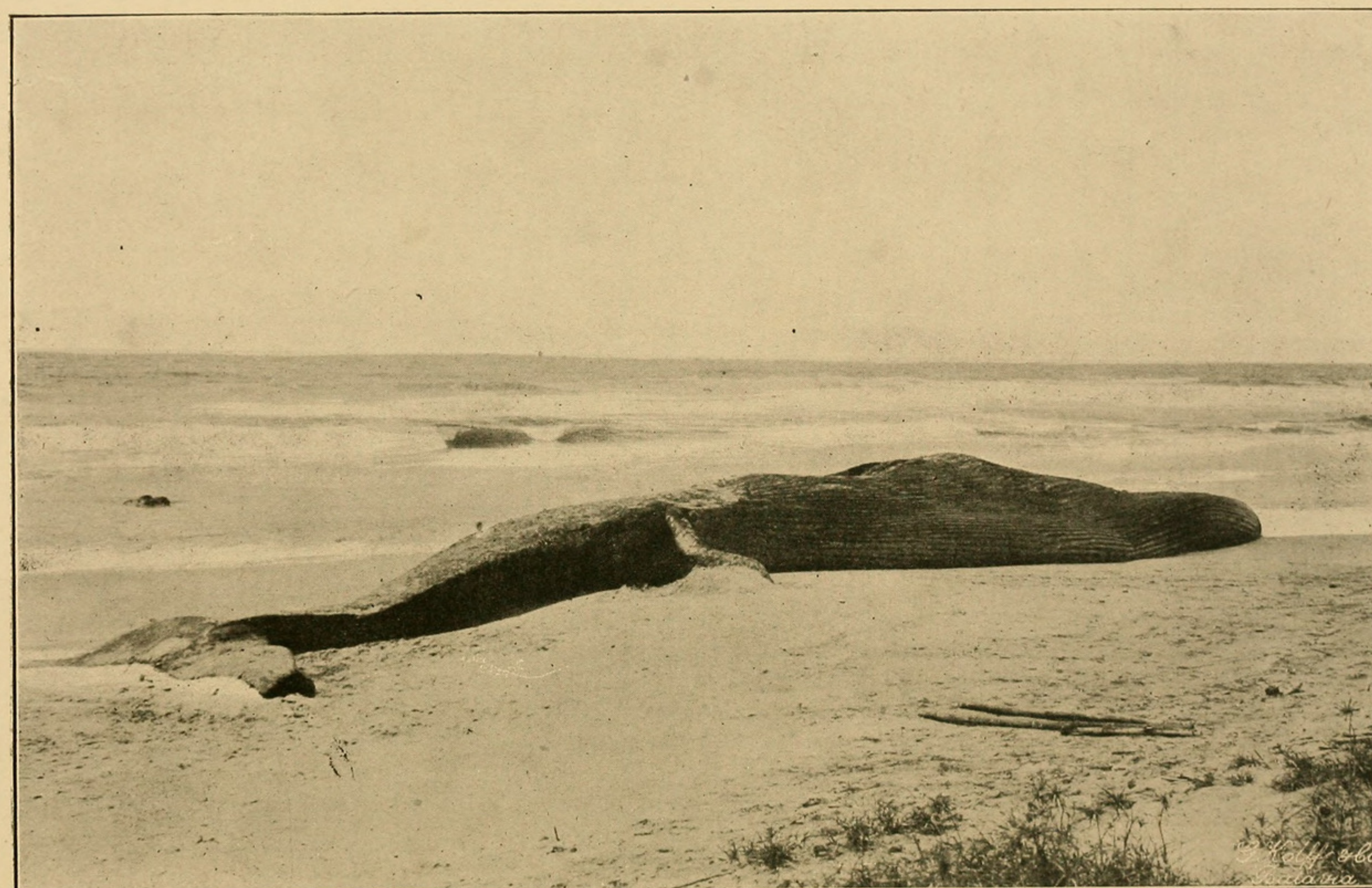


Fig. 44.

The whale on the shore of Preanger-coast; ventro-cranial view.



The whale on the shore of the Preanger-coast; ventro caudal view

The whale on the shore of the Preanger-coast; caudal view.