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TRANSACTIONS

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TRANSACTIONS

OF

THE ZOOLOGICAL SOCIETY.

I. *On the Characters and Affinities of* Potamogale, *a genus of Insectivorous Mammals.*

By George J. Allman, *F.R.S., Corr. Mem. Zool. Soc. Lond., Regius Professor of Natural History in the University of Edinburgh, and Regius Keeper of the Edinburgh Museum of Natural History.*

Read June 13th, 1863.

[Plates I. & II.]

A SMALL mammal, with which I was entirely unacquainted, was lately placed in my hands by Mr. Archibald Hewan, who had just returned to this country from the west coast of Africa, where he had been for some time residing, at Old Calabar, in the capacity of medical missionary. The notes which accompanied the specimen were scanty. It is stated to have been observed by one of the natives on the banks of a stream, when it was pursued, and killed, and taken to the missionary-station, where, after having been partly eviscerated, it was put into spirits. In this condition it was brought to England by Mr. Hewan, along with various other objects of interest from the same quarter*.

A little examination was sufficient to show that the Old Calabar mammal belonged to the order *Insectivora*, but that, with a well-marked insectivorous organization, it possessed characters of a very peculiar kind, and such as separated it widely from every genus hitherto referred to this order.

While engaged in preparing a description of the new insectivore, I showed the specimen to Mr. Sclater, the accomplished Secretary of the Zoological Society, who at once recognized it as identical with a very badly preserved skin which had been brought

* The specimen is now preserved in the Edinburgh Museum of Natural History.

over by Mr. Du Chaillu from tropical Africa, and which forms at present part of the collection in the British Museum. This skin, however, is in a wretched condition; the skull and teeth are altogether absent, and the specimen is otherwise mutilated; so that it had been quite impossible to obtain from it characters which might enable its zoological affinities to be satisfactorily determined.

Mr. Du Chaillu, however, had already described the animal from his mutilated skin, aided by his recollection of it when alive; and I am indebted to Mr. Sclater for having directed my attention to an article* in the 'Proceedings of the Boston Society of Natural History,' in which the African traveller describes, among other animals from equatorial Africa, that to which the skin in question belonged, referring it to the carnivorous genus *Cynogale*, under the name of *Cynogale velox*, Du Chaillu. Mr. Du Chaillu, however, is not without doubt as to the correctness of assigning his new animal to the genus *Cynogale*; and having in view the possibility of its being afterwards deemed desirable to construct for it a separate genus, he suggests the name of *Potamogale* as a provisional generic appellation.

The skin having been subsequently secured for the British Museum, it was examined by Dr. J. E. Gray, who disputed the justice of Du Chaillu's determination of its affinities, and maintained not only that it had no relation with *Cynogale*, but that it probably did not even belong to the order Carnivora, while he suspected that its real relations would be found with the Rodentia. Under this impression, he proposed for it a new generic name; and the *Cynogale velox* of Du Chaillu became the *Mythomys velox* of Gray †.

Dr. Gray's characterization of his new genus is much more correct than that given by Mr. Du Chaillu; but, as just said, not a remnant of the dentition had been left in the skin, which was in other respects so very imperfect that it can afford no matter of surprise to find so experienced and excellent a zoologist as Dr. Gray failing to discover its true affinities; and it is only the chance which has thrown a comparatively well-preserved specimen into my hands that has enabled me to determine the real position and relations of this remarkable mammal.

It is not always that provisional names ought to be accepted; they are not unfrequently a mere subterfuge, in which the ignorance or incapacity of the describer of some new species seeks to take refuge without his thereby abrogating his claim to be regarded as the original namer, though sounder views of the obvious facts may prove the incorrectness of his determination. But when, as in the present case, the actual absence of data renders it impossible to determine important characters, the describer is quite justified in making the best of the material at his disposal, and, by the suggestion of a provisional name, reserving to himself the right of giving this name to his discovery, if further facts rendering it expedient should be brought to light.

* Du Chaillu, "On Animals from Equatorial Africa believed to be new," Proc. Bost. Soc. Nat. Hist., vol. vii. p. 353.

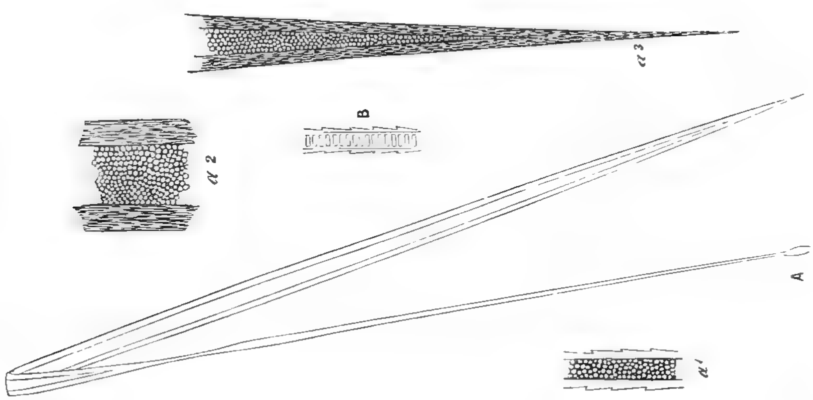
† Proc. Zool. Soc., 1861, p. 275.

It is exactly in this position that Mr. Du Chaillu's name of *Potamogale* stands: it has thus precedence over Gray's name of *Mythomys*; and the laws of natural-history nomenclature compel us to accept it. The synonomy of Mr. Du Chaillu's animal will accordingly stand as follows:—*Potomogale* (prov. gen.) *velox*, Du Chaillu,=*Cynogale velox*, Du Chaillu,=*Mythomys velox*, Gray (gen.).

External Characters and Teeth.

Potamogale velox (Plate I.) is somewhat larger than a stoat; it has very much the aspect of a small otter, but is rendered especially striking by its broad, almost spatuliform muzzle and its very large laterally compressed tail. Both fore and hind limbs are short and nearly equal to one another in length. The body is clothed with somewhat coarse but soft hair, which projects from a shorter dense coat of very fine silky hairs; and the same kind of clothing covers the base of the tail as far as an oblique line which terminates below at about an inch behind the vent, and above at about an inch still further back; the whole of the rest of the tail is covered with short, coarse, closely appressed hairs. The sides of the upper lip give origin to stiff bristle-like whiskers, which commence at the point of the nose, and continue to be borne as far back as a point nearly vertically over each angle of the mouth, increasing in length and thickness from before backwards; the most anterior are short and incline forwards, and they then acquire more and more of a backward direction until we find the most posterior

Fig. 1.

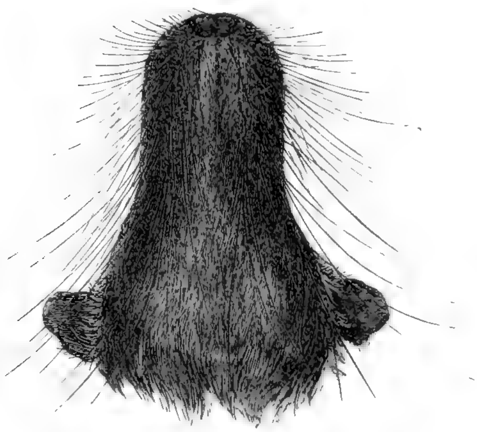


Hair from the body of *Potamogale velox.*—A, one of the longer hairs, magnified about ten diameters; B, a portion of one of the shorter and ner hairs, magnified about 40 diameters to show its structure; a^1, a piece from near the middle of the narrow basal portion of A; a^2, from the middle of the broad terminal lamina; and a^3, the terminal portion of the lamina: the last three magnified about 40 diameters.

attaining a length of nearly two inches, and inserted so obliquely that their tips are nearly an inch behind the ears; a few stiff bristles also arise from the cheeks, a little below and in front of the ears. The underside of the muzzle is clothed towards its extremity with very short hairs, which gradually increase in length as they approach the angles of the mouth. The upper side of the head, with the back and the entire tail, and the outer side of the fore and hind limbs are dark brown. The whole of the underside of the body, from the extremity of the nose to the vent, is brownish yellow.

The fine hairs which constitute the shorter and denser coat are seen under the microscope to be of uniform thickness, with the cortical substance presenting an imbricated structure, and the cells composing the medullary substance so disposed as to give a septate appearance to the interior of the hair (fig. 1 B). The long hairs, A, which project from this coat have a remarkable form: commencing very thin at the bulb, they gradually increase in thickness for about a third of the entire length of the hair, then suddenly contract, and immediately after expand into a broad lanceolate lamina, which terminates in a fine point. The basal portion of these hairs has a thin imbricated cortical investment and medullary contents, which consist of an aggregation of small spherical cells (a^1). In the broad lamina, the cortical portion has acquired greater thickness, has lost its imbricated character, and is seen to be composed of minute longitudinally arranged fusiform cells; the medullary substance is here composed of aggregated spherical cells like those of the basal portion of the hair, and dies out before it reaches the point (a^2, a^3). The remarkable difference thus observed between the two kinds of hair presents us with a condition not unusual among the Insectivora, and one which finds its maximum in the aculeate genera of this order.

Fig. 2.



Head viewed from above.

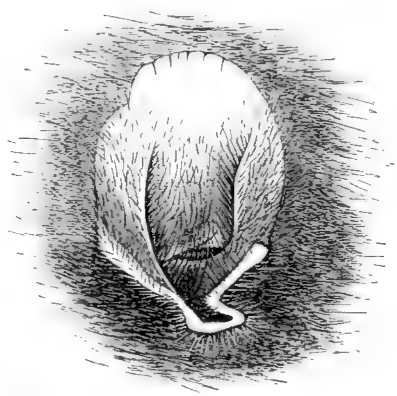
Fig. 3.

Head viewed from below.

The muzzle is long and broad, and so much appressed as to acquire a somewhat spatulate form (figs. 2, 3). It projects in front for half an inch beyond the extremity of the lower jaw, and for more than a quarter of an inch beyond the jaw at its sides; the angles of the mouth are situated at about a quarter of an inch in front of a vertical line from the eyes. Each nostril opens beneath the external edge of a cartilaginous valve, which extends over it from the septum, and by which it may be completely closed; the two valves form together a heart-shaped, naked shield by which the muzzle is terminated.

The ears (fig. 4) are inserted about half an inch behind the eyes, and project for about the same distance from the head. They are rounded, the breadth being about two-thirds of the height; and at about one-fourth from the summit they have a deep notch on their posterior edge: the upper fourth is quite naked, but the rest is clothed with silky hairs. The helix is distinct anteriorly and posteriorly, but is obsolete towards the tip; the anthelix is represented by a short, nearly transverse ridge; the tragus is indistinct, but the antitragus is well developed.

Fig. 4.



Right ear, enlarged.

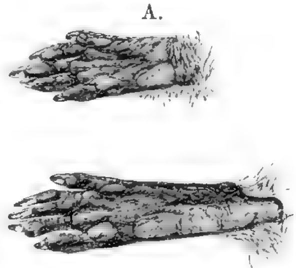
The eyes are very small. The opening of the eyelids, when fully expanded, is one-tenth of an inch in its antero-posterior, and a little less in its vertical diameter; it leads into an oval palpebral chamber, which extends for some distance beneath the anterior and posterior margins, somewhat further posteriorly than anteriorly. In the specimen, the globe of the eye was retracted into this cavity, and thus rendered difficult to detect; it is about one-twelfth of an inch in diameter, and, so far as could be determined from the state of the specimen, is completely developed, and receives an optic nerve fully proportioned to its size.

The fore limbs, as far as the wrist, are clothed with moderately long hair, which on the back of the metacarpal bones becomes very short and appressed, and is thus continued over the back of the fingers as far as the claws; the whole of the palm, with the underside of the fingers, is naked (fig. 5 A). The fingers are five in number, and are connected at their bases by a very narrow extension of the skin, but nothing like a distinct web is developed; they gradually increase in length from the outer finger to the middle, which is the longest of all; the index is a very little shorter than the annularis; and the pollex, which is inserted a little further back than the index, is the shortest. The claws are of moderate size, nearly equal on all the fingers, compressed, curved, and with a furrow on the underside.

The hind limbs are clothed, as far as the tarsus, with moderately long hair, which becomes short and appressed upon the entire back of the foot as far as the claws; the entire sole of the foot is naked (fig. 5 B). The toes are five in number; the outer and inner toes are the shortest, the inner being a little shorter than the outer; the second, third, and fourth are nearly equal to one another in length; the second and third are

Fig. 5.

A.



B.

Feet, plantar surface.—
A. Right anterior.
B. Right posterior.

united by their opposed surfaces for the entire length of the first phalanx, a very narrow extension of the skin existing at the base of the other digital intervals; the claws are of the same form as those of the fore limbs, but are a little longer. The outer edge of the sole projects as a narrow membranous border along the whole of the metatarsal region.

The length of the tail, measured from the posterior margin of the vent, is equal to the distance from the same point to the middle of the throat. It is so thick at its base that the trunk seems uninterruptedly continued into it; but it soon becomes laterally compressed, and then grows gradually thinner and narrower towards the tip; immediately in front of the vent it is nearly cylindrical, with a diameter of about $1\frac{3}{10}$ inch; from this point it gradually thins away, and, at an inch beyond it, its vertical height is $1\frac{1}{10}$ inch, and its breadth $\frac{7}{10}$ inch; while at three inches from the same point its height is 1 inch, and its thickness $\frac{4}{10}$ inch; its lower edge is rounded, and its upper is continued into a membranous crest of about $\frac{1}{8}$ inch in height, and clothed with the same short, stiff, appressed hairs with which the distal part of the tail is covered.

Teeth.—The determination of the dental formula is not without difficulty. The incisor teeth of the upper jaw (Pl. II. & fig. 7, p. 10) can be easily ascertained by the limits of the premaxillary, whose suture with the maxillary continues very distinct. They will be found to be three on each side, though one of them closely resembles a large projecting canine; so also to the first three teeth on each side in the lower jaw the same significance must be assigned. A difficulty, however, lies in the tooth which in each jaw succeeds to the incisors. In position it is a canine, but in form it is a premolar. It follows close upon the third incisor, without the intervention of any distinct diastema; but in the upper jaw it is two-fanged, and in other respects is entirely similar to the premolar which follows it; in the lower jaw, however, it is implanted by a single fang, and does not so entirely resemble the succeeding premolar as in the upper jaw; this lower tooth passes immediately in front of the upper one when the jaw is closed, and must certainly be regarded as its equivalent. Considering, therefore, that in the upper jaw the tooth in question is absolutely similar both in its root and in its crown to an indubitable premolar, I believe we may safely regard it and its corresponding tooth in the lower jaw as premolars rather than canines; and the dentition of *Potamogale* will then present a series in which the canine teeth are suppressed, and which may be formulated as follows:—

$$i.\ \frac{3-3}{3-3},\ c.\ \frac{0-0}{0-0},\ p.\ \frac{3-3}{3-3},\ m.\ \frac{3-3}{3-3},=36.$$

In the upper jaw the first incisor resembles a canine; it projects more than any other tooth in the jaw; it is conical and pointed, converging above from its base toward its fellow, and then diverging below so as to form a curve whose concavity looks outwards; it is curved also in another direction, having the concavity looking backwards. The second incisor is separated from the first by a narrow space which receives the second incisor of the lower jaw when the mouth is closed; it is triangular, compressed, with a sharp anterior and a sharp posterior edge—the anterior edge being convex, and the posterior slightly concave. The third incisor is of the same form as the second, but a little smaller. The incisors are each implanted by a single fang.

Since in the view here adopted the canine is supposed to be absent, the first premolar follows immediately on the third incisor, with an interval so slight as to have no claim to be regarded as a distinct diastema; it is inserted by two fangs; its crown is slightly larger than that of the third incisor, but otherwise it resembles it. The second premolar is also implanted by two fangs, and is otherwise similar to the first. The third has the form of a triangular pyramid, with a small cusp developed from the posterior internal basal angle, and another from the posterior external; it is implanted by three fangs.

The first, second, and third true molars are similar to one another: they are triangular in horizontal section, with the apex of the triangle situated internally; the greatest antero-posterior diameter of the crown is to its transverse diameter as 2 : 3; the internal angle of the crown presents a single cusp; the centre, two; and the external side projects downwards as a tuberculate ridge; they are each implanted by three fangs.

In the lower jaw (Pl. II. & fig. 8, p. 11) the incisors present, as in the upper, the usual single-fanged insertion. The first is very small, chisel-shaped, and with its crown converging to that of its fellow. The second incisor is high, conical, curved, with the concavity of the curve looking backwards, and presenting from its base to its apex two surfaces separated by a sharp ridge; it is sharp-pointed, and resembles a canine; it is the most projecting tooth in the jaw. The third incisor is small, irregularly conical, convex anteriorly, concave posteriorly; it is the smallest of the teeth, except the first incisor.

The first premolar is triangular, compressed, with a sharp convex anterior edge and a sharp concave posterior edge; it has but a single fang. The second premolar is triangular, compressed, with sharp anterior and posterior edges; it is implanted by two fangs; its crown is a little lower than that of the first, but it otherwise resembles it. The third premolar is a little larger than the first, triangular, compressed, with sharp anterior and posterior edges; the anterior and posterior basal angles have each a small tubercle; it is implanted by two fangs.

The first, second, and third true molars are prismatic, and equal in height to the second premolar; the crown is furnished with three cusps in front and a single one on a lower level behind. They are each implanted by two fangs.

A very striking aspect is given to the dental series by the form of the crowns of the second, third, fourth, and fifth teeth of the upper jaw, which are all triangular, much compressed, with sharp anterior and posterior edges, thus vividly reminding us of the teeth of certain sharks. In this respect they resemble the premolar teeth of the viverridan genus *Cynogale*—a resemblance which did not escape Mr. Du Chaillu, and which, doubtless, decided him in referring his animal to that genus.

The characters thus presented by *Potamogale velox* would justify a belief in the aquatic habits of the animal. Indeed it is scarcely possible to connect with any other mode of life the valvular nostrils, and broad, strong, vertically flattened tail, with (as will be presently seen) its greatly developed hæmal arches. The trenchant incisors and premolars, so like the teeth of a shark, also point to the same conclusion, and indicate a diet exceptional among the Insectivora*.

Skeleton. (Plate II.)

Cervical Region.—The transverse process of the atlas is broad and flattened horizontally. The neural spine is reduced to a mere tubercle. The body of the axis is carinated below; its transverse processes are short, narrow, and directed backwards, while the neural spine forms a large, vertical, laterally compressed, sharp-edged, and hatchet-shaped plate. In the third cervical, the transverse process is longer and thicker. In the fourth and fifth, the pleurapophysis forms a flat process coalescent with the diapophysis, and extends forwards with a sharp angle, so as to slightly underlap the vertebra in front; while in the sixth it becomes much larger and hatched-shaped, and extends backwards so as to underlap the seventh. The transverse process of the seventh has no canal for the vertebral artery, and consists of a simple stiliform diapophysis. The neural spines of the third, fourth, and fifth cervical are very short, those of the sixth and seventh longer. From the inferior surface of the body of the third, fourth, and fifth cervical a prominent hypapophysis is developed, which becomes smaller in the sixth and seventh.

Dorsal and lumbar Region.—There are sixteen, dorsal and five lumbar vertebæ. The commencement of a metapophysis shows itself in the second dorsal, acquires greater length in the third, still greater in the fourth, and then continues of equal length as a long blunt process on every vertebra as far as the twelfth; on the thirteenth dorsal it becomes shorter, and is here associated with a short anapophysis, and then continues of the same length, but broader, on the fourteenth, fifteenth, and sixteenth dorsal, and on the whole of the lumbar. On the last three dorsal vertebræ the anapophysis

* The account which Mr. Du Chaillu (*loc. cit.*) has given us of the habits of his *Potamogale velox* is entirely in accordance with what the structure of the animal would suggest. "This extraordinary animal," he says, "is found in the mountains of the interior, or in the hilly country explored by me north and south of the equator. It is found along the water-courses of limpid and clear streams, where fish are abundant; it hides under rocks along these streams, lying in wait for fish. It swims through the water with a rapidity which astonished me; before the fish has time to move, it is caught. On account of the rapidity of its movements, I have given it the specific name of *velox*. The animal returns to land with its prey almost as rapidly as it started from its place of concealment. The great motive power of the animal in the water seems to be in its tail."

becomes separated by a wide interval from the metapophysis, and then disappears on the first lumbar. No diapophyses are developed on the fifteenth and sixteenth dorsal; but they reappear on the first lumbar, and constitute broad, flat processes, directed downward and outward and a little forward, on all the lumbar. The diapophysis of the first lumbar is terminated by a flat, nearly square pleurapophysis, which appears as a simple continuation of the diapophysis, but whose line of junction with it still remains distinct.

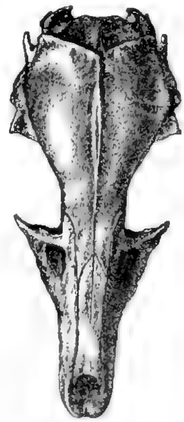
The neural spine of the first dorsal is nearly vertical, long, and slightly compressed; those of the second, third, and fourth are equal to it in length, and of a similar form, but incline more backwards, the inclination gradually increasing to the fourth; from the fifth to the tenth, the neural spines are stiliform, gradually decreasing in length, and incline so much backwards that the anterior rests upon the posterior; and the vertebræ here present a remarkably imbricated appearance; from the eleventh to the thirteenth, the neural spines are shorter, and incline less backwards; they then assume the form of laterally compressed vertical plates, gradually increasing in size to the first lumbar, whence they continue of nearly the same form and size to the fifth lumbar. From the body of the first dorsal a small hypapophysis is developed; it becomes somewhat larger on the second, third, and fourth, is reduced to a nearly obsolete keel on the fifth, and then entirely disappears.

The ribs are sixteen in number, of which the first nine articulate with the sternum; the remainder are free. The first is the shortest and stoutest; its cartilage is broad and flat, and articulates with the manubrium; of the remaining ribs, the last two articulate with the bodies only of their respective vertebræ, while the others articulate also with the transverse processes. The sternum is composed of eight pieces: the manubrium is spade-shaped; from the second to the sixth, they form quadilateral prisms, gradually decreasing in length and increasing in breadth; the seventh is nearly cubical, with two surfaces posteriorly for the articulation of the cartilage of the eighth pair of ribs; the eighth piece is long and appressed, and carries the small xiphoid cartilage on its extremity.

Sacral and caudal Regions.—There are three sacral and thirty-three caudal vertebræ, the *ossa innominata* being united to the first and second sacral. The neural spines, metapophyses, and diapophyses continue to be well developed on the sacral and for some distance on the caudal vertebræ; they then gradually diminish on the caudal vertebræ with the diminishing size of these, until towards the end of the tail they disappear, and the vertebræ become reduced to minute centra. All the caudal vertebræ, from the second to about the twenty-third, are provided with chevron bones: towards the proximal end of the tail these bones are remarkably large; they then gradually diminish in size, and become mere rumdients before their final disappearance. They are each articulated in an intervertebral space; most of them develope a short hæmal spine, and send off at each side from their lower surface a broad horizontal plate.

The Skull.—Viewed in its vertical aspect, the skull presents a piriform shape between the occiput and a line immediately behind the orbits, and then, becoming suddenly contracted, it is bounded by parallel sides as far as the end of the muzzle, interrupted, however, by the projection of the posterior part of the alveolar border of the maxillaries. The profile contour of the skull, from the lambdoidal crest to the nostril, is nearly a straight line.

Fig. 6.

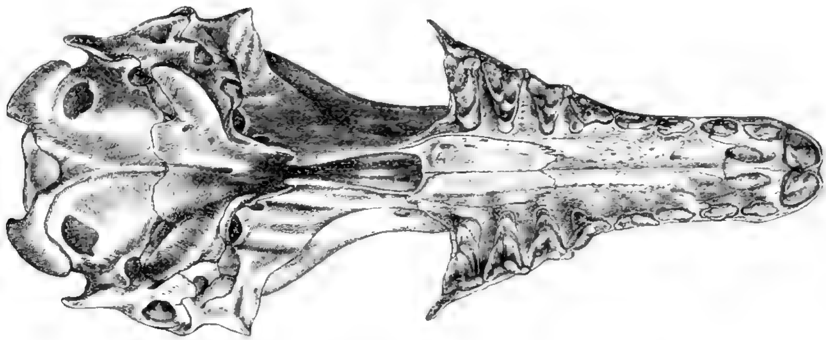


Skull, vertical aspect: nat. size.

The basioccipital is thin and flat, broader than long, and extends forwards as far as the junction of the posterior and middle thirds of the tympanic bullæ. The occipital condyles are large, about a line distant from one another below; and thence extending upwards and outwards, they reach a point a little above the level of the superior margin of the foramen magnum. The foramen magnum is transversely oval; its plane extends upwards and backwards at an angle of about 100° with the base of the skull. The supraoccipital extends upwards and forwards, and forms by its upper and outer edge a well-marked, sharp, lambdoidal ridge. The paramastoids constitute two small but well-marked processes, which extend horizontally backwards. The anterior condyloid foramina are very large.

The basispenoid is broad behind at its junction with the basioccipital, and then rapidly contracts as it passes forwards, forming on the cerebral aspect a narrow vertical crest between the internal openings of the foramina lacera anteriora: there are no clinoid processes.

Fig. 7.



Skull, basal aspect: twice the nat. size.

The tympanic and petrosal bones unite to form tympano-petrosal bullæ of moderate size.

The sagittal suture is obliterated, its place being taken by a nearly obsolete sagittal crest.

The coronal suture is very faintly indicated by a line which forms an arch, very concave in front, where it embraces the posterior margin of the frontal bones. These are narrow, forming by their union a very convex margin posteriorly, which is received between the parietals and a deep notch anteriorly, which receives the nasal bones. The frontals are entirely excluded from the orbits by the anterior extension of the parietals, which, passing between them and the lachrymals, are separated from the maxillaries by a very narrow extension of the lachrymals, which ascends to unite with the frontal. The frontal suture is obliterated posteriorly, but anteriorly it continues as an harmonia. The nasal bones are long and flat, forming a very convex edge posteriorly, where they are received between the frontals, while their anterior free edge presents a wide semicircular notch. The nasal suture, except for a short distance posteriorly, is entirely obliterated; the external edges of the single bone, thus formed, are nearly straight and parallel.

The zygomatic process of the squamosal forms a small, horizontal, triangular plate, whose lower side affords a surface for the glenoid cavity. This cavity is bounded behind by a broad vertical process, which checks the retraction of the mandible; the axis of the cavity is inwards and slightly forwards.

The facial plate of the maxillary is united internally with the premaxillary, the nasal, and the frontal, anteriorly with the premaxillary, and posteriorly with the lachrymal. The alveolar margin for the hindmost four teeth projects outwards and backwards, forming, by its coalescence with the rudimental malar, a compressed, sharp-edged process. There is no zygomatic arch. The antorbital foramen is very large. The orbits are very badly defined; they are marked by no postorbital process, and are continued without interruption into the wide temporal fossa.

Fig. 8.

Lower jaw, twice the nat. size.

The palatine plates of the maxillary form the greater portion of the palate; the palatines form the posterior third, and the premaxillaries about a sixth. Two large incisive notches exist in the premaxillary, and are completed into foramina by the anterior edge of the palatine plate of the maxillary.

The pterygoid ridges converge from before backwards, and enclose a deep, narrow interpterygoid fossa, whose roof is continued without interruption into the inferior surface of the basisphenoid and basioccipital.

The horizontal ramus of the mandible is straight, with its upper and lower edge parallel; it forms with its fellow an acute angle, with a rather long and very oblique symphysis. The condyle is borne on a distinct neck; its axis is directed inwards and slightly downwards and forwards. The posterior margin of the ascending ramus is thin, and runs from the neck of the condyle upwards and slightly forwards to the coronoid process, and downwards and backwards to the prominent hook-like angle. The anterior edge of the coronoid process runs downwards and slightly forwards, with a convex curve; it meets the horizontal ramus at about a line behind the posterior molar.

Anterior Extremities—The scapula measures one inch in length, and is half an inch broad at its base, which forms a uniform convex curve. From the angles of the base the superior and inferior costæ converge towards the anterior end of the spine, where the scapula becomes contracted into a neck, whose superior margin is continued into a slightly prominent coracoid. The supraspinal fossa is posteriorly about twice as broad as the infraspinal fossa; but it rapidly narrows towards the neck of the scapula, and then disappears, while the infraspinal fossa continues still distinct. The long free edge of the spine is continued forwards as a very slender acromion. The glenoid cavity is ovo-triangular, with its apex directed downwards. The subscapular surface is smooth and slightly concave.

The clavicles are entirely absent.

The humerus, measured from the upper surface of its head to the lower end of the bone, is $1\frac{3}{10}$ inch in length. The head is nearly hemispherical; the lesser tuberosity forms a slightly elevated prominence; while the greater tuberosity forms a strong pyramidal projection, by which the axis of the shaft is continued for about $\frac{2}{10}$ths of an inch beyond the head. The shaft of the humerus presents a sharp edge in front, and is smooth and rounded behind. The anconeal fossa is imperforate, and there is no foramen above the internal condyle. Almost the whole of the front of the elbow-joint is formed by the surface for the radius.

The ulna, measured from the superior margin of the great sigmoid cavity to the lower end of the bone, is 1 inch in length; the olecranon process is $\frac{3}{10}$ths of an inch. The radius and ulna are quite distinct; but the radius cannot be rotated on the ulna so as to effect supination.

There are eight bones in the carpus, arranged in the usual proximal and distal series, with four bones in each series. The pisiform bone is large and subcylindrical; it projects backwards from the outer side of the wrist, so as to form a sort of carpal heel. The metacarpal bone of the pollex is the shortest; that of the minimus comes next to it in length; those of the index and annularis come next, and are equal to one another, while that of the medius is the longest.

Posterior Extremities.—The pelvis is narrow. The ossa innominata articulate with the first and second sacral vertebræ. The ilium is a narrow bone, nearly semicylindrical in shape, convex on its outer surface, and with its superior or anterior end slightly everted. The ischium nearly continues the axis of the ilium as far as the thin tuberosity, and then turns vertically downwards to form the posterior boundary of the oval obturator foramen. The pubic bones form an angle of about 188° with the iliac, being thus almost on a line with them. The two pubic bones converge towards one another, at an angle of 40°; but they form no true symphysis, being separated from each other at their posterior and inferior angle by a space of about $\frac{1}{10}$th of an inch wide, which is occupied by a ligament admitting of considerable motion between the two bones at this spot.

The femur is of the same length as the humerus, measured in each case from the upper surface of the head to the distal extremity of the bone; it has a prominent tubercle, with a rough surface, upon the middle of the outer side of the shaft.

The tibia is $1\frac{4}{10}$ inch in length, measured from its upper to its lower articular surface. The tibia and fibula are confluent with one another for the lower third of their length. The tibia is curved, so as to present in its upper two-thirds an arch, convex forwards. The fibula is a slender bone, forming the cord of the arch produced by the curvature of the proximal two-thirds of the tibia.

The tarsus is composed of seven bones. The calcaneum is large, and projects for about one half its length behind the tibia.

The metatarsal bone of the hallux is the shortest; that of the outer toe is next in length; and the metatarsal bones of the three middle toes are the longest, and are nearly equal to one another.

Anatomy of the Soft Parts.

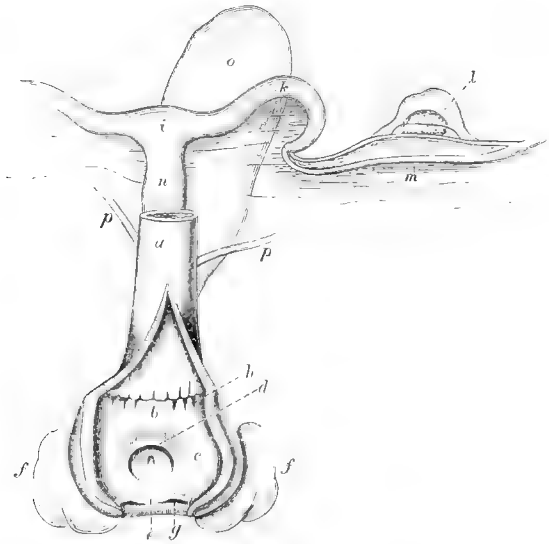
The imperfect state of preservation of the viscera, combined with the small amount of time which it was possible for me to spare from other avocations, has not allowed of more than a fragmentary description of the anatomy of the soft parts of the animal.

The stomach and the whole of the organs of digestion between this and the vent, with the exception of about an inch of the terminal portion of the rectum, had been removed before the specimen was placed in my hands; so that certain important characters, such as that derived from the presence or absence of a cæcum, could not be ascertained. The terminal portion of the canal, however, which escaped (fig. 9) presents several points of interest. The rectum, instead of opening directly on the surface of the body, opens into a sort of cloacal or postanal chamber, which also receives the orifices of the vagina and urethra, and those of the ducts of a pair of large anal glands.

These glands are oval, about half an inch in their longer diameter. They are situated immediately beneath the skin, one on each side of the postanal chamber, into which each discharges its secretion by a single orifice. The excretory orifice of each gland opens into the bottom of a little pouch formed by a fold of the lining membrane of the postanal chamber at each side immediately within its margin. Just behind the line where the cavity of the rectum becomes continuous with the postanal chamber, may be seen several very oblique pores in the mucous membrane of the chamber—apparently the outlets of small submucous glands.

The uterus and its appendages and the urinary bladder were also left behind in the specimen; but the kidneys had been cut away with the other viscera. The fundus of the uterus is continued at each side into a long, curved, cylindrical cornu, which gives off the oviduct from its distal extremity. The ovaries are situated at a short distance

Fig. 9.



Terminal portion of intestine with the adjacent structures, slightly enlarged: *a*, rectum; *b*, margin of anus; *c*, postanal chamber laid open from behind; *d*, vulva; *e*, orifice of uretha; *f*, anal glands; *g*, pouches into which their ducts open; *h*, mucous pores; *i*, uterus; *k*, cornu of uterus; *l*, ovary; *m*, oviduct; *n*, vagina; *o*, urinary bladder; *p*, ureters.

from this extremity, to which they are attached by a narrow cord-like ligament, which accompanies the oviduct; they are surrounded by a hood-like covering of peritoneum. From the uterus a wide, straight vagina passes backwards to open into the vulva, which also receives the orifice of the urethra, and is situated on the walls of the postanal chamber.

The position of the mammæ was unfortunately neglected to be ascertained before the specimen had been skinned, and it is now impossible to find any indication of them in the dried skin. They are probably uropygial as in *Solenodon*.

The brain was in a very bad state of preservation: the cerebellum and medulla oblongata were entirely broken down; but the cerebral hemispheres were sufficiently well preserved to show that they are destitute of distinct convolutions. The corpora quadrigemina were also preserved; they are large, and are exposed behind the posterior margin of the hemispheres; the posterior pair are larger than the anterior. The olfactory lobes are rather large, and project in front of the cerebral hemispheres.

From the details given above, certain characters, as perhaps eminently distinctive, may be selected and embraced under the following diagnosis:—

POTAMOGALE, Du Chaillu.

$$\text{Teeth, } i.\,\frac{3-3}{3-3},\ c.\,\frac{0-0}{0-0},\ p.\,\frac{3-3}{3-3},\ m.\,\frac{3-3}{3-3}=36.$$

Superior—first incisors laniariform; second and third incisors and first and second premolars triangular, compressed, with sharp anterior and posterior edges; third premolar pyramidal; true molars prismatic: inferior—first incisor very small, chisel-shaped; second large and laniariform; third small, conical; first, second, and third premolars triangular, compressed, sharp-edged; true molars prismatic. Muzzle broad, appressed. External ears well developed. Eyes very small. Nostrils valvular. Limbs of moderate length, plantigrade, pentadactyle. Second and third toes of hind feet syndactyle for the length of the first phalanx. Tail large, compressed; its distal portion covered with short, stiff, closely appressed hairs, while the hair covering the proximal portion resembles that upon the body. Body clothed with soft, rather coarse, hair, which projects from a dense covering of very fine, short, silky hairs. Anal glands two. Anus, vulva, urethra, and ducts of anal glands opening into a postanal chamber. Zygomatic arches absent. Clavicles absent. Radius and ulna separate. Tibia and fibula adnate.

From the description now given, it will probably be conceded that *Potamogale* is more nearly allied to *Solenodon* than to any other known genus of Insectivora. The absence of zygomatic arches, small eyes, well-developed ears, and large tail are all so many points of direct affinity. On the other hand, the remarkably compressed, triangular teeth, the compressed form of the tail, the broad appressed muzzle, the presence of anal glands, the coalescence of tibia and fibula, and, above all, the absence of clavicles are points of marked divergence from the West-Indian genus.

On the whole I am of opinion that the genus *Potamogale* ought to be assumed as the type of a distinct family of Insectivora, to which the name of *Potamogalidæ* may be given.

The above paper had been already printed when I became acquainted with a description of *Potamogale velox*, contained in a communication presented to the Zoological Society on the 25th of April, 1865, by Professor J. V. Barboza du Bocage, "On certain rare and little-known Mammifers from Western Africa, preserved in the Lisbon Museum,"* as well as with another and more extended memoir, on the same animal, read by Professor Barboza du Bocage at a meeting of the Lisbon Academy, on the 27th of April, 1865.

The specimen from which the Lisbon Professor's description had been drawn up was sufficiently well preserved to enable him to recognize the true insectivorous relations of the animal, and to give a detailed account of its external characters and osteology. He will not, however, accept the generic name of either Du Chaillu or Gray, but constructs

* See Proc. Zool. Soc., 1865, p. 401.

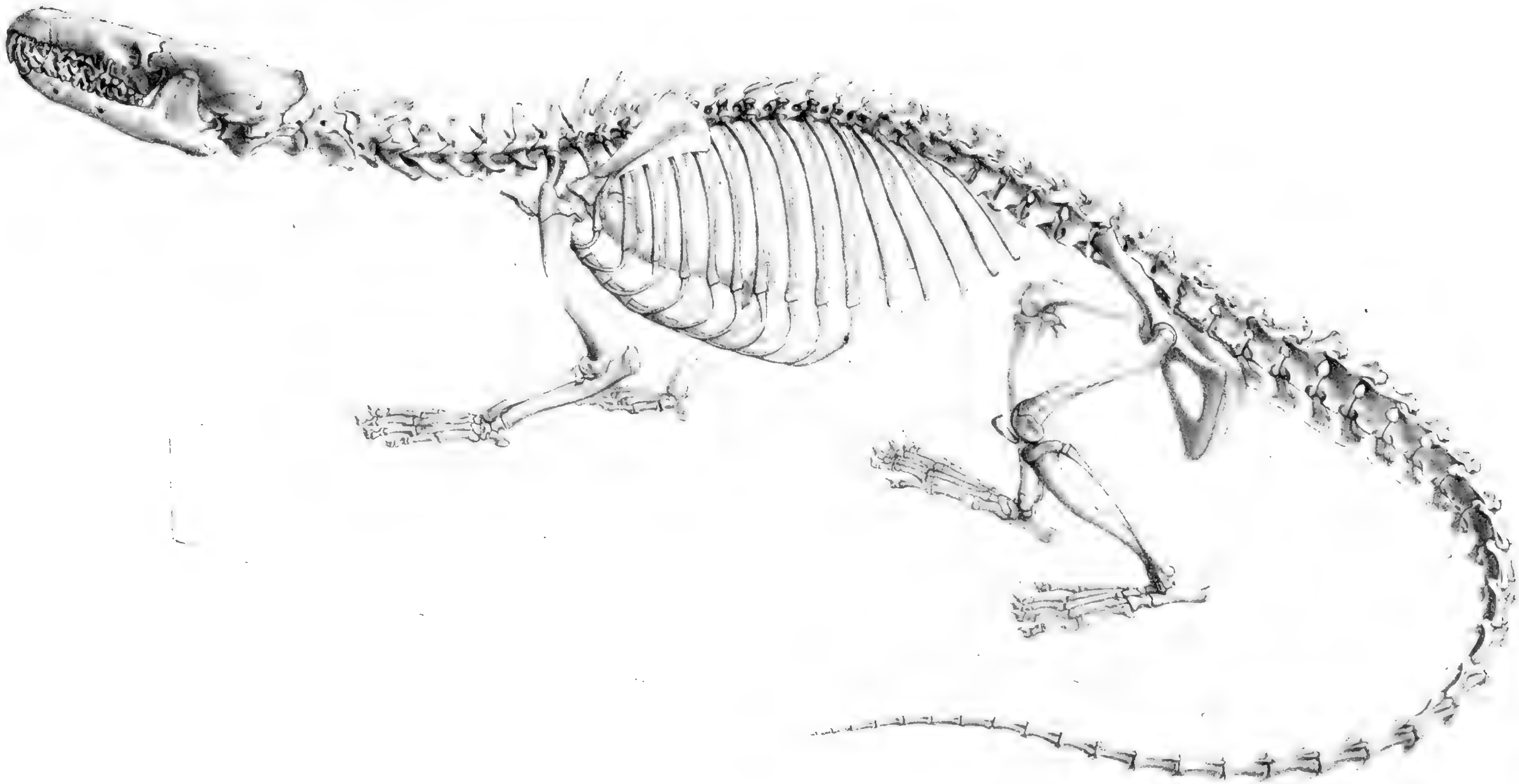
a new one of his own, and proposes to call the West African insectivore by the name of *Bayonia velox*. For the reasons, however, already stated, I must still adhere to the claims of "*Potamogale*" over all other synonyms.

EXPLANATION OF PLATES I. & II.

Plate I. *Potamogale velox*, size of life.
Plate II. Skeleton of *Potamogale velox*, of the natural size.

J Wolf lith

POTAMOGALE VELOX



G.H.Ford

W.West imp.

POTAM ALE VEL

II. *On some Indian* Cetacea *collected by* WALTER ELLIOT, Esq. *By* Professor OWEN, *F.R.S., F.Z.S., &c.*

Read June 26th, 1865.

[PLATES III—XIV.]

CONTRIBUTIONS to our knowledge of the singular and interesting order of Cetacean mammals (*Cetacea vera*, Cuv.) are so desirable, and acquisitions of evidences of exotic kinds are so few and far between, that I am induced to think the following may be deemed acceptable and worthy of publication by the Zoological Society.

The materials chiefly consist of coloured drawings and skulls of species captured or cast ashore on the east coast of the Indian peninsula, in the vicinity of the harbour of Vizagapatam, in the northern circars of the Madras Presidency.

Special care was taken by Walter Elliot, Esq., of Wolfelee[1], when resident at that locality, to have all such "stray waifs" from the whale-family brought directly to his cognizance; and he availed himself of the skill of a native artist, for whose accuracy he vouches, to make drawings of the specimens while recent; and these, for the most part, were executed under Mr. Elliot's own eyes. A selection from the drawings and some skulls of the Vizagapatam Cetacea have been confided to me by my friend for comparison and description; and the results of this labour, as respects what seemed "new to science," I have now the pleasure to communicate.

Family DELPHINIDÆ.

Genus DELPHINUS, *Cuvier.*

DELPHINUS (subgenus STENO, *Gray*) GADAMU, *Owen.*

The "Gadamu" Dolphin. (Pl. III. figs. 1 & 2.)

This species is known to the Vizagapatam fishermen by the name of "Gadamu." It averages about 7 feet in length. The specimen figured is a female of 6 feet 10 inches in length.

The body is fusiform, gaining its greatest diameter at the fore part of the dorsal fin, where the girth is 3 feet 9 inches. From this point the body decreases forward to the head, by straight converging lines laterally (fig. 2), and with a gentle convex curve superiorly (fig. 3), to the eyes and blow-hole; thence the sides of the head converge more acutely to the

[1] Now Sir Walter Elliot, K.C.S.I.

base of the snout, while the forehead descends with a bold convex curve to the same part. The snout, which is divided from the forehead by a transverse groove, extending almost horizontally nearly to the angles of the mouth, equals in length the distance from its base to the eyes, which is five inches and a half. Its vertical diameter at the base rather exceeds the transverse diameter: it gradually decreases to an obtuse apex. The lower jaw projects a little beyond the upper: the "rictus oris" extends backward to very near the eye. This opens at the junction of the lower with the middle third of the vertical diameter of that part of the head. The "blow-hole" is on the same transverse line with the eyes, symmetrically situated on the middle of the vertex, of a crescentic form, with the cresses bent forward (fig. 2, *b*). The pectoral and dorsal fins are falcate, of nearly similar size. The pectorals commence at the beginning of the second fourth part of the entire body: the extent of their base (*i. e.* from the attached fore part to the angle at which the concave hind border begins) is about 9 inches; their length, following the anterior marginal curve, is 1 foot 6 inches: they are attached low down.

The dorsal fin commences 3 feet from the end of the snout (in a straight line): the extent of the attached base is 13 inches; that of the convex anterior border, following the curve, is 1 foot 4 inches.

From the dorsal fin the trunk diminishes in size to the root of the tail-fin, more rapidly laterally than vertically; from the dorsal to the end of the caudal measures 24 inches. The antero-posterior extent of the middle of the tail-fin is 7 inches; the extreme breadth of the fin is 1 foot 10 inches; the circumference of the base or pedicle of the tail-fin is 10 inches. The vent is situated on the mid line below, in the interval between the vertical parallels of the dorsal and caudal fins, and nearer the dorsal, being 2 feet 6 inches from the hind border of the caudal fin: about 2 inches in advance of the vent is the vulva.

The colour of the body is a dark plumbeous grey, almost black upon the fins, especially at their fore part, becoming very gradually lighter to the longitudinal parallel of the attachment of the pectorals, below which the body, from beneath the base of the snout and eye to below the base of the tail, is of a pinkish ashy-grey tint, with a few small irregular blotches of light plumbeous grey. The length of the snout, from the frontal groove, is 5 inches 6 lines; that of the "rictus oris," in a straight line lengthwise, is 11 lines; the eye is about equidistant from the end of the snout and the beginning of the pectoral fin. The greatest vertical diameter of the body is 1 foot 5 inches; the greatest transverse diameter is the same; the greatest girth is 3 feet 10 inches; the vertical diameter of the base of the snout is 3 inches, the transverse diameter 2 inches 6 lines. The number of teeth, as noted by Mr. Elliot in one specimen, was $\frac{27-27}{27-27}=108$; in a second specimen, $\frac{24-24}{24-24}=96$; in the skull transmitted, $\frac{23-23}{27-28}=101$.

This Dolphin would probably belong to that section which Dr. Gray has characterized, under the name of *Steno*, as having the symphysis of the lower jaw "elongate, about $\frac{1}{4}$ the length"[1]; but the definition of the term of comparison being omitted, whether it may be "length of the dental series," "of the mandibular ramus," or "of the entire skull," detracts from my means of testing this osteological character, whatever may be its value in regard to the variation in length of the "symphysis mandibulæ" of the restricted *Delphini* of Cuvier's system.

In the skull, no. 423, of the "Gadamu" (Pl. IV.), the symphysis mandibulæ (figs. 3 & 4, 5, 5) is more than $\frac{1}{4}$th the length of the entire dental series, and about $\frac{1}{5}$th the length of the entire ramus.

Assuming, however, the section or subgenus of the present Dolphin to be *Steno*, it then belongs to that subsection which is characterized as having the "** *Beak separated from the forehead by a cross groove*"[2].

In this section the present species differs from the *Delphinus* (*Steno*) *malayanus* in colour, in number of teeth, and perhaps also in size. The *D. malayanus* is "greyish above and below;" the dental formula $\frac{36-36}{36-36}=144$. From the *Delphinus* (*Steno*) *frontatus* of the Indian Ocean, with teeth $\frac{21-21}{22-22}=86$ or $\frac{21-21}{21-21}=84$, *D. gadamu* differs in the greater number of teeth. From *Delphinus* (*Steno*) *compressus* the present species differs in the minor compression of the head, the shorter and less attenuated snout. The *D.* (*Steno*) *attenuatus*, Gray, departs still further from *D. gadamu* in the length and slenderness of the snout and the more numerous teeth, the formula being $\frac{40-40}{40-40}=160$.

In the skull of *D.* (*Steno*) *gadamu* (Pl. IV.) the maxillo-premaxillary part of the rostrum is broader and lower than in *D.* (*Steno*) *frontatus*, the premaxillaries rise above the maxillaries, at the middle of the rostrum, with a more abrupt transverse convexity, and the maxillaries slope therefrom outward and less steeply downward to the alveolar border. Behind the dental series the bony palate, there formed by the back part of the maxillaries, by the palatines, and pterygoids, forms a longitudinal bar convex across and increasing in depth as it recedes; the sides of the bar are continued into channels of the same length, concave transversely, and impressing the sides of the posterior palatal surface of the maxillaries. This undulating disposition of the bony palate subsides opposite the penultimate or antepenultimate teeth, in advance of which the bony palate is nearly flat, with a strip, 2 inches long, of the vomer at the mid line, and in advance of this is slightly hollow transversely, or canaliculate.

The sockets of the teeth are in contact, about 4 lines in diameter. In the skull transmitted, and here noticed and figured (Pl. IV.), I count 23—23 in the upper jaw, and 27—28 in the lower jaw. The teeth have a long and large rounded base and a short enamelled crown, slightly incurved, not very sharply pointed; about ten anterior alveoli are coextensive with the symphysis.

[1] Zoology of the Voyage of H.M.S. Erebus and Terror: "Cetacea." 4to. 1844, p. 43. Not any of the figures of the skulls of *Steno*, Gray, illustrate the symphysial character in question. In a specimen of *Steno frontatus* in the British Museum the mandibular symphysis is about one-fourth of the entire length of the skull.

[2] Ibid.

The specimen of the Gadamu Dolphin here figured was taken on the 20th March, 1853, at Waltair, the civil station at Vizagapatam; the posterior margin of the dorsal fin had been accidentally slit.

DELPHINUS (STENO?) LENTIGINOSUS, *Owen.*

Freckled Dolphin. (Pl. V. figs. 2 & 3.)

By the same general fusiform character of the body, diminishing to the ends from the greatest girth at the fore part of the dorsal fin, and by the small size of this fin and especially of the pectorals, I am induced to place this Dolphin in the same section with the preceding. From the Gadamu it differs, not only in colour, but in the size of the fins, the pectorals and dorsals being relatively smaller, the caudal fin larger. The body is narrower, being subcompressed; the vertical diameter at the deepest part (fig. 2) exceeds the transverse (fig. 3). The back is rounded in front of the dorsal fin, but is sharp, or keeled, behind it for about half the distance to the caudal, where it again becomes convex until near the root of the tail-fin, which is compressed and sharp above. The forehead is higher and more convex than in *D. fusiformis* (Pl. V. fig. 1), but is continued by an alteration of curve more directly into the rostrum than it is in *D. gadamu* (Pl. III. fig. 1). The transverse groove, as indicated in the drawing (Pl. V. fig. 6, *c*), is defined at the sides of the base of the beak, but above it is less deep or definite than in the two above-named species. The contour-line from the dorsal fin to the forehead is nearly straight, very slightly undulated, not convexly curved as in *D. gadamu.*

The specimen figured (Pl. V. figs. 2, 3) was a female, captured at Waltair, September 18, 1854. She measured 7 feet 10 inches in length, and 4 feet in greatest circumference, being probably pregnant. The colour is pretty uniformly bluish cinereous, or slaty, freckled with irregular small spots or streaks of brown or plumbeous pigment, the streaks longitudinal and flecked with white; the under surface is a shade lighter than the rest of the body. The snout is 6 inches in length, $3\frac{2}{3}$ inches in depth at the base, and 3 inches there across; the skull shows better the predominance of the vertical over the transverse diameter of the rostral production of the jaws. The "rictus oris," 1 foot in length, bends gently upward from the base of the snout to within 2 inches of the eye. This is situated just above the middle of the vertical line crossing that part of the head. From the end of the snout to the eye is $14\frac{1}{2}$ inches. The blow-hole, median in position and shaped as in the foregoing species, is a little in advance of the vertical parallel of the eyes; in the male specimen it was on the same parallel. From the end of the snout to the pectoral fin is 2 feet; the attachment of this fin is subpedunculate, the antero-posterior extent of the peduncle being only 3 inches, while the breadth of the fin, at the posterior basal angle, is 5 inches; the length of the anterior margin, following its very slight convex curve, is 12 inches. The dorsal fin is relatively lower than in *D. fusiformis*, much more so than in *D. gadamu*; the hind border slopes away gradually to an extensive base of attachment, which is continued as a ridge halfway between the dorsal and caudal fins: the length of the dorsal at its front margin is 1 foot 1 inch; from the end of the snout to the dorsal fin is 3 feet 4 inches; from the front border of the fin's base to the mid fissure of the tail-fin is 4 feet 2 inches; the fin is rather more posterior in position than in *D. fusiformis*, and is more obtusely terminated than in that species or in *D. gadamu*, From the hind border of the caudal fin to the vent is 2 feet 5 inches: the vulva is $2\frac{1}{2}$ inches in advance of the vent. The upper part of the pedicle of the caudal fin is obtusely ridged; the middle of the posterior margin of the fin is notched, as in the two foregoing species; the antero-posterior breadth of the fin, near the notch, is 7 inches 6 lines; the transverse breadth of the entire fin is 1 foot 9 lines.

A profile-view of the head and pectoral fin of a male *D. lentiginosus*, taken also at Waltair, which was of a rather darker bluish slate-colour than the female, shows the feeble indication of the fronto-rostral groove beyond the lateral indentations; the interruption of the convex curve of the forehead, before reaching the snout, is rather more marked. The mouth is represented a little open, indicating the relative size of the teeth so exposed; they were $\frac{32-32}{32-33}=129$. As in the female specimen, the pectoral fin is not falciform, but has rather the shape of a scalene triangle, the two shorter sides straight.

The skull of *Delphinus* (*Steno*) *lentiginosus* is rather narrower in proportion to its length than in *D. gadamu*; the occipital condyles are larger, the superoccipital surface is narrower, the temporal fossæ more squared above; the premaxillaries do not rise to form a distinct convexity at the upper part of the rostrum, as in *D. gadamu*, but continue upwards the roof-like slope, begun by the maxillaries, which gives a triangular transverse section to the middle and fore part of the rostrum. The breadth of the rostrum at the antorbital notches is the same in both species, viz. 4 inches; the length of the rostrum, from the notches, is $10\frac{1}{2}$ inches in *D. gadamu*, 11 inches in *D. lentiginosus*. But the chief distinction is in the number of the teeth: in the skull here noticed and figured there are, in the upper jaw, 33—33, in the lower jaw, 32—32 =130, and the teeth are smaller. The extent of the dental series of the upper jaw in *D. lentiginosus* is 9 inches 9 lines, but is not more than 8 inches 6 lines in *D. gadamu*.

The *D. lentiginosus* is known to the Waltair and Vizagapatam fishermen by the Telugu name of "Bolla Gadimi."

DELPHINUS (STENO?) MACULIVENTER.

Spot-bellied Dolphin. (Pl. VI. figs. 1 & 2.)

In the degree of convexity of the forehead the present species resembles the *D. fusiformis* (Pl. V. fig. 1); but the head is relatively larger, and the body is deeper in proportion to its length, than in either *D. fusiformis* or *D. gadamu*.

In colour it presents a well-marked distinctive character from all the Vizagapatam species; it is of a deep, shining, plumbeous black on the upper part, becoming paler near the belly, which, from the under part of the jaw to the perineum, is ashy grey, with irregular spots or blotches, whence the specific name *maculiventer*. The specimen from which figs. 1 and 2 were taken was a female, 6 feet 11 inches in length, found at Waltair, 26th April, 1854. It is called by the fishermen "Suvva."

The fronto-rostral groove is well marked, but short; the "rictus oris" slightly rises as it extends back, to about 3 inches below the fore part of the eye; the under jaw extends beyond the upper, and chiefly forms the obtuse end of the rostrum; this is 5 inches in length, and higher at its base than it is broad. The blow-hole resembles in position and shape that of the previously described species. Both pectoral and dorsal are falcate, but small; the length of the front border of the pectoral, following the curve, is 1 foot 3 inches; from the end of the snout to the setting-on of this fin measures 1 foot 9 inches. The greatest circumference of the body is just in advance of the dorsal fin; the height of this fin is 8 inches, the extent of its basal attachment 18 inches; to the fore part of the dorsal from the end of the snout, in a straight line, is 3 feet 4 inches; from the back part of the dorsal to the hind border of the base of the caudal fin is 3 feet. The body is more compressed than in *D. lentiginosus* (Pl. V. fig. 3). The girth of the pedicle of the caudal fin is 1 foot 2 inches; the fore-and-aft diameter of the fin is 7 inches, the extreme breadth is 1 foot 8 inches; from the median notch of the caudal to the vent is 2 feet 3 inches; extent of perineum (or between the vent and vulva) 3 inches.

The dentition of this species is $\frac{27-27}{30-30}=114$. It appears not to be rare. Specimens were taken in March 1853 and April 1854, all showing the character of colour given in the female figured in Pl. VI. figs. 1 & 2.

DELPHINUS (LAGENORHYNCHUS) FUSIFORMIS, *Owen*.

Spindle-shaped Dolphin. (Plate V. fig. 1.)

The present species is more slender in proportion to its length, has a less elevated and less convex forehead, a proportionally thicker, broader, and more obtusely terminated snout, a deeper mandible or under jaw, especially posteriorly, and smaller dorsal and pectoral fins, especially the latter, than in the foregoing species of *Delphinus*. It appears, likewise, to be a smaller species. The specimen figured, which was the largest taken (at Waltair, on the 23rd August, 1853), was a female, 6 feet in length: the dentition $\frac{22-22}{21-21}=86$. The greatest girth of the body is at the fore part of the dorsal fin; from this the body tapers to both ends, and, through the lower forehead and thicker snout, more regularly than in *D. gadamu*, and presenting a truer spindle-shape of the whole animal, whence the specific name. The "rictus oris" bends upward as it recedes, and does not approach so near the eye as in *D. gadamu*. Both the angle of the mouth and the eye are more elevated in position; the blow-hole is medial, symmetrical, on the same vertical parallel with the eyes; crescentic, with the angles bent forward. The length of the snout is 6 inches, of the "rictus oris" 10 inches; from the end of the snout to the eye 1 foot; from the same to the setting-on of the pectoral fin 1 foot $7\frac{1}{2}$ inches; from the same to the setting-on of the dorsal fin 2 feet 7 inches; from the hind part of the base of the dorsal fin to the hind border of the caudal fin 2 feet 8 inches. The pectoral fin measures 5 inches across the broadest part of its base, and is 1 foot in length, following the curve of the front border, which curve is much less than in the Gadamu. The dorsal fin is lower in proportion to the length of its base; its anterior border also shows a minor degree of convexity; the extent, following the curve, is 10 inches; the line of attachment measures 11 inches. The fore-and-aft extent of the mid part of the caudal fin is 5 inches; the extreme breadth of the fin is 1 foot 4 inches. The vent is 1 foot 9 inches in advance of the mid notch of the caudal fin; the vulva is 5 inches in advance of the vent, the interspace being relatively greater than in the Gadamu.

The colour of the "Spindle-shaped Dolphin" is less darkly plumbeous than in the Gadamu, and becomes more gradually lighter towards the belly; the dorsal fin, the fore part of the pectoral and caudal fins, and the snout have the darkest pigment; the light ashy-grey belly shows no spots.

The difference from any of the three preceding species is still more marked in the skull (Pl. VII.), which presents the general characters of that section of *Delphinidæ* to which the term "*Lagenorhynchus*" has been attached. It resembles in size and general characters the skull of *Lagenorhynchus electra*, Gray; but the occipital condyles are more approximate below the foramen magnum, the presphenoid is narrower, the longitudinal channel formed by it and the pterygoid is deeper and narrower: the rostrum is of equal length in the two species, viz. 9 inches 8 lines from the antorbital notches (*k*); but the breadth there is $5\frac{1}{2}$ inches in *Lagenorhynchus electra* and 5 inches in *Lagenorhynchus fusiformis*. In this species a narrow slip of the vomer (fig. 4, 13), about an inch in length, appears on the bony palate, 3 inches from the anterior end.

In *Lagenorhynchus* (Pl. VII.) the skull is broader in proportion to its length, and the mandibular symphysis shorter, than in *Steno* (Pl. IV.); the transverse undulation of the hind part of the palate is less marked, the middle convex tract being broader and lower, and the lateral channels wider and shallower.

DELPHINUS POMEEGRA, *Owen*.

The Pomeegra Dolphin. (Pl. VI. fig. 3.)

This species belongs to the same section of *Delphinus* as the Black Dolphin of the Cape and Ceylon (*Delphinus longirostris*, Gray[1]) and the *Delphinus forsteri*[2] of the Pacific.

[1] Schlegel. Mr. Blyth has inserted a note on this species in the 'Journal of the Asiatic Society of Bengal,' 1848, pp. 249, 250.

[2] Forster, "Descriptio Animalium," drawing no. 24 (copied by Dr. Gray, in the 'Zoology of the Erebus and Terror,' "Cetacea," 4to. 1845, plate 24).

It was taken off the coast of Madras, and is known to the fishermen there as the "Pomeegra." It is of a very deep plumbeous shining colour, almost black, with a rather lighter shade at the under part of the belly. Mr. Elliot, who was indebted to Mr. Blyth for the specimen, notes it as "a small Cetaceous species;" but the length is not given. The proportions of the snout, of the rictus oris, of the fins, and the form of the forehead (which rises from the base of the snout with a low convexity) are characters in which the *D. pomeegra* resembles the *D. longirostris*, Gray. It chiefly differs in the larger proportional size and smaller number of the teeth, viz. $\frac{41-41}{45-46}=173$. The blow-hole is crescentic, and on the same vertical parallel as the eye. The body enlarges more gradually to the origin of the dorsal fin than in *D. forsteri*, the greatest circumference being at the fore part of that fin. It is more slender in proportion to its length than any of the above-described fusiform Dolphins belonging to the subsection *Steno*, Gray. The symphysis mandibulæ (Pl. VIII. fig. 4) is less than $\frac{1}{6}$th the entire length of the ramus. The hinder half of the palate (ib fig. 2), is widely and deeply channelled on each side. This is, however, but an extension of the modification already pointed out in the hind part of the palate of *D. gadamu* (Pl. IV.), and it is subject to varieties in species which, from the brevity of the mandibular symphysis, the great number and small size of the teeth, and the transversely convex rising of the premaxillaries along a considerable part of the rostrum, would be retained among the *Delphini* as restricted by Dr. Gray. In *Delphinus euphrosyne*, e. g. (Pl. VIII. fig. 5: no. 15, p. 251, 'Catalogue of Cetacea in the Br. Mus.'), the hinder middle tract of the bony palate is not longer, deeper, nor more convex transversely than in *Steno* and *Lagenorhynchus*, and the lateral channels show the same proportions as in the latter subgenus. The prominent mid tract of the palate is too broad and obtusely convex to be regarded as a "ridge," in any species of *Delphinus* proper that has come under my observation.

Sp. dub. Delphinapterus molagan, *Owen*.

Mr. Elliot writes, "I have (or rather 'had,' for I cannot find it) a drawing of a small Cetacean, copied from one made in the Chief Engineer's Office at Madras for Col. Monteith, which was taken from an individual, 32 inches long, of a uniform black colour, with a rounded obtuse head, small mouth, and *no dorsal*. The Tamil fishermen called it 'Molagan.'"

Genus Phocæna, *Cuvier*.

Phocæna (Orca, *Gray*, *Reinhardt*) brevirostris, *Owen*.

Short-snouted Porpoise (skull). (Pl. IX. figs. 1, 2, 3.)

Of this Cetacean I possess only the cranium; but, as it presents the characters of maturity, it is too small for the species represented by the drawings already described, if even the proportions of the rostral part of the skull (Pl. IX. fig. 1, 21' 22) did not show that it belongs to a different section of *Delphinidæ*[1]. The present part of a Cetacean skeleton, as the skulls of those species, figured in Pls. IV. VII. VIII. demonstrate, affords better grounds for comparison and specific determination than do coloured drawings of the entire animal, however accurate,—the number of skulls of ascertained species in home-museums, or otherwise accessible, being much greater than entire and stuffed specimens of the Cetacea, which rarely give the natural contour of head or body.

The animal from which this skull was taken was thrown ashore in the harbour of Vizagapatam in too decayed a state to be figured, and was noted as a "small kind of Porpoise" by Mr. Elliot, who fortunately secured the present evidence of the species, which is now preserved in the British Museum.

The following are the dimensions of the skull:—

	inches.	lines.
Length	11	0
Breadth, greatest, across zygomata	7	4
From the back of occipital condyle to antorbital process of malar bone	7	6
From the antorbital process of malar to anterior end of premaxillary	4	8
From the back part of nostrils to do. do.	7	6

These dimensions show that in the shortness of the "facial" as compared with the "cranial" part of the skull the species agrees with the section of *Delphinidæ*, including the Grampuses and Porpoises, for which Cuvier proposed the subgeneric name *Phocæna*[2], and which, in his 'Ossemens Fossiles,' tome v. part i. (1823), he distinguished as "§ 2. Les Dauphins à tête obtuse" (p. 280), from "§ 1. Les Dauphins à bec" (p. 275) (*Delphinus*, proper)[3].

The number of *Delphinidæ* with obtuse heads or short jaws, which have since been observed, have manifested so many minor modifications in the relative size, shape, and number of the teeth, in the relative size and length of the jaws, in the formation of the bony palate, in the extent of anchylosis, and the forms of processes, &c., of the cervical vertebræ, that numerous subgenera have been founded on these characters. Nevertheless, as each additional kind of blunt-headed Dolphin tends to exemplify the gradational tendency of these modifications, the benefit to zoology of the additional *quasi*-generic names is doubtful; and I shall refer the present skull, which appears to me to belong to an undescribed species, to the *Phocæna brevirostris*, as a member of the section of Cuvier's *Phocænæ*, characterized by conical teeth, in which its nearest alliance appears to be with the *Phocæna globiceps*, Cuv.[4]

[1] The following is Mr. Elliot's note respecting this specimen:—"August 1852. Got the skull of a porpoise which one of the fishermen found dead at the mouth of the Vizagapatam river. He called it 'Ganumu,' and described it as having a rounded head, without beak, colour black or dark above, white below; perhaps a *Phocæna* or *Globicephalus*."

[2] Règne Anim. tome i. p. 290 (1829). [3] Ibid. p. 287.

[4] Ibid. p. 290; Annales du Muséum, tome xix.; Ossem. Foss. tome v. part i. p. 290, tab. 21. pls. 1, 2, 3, figs. 11, 12, 13.

The elements of the occipital have coalesced. The basioccipital (Pl. IX. fig. 3, 1) forms the lower fifth of the foramen magnum, intervening for an extent, measured in a straight line, of $10\frac{1}{2}$ lines between the lower ends of the occipital condyles (ib. 2'): it is here thick and concave transversely: it becomes thinner vertically and expanded laterally as it advances to join the basisphenoid (ib. 5), with which it has coalesced: a slight median longitudinal obtuse rising divides two large shallow concavities, from the sides of which the aliform expansions of the basisphenoid extend, which bend slightly downward to form the lower and inner or mesial wall of the otocrane (ib. *or*). The occipital condyles (figs. 1 & 3, 2', 2') are narrow, vertically elongate, oval convexities, wider at their lower half, with the mesial margin gently convex, the lateral or outer margin sinuous, through a slight concavity marking off the upper third of the condyle: the length of the condyle in a straight line is 2″ 1‴, the greatest breadth 1″ 11‴: the upper ends of the condyles are 1″ 3‴ apart; they are low and sessile. The foramen magnum is vertically oval, widest above, and notched at the middle of the upper border; its length, to the end of the last notch, is 2″, its breadth 1″ 3‴; the breadth across the broadest parts of both condyles is 2″ 9‴. The paroccipital (figs. 1 & 3, 4) an exogenous growth of the exoccipital, forms the back part of the otocrane, towards which it is sinuous or slightly concave, and terminates below in a thick rough border, 4‴ across the thickest part (figs. 3, 4‴); this border is divided by a notch from the otocranial plate (5') of the basisphenoid, and just within the bottom of that notch opens the canal for the nervus vagus. The superoccipital (figs. 1, 2, 3) rises and expands, as in other *Delphinidæ*, into a broad and lofty convex plate reaching the vertex, and there articulating with the parietals (7) and interparietal (7*); a low median ridge (fig. 2, 3') divides vertically the upper half of the superoccipital. On the inner surface, 1″ 6‴ above the foramen magnum, a vertical triangular plate of bone descends into the falx; it is thickest behind, where its base is grooved transversely by the lateral sinus.

The alisphenoids (Pl. IX. figs. 1, 3, 6) coalesce with the fore part of the lateral borders of the basisphenoid, in advance of the otocrane (fig. 3, *or*), of which it forms the anterior wall or boundary: the base of the alisphenoid is notched posteriorly for the third, and anteriorly for the second, division of the trigeminal; it expands as it passes outward, slightly rising (fig. 1, 6) to join the parietal (7), and frontal (11), and to overlap the process of the squamosal (fig. 3, 27'), continued, mesiad, from the glenoid cavity (*g*). The suture between the interparietal (fig. 2, 7*) and superoccipital (3) is obliterated, and that with the parietals is partially so. The suture between the parietal and superoccipital remains at its lower half (fig. 1, 7), showing that a narrow strip of the parietal appears on the external surface of the cranium, extending backward, between the squamosal (27) and superoccipital (3) to the exoccipital (2), and slightly expanding at its junction therewith.

The presphenoid (ib. fig. 3, 9) is distinct from the basisphenoid (5), and extends in the form of a compressed rostrum forward, contracting, to be enclosed by the posterior sheath-shaped part of the vomer (13). The orbitosphenoids (ibid. 10) extend outward, overlapping the pterygoids (24), contract where they form the fore part of the foramen lacerum anterius and the optic foramina, beyond which they expand to support the orbital plate (fig. 3, 11′) of the frontal.

The frontals (Pl. IX. figs. 1 & 2, 11, 11′), in great part overlapped, as in other Cetacea, by the maxillaries (21), show at their narrow exposed strip, extending transversely across the summit of the cranium, the persistant frontal suture, half an inch in length; from this suture the strip curves outward and backward, expanding beyond the interparietal (7*), and then downward and forward, contracting and again expanding, to form the post-orbital process (figs. 1, 2, 12): this is triangular and three-sided, one facet being a continuation of the exposed strip, a second contributing to the temporal fossa, and a third to the orbit (*or*). In the temporal fossa, the frontal (fig. 1, 11) articulates with the parietal (7) and alisphenoid (6); in the orbit (ib. *or*), with the orbito-sphenoid (fig. 3, 10) and malar (26′); then, arching forward from the postorbital process, the frontal forms the superorbital ridge (fig. 1, 11), and articulates anteriorly by a kind of gomphosis with the malar (26′); it is overlapped here, as on the cranium, by the maxillary (21″). The medial parts of the frontals (fig. 2, 11) are united posteriorly with the interparietal (7*), anteriorly with the nasals (15).

The vomer (ib. fig. 3, 13) extends forward to within an inch and a half of the end of the premaxillaries, and behind these it intervenes upon the bony palate between the maxillaries, along a strip of two inches extent and three lines across the broadest part. This palatal part of the vomer (13) is the lower convexity of the canal formed by the spout-shaped bone; the hollow of the canal is exposed at the upper interspace of the premaxillaries. Here, also, is seen, two inches behind the fore end of the vomer, the rough thick anterior border of the coalesced prefrontals (fig. 2, 14), which contracts as it passes into their upper border, forming the septum of the nostrils, expanding below and behind to form the back wall of the nasal passages (14′). At this part a trace of the suture between these foremost neurapophyses of the skull remains. Their bifid spine —the small transversely extended subquadrate nasals (15)—intervenes between the frontals (11) and prefrontals (14′). The palatine bones appear on the palate as narrow strips (fig. 3, 20) wedged between the maxillaries, (21) and pterygoids (24), and united together beneath the vomer by a longitudinal suture of 3‴ extent: then, passing outward and forward, after a brief contraction they suddenly expand and bend upward to line or form the mesial wall of the orbit, and again contract to articulate with the frontal at the superorbital fossa; the mesial borders of the palatines articulate with the vomer and prefrontals; and between the pterygoids and the vomer the palatines form the fore part of the lower half of the nasal passages. The orbital plate of the palatine sends off an outer thin lamina, which terminates by a free margin at the back of the orbit. The palatine plates of the maxillaries (21) unite together for about an inch in front of the palatines, then slightly diverge to give place to the vomer (33), which, however, does not sink to their level; in advance of the vomer the plates slightly diverge to their anterior ends, giving place to the premaxillaries (22′), which form the apex of the muzzle: the rest of the disposition of the maxillaries accords with Cuvier's account in *Phocœna globiceps*; the superorbital plate (fig. 1, 21*) is divided by a notch from the rostral part (21) of the maxillary, and forms a tuberosity articulated with the underlying malar (26′). The premaxillaries (22) accord equally with those in *P. globiceps*, save in their shorter proportions concomitantly with the shorter muzzle. They are perforated near the outer margin, between the posterior and middle third, the canal leading forward and inward. The three perforations (fig. 2, *a*, *b*, *c*) in the maxillary external to the nasal portions of the premaxillary (22′), are the upper outlets of canals which converge to open into an oblong fossa (fig. 3, 26) beneath the fore part of the roof of the orbit.

The pterygoid (fig. 3, 24, 24′) is a large sinuous plate folded upon itself from within, upward, outward, and backward; the thick fore part (24) articulates with the palatine, whence it continues the bony roof of the mouth backward for the extent of 1″ 8‴, with a convex surface, divided from its fellow by a vacancy of 8‴ breadth, exposing the presphenoid and vomer; the inner plate of the pterygoid forms the outer wall of the lower part of the nasal passage, and continues that passage obliquely backward, as an open canal (24′), beneath the base of the alisphenoid (6), as far as the otocranial plate of the basisphenoid (5′). This posterior production of the pterygoid is three-sided; the inner or narial one is concave; the outer one is also concave, forming a channel leading upward and forward to the orbit; the upper facet is sutural, and articulated with the basi-, pre-, ali-, and orbito-sphenoids. The anterior external lamina of the pterygoid bends outward and upward to articulate with the corresponding free lamina of the palatine, bounding the narrow and deep sinuous fissure between the outer and inner portions of both bones.

The malar, as in other *Delphinidæ*, consists of the antorbital (Pl. IX. fig. 1, 26′) and styliform (26) portions. The former (26′) is a narrow triangle, with the base thick, convex, turned forward, underpropping the fore part of the superorbital plate of the maxillary (21*), and articulating with the same part of the frontal; the apex extends backward, and is wedged into the roof of the orbit between the frontal and maxillary. The styliform portion (26) is given off by a process extending inward (mesiad), at right angles to the antorbital portion (fig. 3), and a few lines behind its fore part; it suddenly contracts and extends backward, with a slight bend, to the squamosal, articulating by a concave, oblique, terminal facet to a tubercle at the fore and under part of the zygomatic process of the squamosal (fig. 1, 27). The length of this part of the malar is 3″; its thickness throughout the greater extent is $1\frac{1}{2}'''$ by 1‴; its squamosal articulation is 4‴ across. The form of the orbit (ib. *or*) so defined below is longitudinally oblong, more arched above than below, 2″ 2‴ in fore-and-aft diameter, 1″ 2‴ in greatest vertical diameter; the chamber communicates, of course, largely with the temporal fossa, and continues into the deep, ascending orbital fossa and the small autorbital fossa (*d*), external to which is the rough malomaxillary fossa (*e*).

The squamosal consists chiefly of its articular or zygomatic part (Pl. IX. figs. 1 & 3, 27), which is deep in proportion to its length, truncate, and three-sided; the outer side is slightly convex and rather rough, 1″ 5‴ in depth posteriorly; the inner side is divided between the articular cavity (fig. 3, *g*), rough for syndesmosis with the mandible, and the smoother surface internal to it, which extends mesiad in a triangular depressed form (27′) beneath the back part of the alisphenoid (6), but without joining it: the upper surface, of an inequilateral shape, contributes a lower wall to the temporal fossa. The squamous portion (fig. 1), continued upward from this facet, is triangular, with a rounded apex, about an inch in length, and rather more in height; it is applied against the alisphenoid (6) and parietal (7). The rough posterior tract articulating with the parietal (7) and exoccipital (2), and contributing to the outer wall of the otocrane (fig. 3, *or*), I consider to be the "mastoid" confluent with the squamosal, together forming the bone which should be termed "squamo-mastoid." The mastoid part terminates below in a rough, flattened, triangular surface (fig. 3, 8), 5″ 7‴ in diameter, which is divided from the zygomatic or articular process of the squamosal (*g*) by a deep fissure. On the inner side of the base or back part of the mastoid, in the line of its suture with the parietal, is the (stylomastoid?) fossa. The squamosal forms no part of the inner or proper wall of the cranial cavity. The glenoid or mandibul-articular surface (*g*) is longitudinally oblong, 1″ 5‴ by 8‴ in diameter, moderately concave, least so transversely, and looking inward, downward, and with a slight inclination forward. The mandible offers no notable peculiarity, save that which relates to shortness in proportion to the entire skull, concurrently with the same specific character of the upper jaw. The depth of the ramus at the coronoid process is relatively as great as in the longer-jawed species, and consequently bears a greater ratio to the length of the entire ramus: this in the present skull is 7″, the greatest vertical extent of the ramus being 2″ 6‴; the shallowest part of the ramus is where it supports the teeth; it deepens a little at the short symphysis. There are fourteen alveoli approximated in a common groove in each mandible, extending along 3″ 3‴ from the symphysis. The corresponding groove of the upper jaw (fig. 3) shows seventeen alveoli, along an extent of 3″ 6‴. The deeper part of the alveolus is distinct in the anterior teeth; but, as they recede, the sockets are indicated by depressions merely in the common groove. The teeth are slender ones: the anterior ones in the upper jaw average a length of 8‴, two-thirds of the irregular cement-covered, thickened, and solid base being implanted, the exposed third forming a smooth, partially enamelled, pointed crown, with a circular transverse section and in most a slight incurvation; the length of crown is from 3‴ to 4‴, the diameter of its base 1‴, that of the inserted root 2‴.

As in other *Delphinidæ*, the bony palate is entire, save at the slight median divarication of the maxillaries and premaxillaries, and the major part of this median fissure is closed by the vomer. A pair of small (neuro-vascular) foramina is situated near the maxillo-palatine suture, and one or two others obliquely groove and pierce the palatine plate of the maxillary.

The optic foramen communicates or is blended with a larger vacuity or fissure between the orbitosphenoid, frontal and pterygoid, which might be termed the spheno-frontal fissure. The foramen rotundum, in like manner, is blended with a larger vacuity between the ali- and orbito-sphenoids, answering to the "fissura lacera anterior" of anthropotomy, and which may be called the "intersphenal fissure"[1].

The removal of the loosely attached petrotympanic exposes the wide otocranial vacuity (Pl. IX. fig. 3, *or*) in the basal walls of the cranium, which is a characteristic feature of the Delphinoid as compared with the Physeteroid skull (Pl. XIII. fig. 2), where the otocranial is walled off from the cranial cavity. The otocrane, in both, is bounded by the paroccipital, basisphenoid, alisphenoid, and squamo-mastoid: in the present species of *Phocæna* it presents a subquadrate form, 1″ 4‴ in diameter, with the angles rounded off, notched anteriorly by the third division of the fifth, whereby the "foramen ovale" blends with this great vacuity.

The entocarotid foramen pierces the outer and fore part of the base of the otocranial plate of the basisphenoid, close to, perhaps at, the line of confluence of the alisphenoid. There are neither olfactory nor lacrymal foramina. The absence of the rhinal capsules simplifies the condition of the prefrontals, and facilitates the comprehension of both the special and general homologies of these interesting bones. A pair of minute foramina lead from the cranial cavity to the narial ones piercing the prefontals; but they do not give passage to olfactory nerves in the *Delphinidæ*.

The departure from symmetry in the present Delphinoid skull is slight: it is seen in the greater backward extension of the nasal plate of the right premaxillary (fig. 2, 22″), in the larger size of the prenarial plate of the right maxillary, and in a feeble inclination of the upper margin of the septum narium to the left.

Family PHYSETERIDÆ (Cachalots or Sperm-Whales).

Genus Euphysetes, *Macleay*.

Physeter (Euphysetes) simus, *Owen*.

The Snub-nosed Cachalot. (Plates X.–XIV.)

The Cetacean which I have next to describe is represented by drawings of the adult male (side view, Pl. XI. to scale) and female (side view, Pl. X. fig. 1; upper view, fig. 2; to scale). It is noted as "a kind of Porpoise" in Mr. Elliot's MS., and is known to the Telugu fishermen of the coast by the name of "Wonga." The male, measuring 6 feet 8 inches in length, was taken at Waltair, February 28, 1853. The female was taken on the 1st of March, 1853, at the same part of the coast; she measured 6 feet in length.

[1] It is noticed as "le trou sphéno-orbitaire," by Cuvier, 'Oss. Foss.' tom. cit. p. 294.

The resemblance to the Porpoise was suggested by the shortness of the snout; but this is more obtuse, and is not marked off from the rest of the head by any sudden narrowing. More important differential characters suggest the affinity of the "Wonga" to a family of toothed Whales, distinct from the *Delphinidæ*.

The first and most important of these is the inferior position of the mouth, beyond the small opening of which the blunt rostrum extends forward from 4 to 6 inches. The blow-hole (Pl. X. fig. 2) is single, but is not medial in position or symmetrical in shape; it is in advance of the eye, opens to the left of the mesial plane, is proportionally larger than in the Porpoise, and is crescentic, but curves obliquely from the mid line outward and backward, with the convexity turned forward and to the left, and the angles or "cresses" directed backward and to the right. The anterior angle is 5 inches from the end of the snout. The eye is small; the palpebral orifice is between 7 and 8 inches from the end of the snout, and opens in the upper half of the head, seen in profile, near the boundary dividing it from the lower half. From the vertical line bisecting the eye to the end of the muzzle the head forms a cone with a blunt apex, less obtuse when viewed from above (fig. 1) than from the side (fig. 2), where the lower slope is interrupted by the small "rictus oris:" this is formed by a kind of semicircular excavation of the under part of the snout, into which the short dentigerous part of the lower jaw fits, like a box in its lid. The length of the "rictus" in a side view, straight line, is 2½ inches in the male, 2 inches in the female. From the the parallel of the eye, the head, as it recedes, enlarges less rapidly; and the trunk continues gradually to expand to about midway between the end of the snout and the base of the tail. The widest part of the trunk is a little more forward in the male than in the female.

According to the figures, the pectoral fin becomes free 1 foot 1 inch behind the snout in the male, and 1 foot 4 inches in the female; but there may be some inaccuracy here. The length of the fin in both is 1 foot; its extreme breadth is 4½ inches in the male, 4 inches in the female: its line of attachment is in the lower third of the trunk, as seen in profile. The dorsal fin is well developed, subfalcate in shape; its anterior border is halfway between the snout and the base of the tail. The length of the base of the fin is 10 inches in the male, 9 inches in the female: the height of the fin, vertically at its back part, where the apex curves back a little beyond the basal attachment, is 7 inches in both. The anterior border of the fin is slightly convex; its length, in a straight line, is 1 foot.

The body, as has been said, gradually expands to near the origin of the dorsal fin, and thence contracts to the setting-on of the caudal fin: here the tail, or tail-end of the trunk, measures 3½ to 4 inches in vertical and nearly 2 inches in transverse diameter.

The expansion of the trunk is pretty equal in every direction towards the dorsal fin, and the upper surface gives the appearance of the fore part being subdepressed: the diminution beyond the dorsal is more rapid from side to side than from above downward. The greatest vertical diameter of the trunk is, in the male, 1 foot 6½ inches, in the female 1 foot $4\frac{1}{2}$ inches: the greatest transverse diameter of the trunk in the female is 1 foot 2 inches.

The caudal fin, the shape of which is given in fig. 2, Pl. X., measures, in the female, 1 foot 7 inches in extreme breadth, and 7 inches across the base of each lateral lobe. Between the dorsal and caudal fins, and nearer the latter, the mid line of tegument is raised into a longish, very low and obtuse ridge. The vent opens 1 foot 10 inches in advance of the posterior cleft of the tail-fin in the male, and 1 foot 7 inches from the same part in the female. It is 10 inches behind the vertical line dropped from the back border of the dorsal fin, in the male, and 8 inches behind the same part in the female. The vulva is three inches in advance of the vent; the prepuce of the male is 9 inches in advance.

The note, as to colour, accompanying the drawings is—"Above shining black, smooth; beneath paler, pinkish, but in one discoloured with blood." The dentition is $\frac{1-1}{9-9}=20$. (Pl. XII. fig. 1, *x*, 32).

The *Physeteridæ* (Cachalots or Sperm-Whales) are characterized by having the opening of the mouth inferior in position, not terminal. The largest known species (*Physeter macrocephalus*, Linn.) has a reduced or boss-like representative of the dorsal tegumentary fin, and a dorsal longitudinal ridge has been attributed to it near the base of the tail. The soft parts of the head, which project in advance of the jaws or opening of the mouth, form a large obtuse truncate mass. The external blow-hole is reduced by its operculum or flap to a single sigmoid fissure on the left side of the upper and fore part of the head, *i. e.* at or near to the summit of the truncate end of the snout. The functional teeth are limited to the lower jaw, and chiefly to the long symphysial part; those of the upper jaw, when present, are minute and concealed in the thick gum, in fossæ which receive the summits of the larger lower teeth when the mouth is closed. The maxillary bones are so developed as to bound a large concavity, or chamber, for the "spermaceti," at the upper part of the skull in advance of the short brain-case (Pl. XIV. fig. 2, 21′).

The question put by Cuvier[1], whether any large Sperm-Whale may exist, characterized as above, but with a high dorsal fin, with the blow-hole near the forehead on the middle of the head, and with the mandibular rami not united at a long dentigerous symphysis, still waits a reply from a direct and good observer of such problematic Cachalot.

The Sperm-Whale towed ashore in the harbour of Port Jackson, New South Wales, December 1849, and referred by Macleay to the species "*Catodon australis*"[2], had the blow-hole situated at the upper termination of the snout, as in the true Sperm-Whale[3]; and the dentigerous symphysis of the mandible was more than half the entire

[1] Ossemens Fossiles, 4to. vol. v. pt. i. p. 340.

[2] 'History and Description of the Skeleton of a new Sperm-Whale, lately set up in the Australian Museum,' by Wm. S. Wall, Curator. 8vo. Sydney, 1851.

[3] Ib. p. 11.

length of the ramus (48 inches to 92 inches)[1]. The blubber-portion of the carcase having been removed previously to the articulator's arrival on the spot[2], no observa on the condition of the dorsal fin or hump was made.

Cuvier characterizes the "Cachalot macrocéphale" (*Catodon macrocephalus*, Art., *Physeter macrocephalus*, Linn.) as having the back provided with a slightly raised prominence, which some have called "fin," others "longitudinal ridge", others "hump" or "tubercle" (*loc. cit.* p. 338): "Il a une dorsale très-peu saillante vers l'arrière du dos, quelquefois réduite à une protubérance, ou à deux ou trois" (ib. p. 339). In the 'Règne Animal,' Cuvier says, "Il n'a qu'une éminence calleuse au lieu de nageoire dorsale" (tom. i. p. 294, ed. 1829). In the judicious criticism on the alleged or nominal species of Sperm-Whales, in the 'Ossemens Fossiles,' Cuvier asks, "Existe-t-il en outre des Cachalots à haute dorsale? en existe-t-il dont l'évent soit percé près du front sur le milieu de la tête? en existe-t-il où les branches de la mâchoire inférieure ne soient pas réunies sur la plus grande partie de leur longueur en une symphyse cylindrique? Voila ce qui reste à chercher, ce qui reste à prouver autrement que par des figures tracées par des matelots. Ce n'est qu'après que des hommes éclairés auront observé ces êtres avec soin, et en auront déposé les parties osseuses dans des collections où elles puissent être vérifiées par des naturalistes, qu'il sera possible à la critique de les admettre dans le catalogue des animaux" (*tom. cit.* p. 340).

As regards large Cachalots these questions, as I have remarked, still wait their solution. In the small Cetacean called "Wonga," of the seas washing the eastern coast of the Indian peninsula, we have, however, a satisfactory reply to them.

In it we possess a member of the *Physeteridæ*—a Cachalot in fact—though small, in which the dorsal is lofty, with the usual shape of such well-developed fin in Cetacea, in which the blow-hole is not terminal but near the forehead, and in which, as will presently be shown, the mandibular rami are united by a symphysis of less than half the length of the "rami." The inferior mouth, unsymmetrical blow-hole, and the second tegumentary production in form of the dorsal ridge, shown in the careful drawings by the native artist, significantly indicated the family affinities of the "Wonga:" the enlightened attention and care bestowed by Mr. Elliot on this seldom-studied branch of zoology has enabled me to place this conclusion on unequivocal grounds, through his transmission, with the drawings, of the skull of one of the individuals figured.

To the study and comparison of this precious evidence I have devoted full attention: it is figured, half the natural size, in Plates XII., XIII., & XIV. fig. 1. Its peculiarity of form is extreme: perhaps no other Cetacean skull has yet been observed in which the cranial so greatly preponderates over the rostral part. In the degree in which this proportion prevails in the skull first made known by De Blainville as of the Cachalot which he called *Physeter breviceps*[3], and in that subsequently described by Macleay[4] under

[1] *Op. cit.* p. 9.

[2] *Op. cit.* p. 4.

[3] Annales Françaises et Etrangères d'Anatomie et de Physiologie, tom. ii. (8vo, 1838) p. 335: "Sur les Cachalots."

[4] *Op. cit.*

the name *Euphysetes grayi*, may be discerned at a glance the more immediate affinities of the present species, which I propose to call *Physeter* (*Euphysetes*) *simus*, in reference to its peculiarly short obtuse muzzle.

Description of the Skull.

(Pls. XII., XIII., & XIV. fig. 1.)

Short as is the upper jaw in proportion to the skull in *Phocæna brevirostris* (Pl. IX.), it is shorter in the subgenus or section of *Physeteridæ* represented by the *Physeter breviceps*, De Bl. (Pl. XIV. fig. 3), and shortest of all in the present species (ib. fig. 1).

In the following Table of admeasurements are given those of the *Physeter* (*Euphysetes*) *grayi*, Macleay (the larger species which was stranded on the Maroobrah beach, near Sydney, New South Wales, and the skeleton of which is now in the Australian Museum of that city), with the few admeasurements appended by De Blainville to his notice of *Physeter breviceps*, from the Cape of Good Hope[1].

	P. simus.		*P. grayi.*		*P. breviceps.*	
	inches.	lines.	inches.	lines.	inches.	lines.
Length from the back of occipital condyles to end of snout	10	5	16	6	15	5
Breadth across postorbital processes	9	5	14	0		
Breadth across the beginning of malo-maxillary fissure	7	10	9	6		
From the back of occipital condyle to antorbital process of malar	7	7				
From the antorbital process of malar to end of snout	4	3				
From the back of occipital condyles to posterior wall of left nostril	4	10	6	0		
From the bottom of malo-maxillary fissure to end of snout	5	0	7	0		
From the beginning of malo-maxillary fissure to end of snout	4	2	5	8		
Breadth of snout between the fore part of the antorbital notches of maxillary	4	9	8	0		
Breadth of snout at its extremity	1	4	2	0		
Breadth of premaxillaries at the malo-maxillary fissure	2	3	3	9		
Breadth between anterior ends of premaxillaries	0	4	1	3		
Antero-posterior diameter of left nostril	1	5	2	0		
Transverse diameter of left nostril	1	0	2	1½		
Antero-posterior diameter of right nostril	0	3½	0	6		
Transverse diameter of right nostril	0	4	1	0		
Length of interfrontal crest, straight line	3	6	6	2		
Width of occipital foramen	1	3	1	6		
Vertical diameter of foramen	1	8	2	4		
Between outer edges of occipital condyles	2	9	4	0		
Breadth between paroccipitals	6	2	11	0		
From the lower border of basioccipital to vertex	5	6	11	0		
Length of mandible, in a straight line	8	6	13	3	13	10
Length of alveolar series	2	9	5	3		
Height of mandible at coronoid ridge	2	1	4	3		

In the skull of the *Physeter simus* the occipital elements have coalesced with each other and with the surrounding bones. The vertical diameter of the basioccipital

[1] Annales Françaises et Etrangères d'Anatomie et de Physiologie, tom. ii. tab. x. (the admeasurements are given in French inches), viz. :—"Longueur du crâne 14 pouces et demi," =15″ 5‴, Engl. "Longueur de la mâchoire inférieure 13 pouces," =13″ 10‴, Engl. Ecartement de ses condyles 12 pouces," =12″ 9‴ Engl.

(Pls. XII., XIII., & XIV. fig. 2, 1) beneath the foramen magnum (ib. *o*) is 8 lines: it is here convex vertically, and concave transversely, showing a width between the lower end of the occipital condyles (to which it probably contributed) of only 4 lines. These (Pl. XII. fig. 2, 2′) are more sessile than in *Phocœna brevirostris*, being raised only by a linear border from the contiguous bone, except at their lower ends, which are rather more prominent: the long diameter of the condyle is 2″ 2‴, the greatest breadth 1″: they are terminal, diverge as they ascend the sides of the foramen magnum, which is widest opposite their upper ends: the outer border of the condyle is more convex than the inner one. The foramen magnum is oval, with the larger end upward and not notched: the aspect of the plane of the aperture is backward and a little upward: in *Physeter macrocephalus* (Pl. XIV. fig. 2, *o*) it is more upward than backward. The ex- (2) and superoccipital (3, 3′) plate inclines from below, upward, outward, and forward, with a moderate convexity or indication of a pair of such. The exoccipital portion (Pl. XII. 2) extends outward and slightly downward, expanding a little vertically, and thickening to form the paroccipital (4); this expanse is moderately concave transversely, convex vertically. The border of the paroccipital is thick and rugged: it is concave toward the otocrane (Pl. XII. fig. 1, and Pl. XIII. fig. 2, *e*), of which it forms the posterior half of the upper, and part of the posterior wall: it is divided below by a fissure (Pls. XII. & XIII. fig. 2, *l*) from the otocranial plate of the basioccipito-sphenoid (Pl. XII. fig. 1, and Pl. XIII. fig. 2, 5′): this plate arches outward and downward, with a slight obliquity backward, and is overlapped anteriorly by the pterygoid (ib. 24′), which seems to form an anterior continuation thereof, converging towards its fellow: but the free border of the basisphenoidal otocranial plate (5′) is more obtuse and thicker than that of its pterygoid prolongation (24). A trace of the suture between the exoccipital (Pl. XII. fig. 1, 2) and squamosal (ib. 27) remains. The ridge across the vertex (Pls. XII. & XIII. fig. 1, 7, 11, 3) is obtuse, but well marked: the proportions contributed by the superoccipital (3), parietal (7), and interparietal (if any) cannot be determined; and the frontal (11), as it ascends, contracting from the superorbital roof, is also blended with those constituents of the ridge[1]. The instructive harmonia between basi- (Pls. XIII. & XIV. fig. 1, 5) and presphenoid (ib. 9) remains.

The alisphenoid (Pl. XIII. fig. 2, 6), coalesced with the basisphenoid, where it is underlapped by the pterygoid (24′), is horizontal; it extends to the lower border of

[1] To afford a comparison with *Physeter macrocephalus*, I propose to append, in the present note, descriptions of the homologous cranial bones of a fœtus of that species described, in my 'Catalogue of the Osteological Series in the Museum of the Royal College of Surgeons,' 4to. 1853:—"The elements of the occipital neural arch are unanchylosed. The lateral margins of the anterior half of the basioccipital are produced and bent obliquely downward. The exoccipitals are much produced and expanded laterally: they are deeply notched below. The superoccipital contributes the upper ends of both condyles: it is in the form of a vertical plate, convex from side to side: a strong internal vertical crest is produced forwards: it is overlapped at its lower and lateral angles by the exoccipitals, anterior to which it reaches the alisphenoids, and is notched externally for the reception of the upper angle of the squamosal" (*op. cit.* p. 442).

the temporal fossa (ib. *t*), underlapping the squamosal (ib. 27), and thinning-off to its outer margin: its anterior border is notched by the intersphenal fossa (*tr*): there is no distinct foramen ovale. It supports the natiform protuberance of the cerebrum, and is divided from the orbitosphenoid (ib. 10) by the intersphenal fissure (*tr*), from which two channels lead toward the back part of the orbital roof (*or*), blending together and widening as they grow shallow[1]. The temporal fossa (Pl. XII. & Pl. XIII. fig. 2, *t*) is 1″ 1‴ in antero-posterior, and 2″ in transverse extent, has its marginal boundary almost completed by the approximation of the postfrontal (ib. 12) to the zygomatic part of the squamosal (ib. 27), the distance between their free ends being but 6‴; but the zygoma terminates on a lower level (Pl. XII. fig. 1, 27).

The presphenoid (Pls. XIII. & XIV. fig. 2, 9) retains its distinction from the basisphenoid (5), but has coalesced with the orbitosphenoids (10), as have these with the alisphenoids (6).

The orbitosphenoid (ib. 10) has its posterior boundary partially defined by the intersphenal fissure, at the fore part of which the optic canal is marked off by an intercranial process arching over the same downward and backward (Pl. XIV. fig. 2, *n*): the orbitosphenoids expand and ascend to form with the coalesced frontals the anterior wall of the cranial cavity; the optic channel extends forward and outward from the intersphenal fissure, and, blending with the trigeminal one (Pl. XIII. fig. 2, *tr*), is lost on the roof of the orbit (ib. *or*)[2]. The fossa (ib. *d*), into which the foramina on the frontal or nasal plate of the maxillary opens, is in advance of the optic channel (ib. 10). There is no intraorbital fossa answering to that in *Phocæna brevirostris*. The roof of the orbit is unbroken, gently concave from before backward, formed chiefly by the frontal (Pl. XII. fig. 1, 11, 11′), which is notched near the middle of the superorbital ridge: this is thick, obtuse, and produced backward and downward into a postfrontal or postorbital process (ib. 12). Above the ridge, the frontal (ib. 11′) contracts; its surface is here free from the maxillary (21′), is slightly concave vertically, before it is reduced by the overlapping of the parietal (7) and superoccipital (3) behind, and of the maxillary (21′) in front, to the narrow strip (11), which rises, bending convexly, to the vertex. The fore part of the superorbital ridge (11′) is obtuse, and thickens to join the malar (26), from which it is partly divided by a notch[3].

[1] "The basisphenoid, or thick hexagonal bone, concave from side to side below, nearly flat above, is anchylosed to the alisphenoids: these are perforated near the middle of their base by the foramina ovalia and rotunda, have a thick quadrate plate on their inner side, forming their entocranial surface: they extend into a point anteriorly, and articulate both with the frontal and with the parietal angle of the superoccipital. The squamosal receives the alisphenoid in a groove anteriorly."—*Physeter macrocephalus*, op. cit. p. 442.

[2] "The presphenoid and the anchylosed orbitosphenoids form the anterior wall of the cranial cavity, and are perforated by the optic foramina: they articulate anteriorly with the frontal, sending up a small process into the interspace at the beginning of the frontal suture, which process is impressed by a fossa in each of its sides: the posterior and lateral parts of the orbitosphenoids unite with the great alæ; the under and anterior part is overlapped by the vomer."—*Physeter macrocephalus*, op. cit. p. 447.

[3] "The frontals are large triangular plates, concave externally, with the outer and fore angle produced into

The vomer (Pl. XIII. figs. 1 & 2, 13, 13′) has partially coalesced with the presphenoid (ib. fig. 2, 9) and underlaps the prefrontals (Pl. XIV. fig. 1, 14): it appears upon the palate, about an inch in advance of the posterior fissure (Pl. XIII. fig. 2, *w*), expands to a breadth of 6 lines (13′), and is continued to the anterior end of the upper jaw, which it forms, contracting there to a breadth of 3 lines. Its under surface is flat; its upper surface (fig. 1, 13), which is similarly exposed on that aspect of the muzzle, is smoothly and widely canaliculate: the groove lodges the cartilage in the fissure separating the premaxillaries (ib. 22), which cartilage terminates anteriorly the series of vertebral centrums, of which the vomer is the inferior or cortical ossification. The fore margin of the confluent prefrontals (ib. 14) is at 3 inches distance from the fore end of the vomer. The prefrontal, losing breadth and gaining depth, recedes with a slight bend to the left, forming the inner boundary of the large left nostril (ib. *ol*) and the corresponding wall of the small right nostril (Pl. XIV. fig. 1, *ol′*). The nasal bones are confluent with that osseous mass (Pl. XIII. fig. 1, 15) which rises from the back of the septum narium and extends in a sinuous course, first convex to the left and then concave before subsiding at the vertex (15′): this ridge also sends off a kind of "spur" (15) from its right side, in the form of a short ridge, inclining to the right, with a convex border, thick and obtuse like that of the main ridge: the intervening space (ib. *y*) between these ridges expands as it extends forward, with a smooth sinuous surface concave across slightly contracting again as it ends behind the right nostril[1].

A trace of the suture of the palatines (Pl. XIII. fig. 2, 20) shows that they entered into the formation of the bony palate for half an inch at the postpalatal end of the vomer (13′), almost meeting each other behind that part: as they extend outward, they expand to a fore-and-aft breadth of 10‴, with a convex surface, most so in their direction from within, outward and backward, contracting to terminate mesiad of the fossa (*d*): they develope no outer or free lamella in *Euphysetes*.

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a long superorbital process, the channel on the under part of which contracts, as it approaches the cranium, into a long, deep, and narrow groove. The median anterior part of the bone unites with both orbito- and alisphenoid, and external to this is the broad sutural surface for the squamosal. The straight median margins of the frontals are thinned off and joined by a squamous frontal suture, the right overlapping the left. The whole posterior and lateral border of the frontals, as far as the junction with the squamosal, presents a broad oblique sutural surface, which joins, by overlapping, the contiguous border of the occipital. The smooth cerebral surface of the frontal is flat at the middle, arched at the sides, and not impressed by any convolutions."—*Physeter macrocephalus*, op. cit. p. 442.

[1] M. de Blainville figures, but makes no mention of this bony ridge bisecting the "postnarial" cavity. Dr. Gray, in appending the term *Kogia* to the *Physeter breviceps*, De Blainv. (Zoology of the Erebus and Terror, "Cetacea," 4to. 1846, p. 22), is equally silent—indeed, adds nothing to De Blainville's meagre sketch of so remarkable a cranium, and quotes his admeasurements as in English inches and lines, without correction for the difference of the French "foot." Macleay was the first who pointed out the heavy ridge of bone that longitudinally divides the spermacetic cavity into two unequal parts (*op. cit.* p. 47) as subgenerically distinguishing his *Euphysetes* from *Physeter* or *Catodon*.

The maxillary (Pl. XII. fig. 1, Pl. XIII. figs. 1 and 2, 21) forms the major part of the bony roof of the mouth: a small triangular strip of the premaxillary (Pl. XIII. fig. 2, 22) is wedged into the short anterior interspace between the maxillary (*x*) and vomer (13′). The palatal surface (21*) is moderately convex transversely, straight lengthwise, and is impressed by an alveolar groove (*al*) retaining one socket and tooth (Pl. XII. fig. 1, *x*) at the fore end and continued in a straight line backward for 3 inches (rather more on the left, rather less on the right side) without indications of alveoli, and in a line not parallel with the outer margin of the bone, but receding to a distance of 1 inch from it, posteriorly; so that the teeth, if developed there, would be rather palatal than marginal in position. The outer border of the maxillary thickens near the malo-maxillary fissure (21, *k*), with a smooth convex exterior. That fissure dilates, as it sinks obliquely backward and inward, to a breadth of from 3 lines to 4 lines, its depth being 1 inch 6 lines (*k*). These fissures mark off the rostral portion of the skull, which is here an equilateral triangle, including above (Pl. XIII. fig. 1) parts of the vomer (13), prefrontal (14), premaxillaries (22), and maxillaries (21): the surface so formed is concave transversely at its posterior three-fourths, almost straight longitudinally. The maxillary, expanding backward beyond the rostrum, bends (at *k*, fig. 1) round the upper and back part of the malo-maxillary fissure; and in close conjunction (here partial confluence) with the malar (26), it forms the large smooth tuberosity (21, 26) external to the fissure: from the tuberosity the convex raised border of the posterior expanded plate of the maxillary comes into connexion with the frontal (11), whence it subsides to form a deep hollow as it sweeps inward to rise again upon the bifurcate sinuous ridge (ib. 15, 15″) which divides this singular postnarial tract, or spermacetic cavity, of the upper surface of the cranium. The total breadth of this cavity is 6 inches 4 lines, the posterior three-fourths of its circumference, so bounded by the maxillaries and describing as much of a circle, being a little produced backward, subangularly, at the hindmost part: the open anterior fourth is continued upon the more shallow concavity of the triangular rostrum. The right maxillary is vertically pierced by two foramina (Pl. XIII. fig. 1, *a*, *b*), which converge to the common inferior outlet (ib. fig. 2, *d*). The upper fissure between the maxillary and premaxillary widens and deepens as it extends backward, and terminates in the canal (fig. 1, *c*), also conducting to the fossa (fig. 2, *d*), which, as it transmits maxillary branches of the fifth pair from the orbit to the exterior of the skull, is homologous with the antorbital foramen of other mammals: the altered position of the outlet, as regards the orbit itself, is the result of the reflection, so to speak, of the facial surface and nasal plates of the maxillaries upon the forehead above and behind the orbits.

The pterygoids (Pl. XIII. fig. 2, 24) meet at the midsurface of the roof of the mouth, and extend the palatine suture (*pl*) backward beyond the palatine bones (20). From this line each pterygoid extends outward and backward, and divides into an internal and external pterygoid plate: the former terminates in a short triedral process, representing the "hamular" one; the outer portion, partly marked off by a ridge from the palatine plate of the inner portion, bends outward and backward with a convexity toward the palate, then slightly inward, as if twisted on itself, and, expanding at its upper attachments to the pre-, orbito-, ali-, and basi-sphenoids, terminates by developing the deep and broad plate (ib. 24′) which appears to continue forward the otocranial plate (5′) of the basioccipito-sphenoid. The inner surface of the outer part of the pterygoid is vertically concave to its posterior lamella, which is so bent as to make that surface somewhat convex: the concave channel prolongs backward the nasal passage (*w*) beyond the septum. A semicircular emargination divides the posterior subvertical plate from the palatine portion (24) of the pterygoid. The total length of the pterygoid is 4 inches 8 lines; the breadth of the pair of bones posteriorly is 5 inches; the sutural union of the pterygoid with surrounding bones persists[1].

The malar bone (Pl. XII. fig. 1, Pl. XIII. figs. 1, 2, 26) is represented in the present skull by the portion of that in *Delphinidæ* (Pl. IX. figs. 1, 3, 26′) which is wedged like a lacrymal[2] between the frontal (11′) and maxillary (21″) at the upper and fore part of the orbit (*or*): it is here of a subtriedral conical shape, with its base notched for a wedged union with the maxillary above, and concave where it joins the frontal behind: the inner angle of the base curves forward, with a slight twist, to unite again with the maxillary at the inner side of the malo-maxillary fissure (*k*). The outer facet of the malar is slightly concave vertically, convex transversely: the antero-internal facet is concave in both directions, except where it curves anteriorly round the obtuse angle between it and the outer surface: the internal or orbital surface is the narrowest, and is conxex transversely, and straight vertically. The apex is subbifid, the outer part (Pl. XII. fig. 1, *z*) low and obtuse, the inner one longer, produced downward and rather backward, and terminating less obtusely; but there is no sign of any slender zygomatic style having been continued from this part, as in *Phocæna brevirostris* (Pl. IX. fig. 1, 26). It would seem, therefore, that the zygomatic processes of both malar and squamosal were short and free; they are separated by an interval of more than 2 inches in the present skull, which interval I found occupied by a ligament ("sclerous" state of malar) in a young Cachalot[3].

The squamosal forms an articular surface (Pl. XIII. fig. 2, 27, *g*) for the mandible, look-

[1] "The pterygoid, which is double the size of the palatine, extends backward to the basioccipital, articulating in that course by its expanded upper border with the pre-, basi-, and ali-sphenoids; from this border the bone descends arching inward toward its fellow, which it joins along the anterior half of its extent: the remaining free border is divided from this by a deep notch, and circumscribes the posterior bony aperture of the nostril."—*Physeter macrocephalus*, op. cit. p. 443.

[2] If this be the homologue of a lacrymal, it is not merely confluent, but connate with the malar.

[3] "The malar is moderately long and slender, bent upon itself at an acute angle; the upper portion, wedged between the maxillary and frontal, is the thickest; the lower and more slender branch is bent downward and backward, circumscribing the orbit anteriorly and below, and is connected by ligament to the zygomatic process of the squamosal. There is no lacrymal bone."—*Physeter macrocephalus*, op. cit. p. 444.

ing downward and forward: the surface is rather convex at the anterior border from behind forward, and is very slightly concave in the rest of its extent; it is smooth and with an ill-defined circumference: the anterior boundary, which also forms the posterior one of the lower outlet of the temporal fossa, is concave: the wall (Pl. XII. fig. 1, 27′) which the squamosal contributes to the posterior and internal part of the temporal fossa (*t*) expands as it bends forward to join the parietal (7) and frontal (11): the suture with the superoccipital (3) is close to the upper boundary of the fossa; that with the exoccipital (2) continues a short way beyond the squamosal, and indicates the extent of the exoccipital. On the outer part of the base of the zygomatic or articular process the bone is tuberous, and represents the mastoid (8); behind the articular surface it is roughly excavated (Pl. XIII. fig. 2, 8′), where it contributes, with the paroccipital (4), to the otocranial cavity[1].

In the interior of the cranium (Pl. XIV. fig. 1) the upper or epencephalic surface of the basioccipital is moderately concave, and is bounded laterally by a short, obtuse, longitudinal ridge, directed mesiad, which may be where the exoccipital suture ran: the outer or lateral beginning of the tentorium receives a short angular ossification, which forms the outer wall of the fossa (*v*), perforated by the vagal and acoustic foramina, both of which pass directly outward to that at the back part of the fundus of the otocranial cavity (Pl. XII. fig. 1, Pl. XIII. fig. 2, *e*). A small branch channel from the vagal one opens upon the outer surface of the exoccipital at the groove which runs to the cleft (Pl. XII. fig. 2, *l*) between the otocranial plates of the basisphenoid (5) and paroccipitals (4). At the fore part of the tentorial process (Pl. XIV. fig. 1, *v*) is the foramen of a canal which opens outwardly upon the alisphenoid: it is too small for the carotid, and may have given exit to a vein. I cannot discover any distinct entocarotid canal, any more than a distinct foramen ovale, foramen rotundum, or foramen opticum: they all seem here to be confounded in the intersphenal fissure (Pl. XIII. fig. 2, *tr*). From the extreme shortness of the jaws, the nerves of sensation to the face must have been very small. The "sella" (Pl. XIV. figs. 1 & 3), scarcely impresses the basisphenoid: its best antero-external boundaries are afforded by the superoptic processes of the orbitosphenoid (ib. *n*). There is no ossification of the falx[2], no trace of olfactory foramina. The greatest diameter of the cranial cavity is in the direction of breadth.

The lower jaw (Pl. XII. fig. 1, 29-32) is 7 inches 4 lines in a straight line from the back

[1] "The squamosal is a comparatively small, but strong and thick, triangular bone; the upper end represents the expanded squamous part in land mammals, and is articulated by broad, dentated sutural margins to the frontal and exoccipital: its anterior border is grooved for the reception of the alisphenoid: the lower angle is as it were truncated, and presents a rough surface for the attachment of the petro-tympanic: a short, obtuse anterior angle bends forward and represents the zygomatic process: the under surface presents a smooth shallow cavity for the condyle of the lower jaw: the inner border of the glenoid surface is produced downward into a slender process."—*Physeter macrocephalus*, op. cit. p. 444.

[2] In the Great Cachalot "a strong medial crest is produced forward from the inner surface of the superoccipital" (*loc. cit.* p. 442).

of the condyle to the fore end of the symphysis. Each ramus has a convex, almost semicircular posterior margin, curving upward and backward from below (30), where the angle normally exists in other mammals, and then forward to the seat of the coronoid process (29): at the hindmost part of this curve the border is thickened to form the sessile condyle, adapted to the glenoid surface of the squamosal. Here the border bends outward: as the ramus advances, converging to its fellow, it is slightly bent with the convexity outward, which again is changed to a concavity (lengthwise), where it joins the opposite ramus to form the elongate symphysis (32), which is continued straight forward to its termination. The symphysis here forms rather less than a third of the entire length of the mandible, being 2 inches 4 lines in extent. The greatest vertical diameter of the ramus is 2 inches 2 lines; that at the beginning of the symphysis is 8 lines[1]. In the alveolar groove are partially excavated sockets for nine teeth; the four middle intervals are severally equal to twice the basal diameter of the tooth: at the ends of the series, especially the anterior one, the alveolar intervals are less. The teeth (Pl. XII. fig. 1, and *A*) are small, straight, conical, obtuse, not exceeding 8 lines in length, of which the cylindrical base has a diameter of 2 lines, that of the crown a diameter of $1\frac{1}{2}$ line, with a length of $2\frac{1}{2}$ lines, diminishing to a subrecurved apex.

The loss of symmetry in this skull is hardly observable in the general contour, whether viewed from above (Pl. XIII. fig. 1) or below (fig. 2): it is chiefly, almost exclusively, confined to the nostrils and the bones concerned in the composition of those passages; and this is only conspicuous in the upper surface of the skull.

In *Euphysetes breviceps*, Bl., according to the figure of the side view of the skull (copied in Pl. XIV. fig. 3), the occipital condyle is more prominent than in *Euphysetes simus* (Pl. XII. fig. 1): the contour of the superoccipital is concave in *Euphysetes breviceps*, but is convex in *Euphysetes simus*—very feebly so, indeed, but as far as it departs from a straight line being in the direction of convexity. The most marked difference, however, is the greater proportional length of the rostral part of the, skull—measured, viz., from the malomaxillary fissure (ib. & Pl. XIII. *k*) to the end of the upper jaw (22, *x*): in *Euphysetes breviceps* it forms about two-fifths of the entire length of the skull, in *Euphysetes simus* about two-sevenths. The proportion of the maxillary, above the frontal and malar, on

[1] "The condyle of the mandible projects from the posterior part of the ascending ramus, which is compressed and produced into a low obtuse coronoid process above, and into a similar angle below: a wide excavation, beginning at the inner side of the ascending ramus, deepens and contracts into the dental canal which enters the substance of the horizontal ramus: a fissure is continued along the inner side of the ramus from this canal, and is the sole indication of a compound structure of the jaw. The vessels and nerves emerge from several foramina at the outer side of the ramus, where it is attached by its long symphysis to its fellow: the upper border of the symphysial part of the ramus is excavated by a continuous dentigerous groove, somewhat resembling, in the present fœtal state, that in the upper jaw. The length of the symphysis in this skull is three-fourths that of the rest of the ramus. In the adult male the disproportionate growth of this part of the jaw leads to more excessive length of the symphysial part beyond the rest of the ramus."—*Op. cit.* p. 444, fœtal *Physeter macrocephalus*.

the exterior of the skull is much greater in *Euphysetes breviceps* than in *Euphysetes simus*, especially in vertical extent: in the upper view of the skull the porportion of the postnarial cavity, especially in breadth, to the extent of the rostrum is less in *Euphysetes breviceps* than in *Euphysetes simus*. To these differences must be added the difference in the number and shape of the teeth. In *Euphysetes breviceps* there are fourteen or fifteen teeth, or sockets for as many, in each mandibular ramus: the entire tooth, figured by De Blainville (copied in Pl. XIV. fig 2. B), is 10 lines in length, and has a proportionally larger and more curved crown than in *Euphysetes simus*. De Blainville writes, "Il me paraît à peu près certain qu'il n'y avait pas de dents à la mâchoire supérieure" (*l. c.* p. 337); and these are equally absent in *Euphysetes grayi*: the first of the maxillary series remains exposed, as a functional tooth, in the quite adult skull of the smaller Indian species, *Euphysetes simus*. From *Euphysetes grayi* the present species differs not only in this dental character and its smaller size, but in its proportionally shorter muzzle, and in the minor number and wider disposition of the mandibular teeth. Thirteen teeth are found in each ramus of the lower jaw of the specimen of *Euphysetes grayi* in the Sydney Museum: they are divided by interspaces of less than their own basal diameter, and have relatively longer crowns than those of *E. simus*. There are twelve teeth in the right, and nine teeth in the left ramus of the mandible of *Euphysetes breviceps*, De Blainv.: they are as wide apart as in *Euphysetes simus*, but have crowns more slender and recurved.

In the figures of the mandible given by De Blainville (*loc. cit.* pl. 10), and by Macleay (*loc. cit.* pl. 2. fig. 5), the breadth between the outer parts of the condyles equals the length of the mandible in a straight line, that is, from the middle of the chord drawn between the condyles to the end of the symphysis. In *Euphysetes simus* the breadth exceeds the length so taken.

Among other differences between the present member of the *Physeteridæ* and the *Delphinidæ* (see *Phocæna brevirostris*, Pl. IX. fig. 1) is the non-production of the upper or hinder expansion (naso-frontal plate) of the maxillary (Pl. XII. fig. 1, 21*, 21″) over the orbital process of the frontal (11, 11′); which, therefore, in *Euphysetes simus* as in *Euphysetes breviceps*, stands out free (Pl. XII. fig. 1, 11′) from the upper and lateral parts of the cranium behind the maxillary (21′ 21″).

Bones of the Trunk and Fins. (Pl. XI. fig. 2.)

Having been favoured with photographs of these bones in *Euphysetes grayi* by the present able Curator (Mr. Kreffts) of the Australian Museum, I have thought it might be useful to add the following notes:—

Euphysetes (Pl. XI. fig. 2) has fifty vertebræ, viz. seven cervical, fourteen dorsal, twenty-nine lumbari-sacro-caudal: in the latter series the hæmapophysial arch first appears between the sixth and seventh (or between the twenty-seventh and twenty-eighth vertebræ counting from the skull): the hæmapophyses cease to be developed at the twentieth (or forty-first from the skull), leaving ten, perhaps eleven, terminal vertebræ represented by depressed centrums, gradually diminishing to the last. The seven cervicals are anchylosed: the diapophyses distinguish the atlas and axis, the former of which vertebræ does not retain, as in *Physeter*, its separate condition; the fifth, sixth, and seventh are lamelliform, from extreme anteroposterior compression. The dorsal spines progressively, but very gradually, gain in height to the last; beyond which they again, and more rapidly, shorten to the base of the tail, disappearing in the fortieth vertebra from the skull. The metapophysis begins to project above the prozygapophysis in the fifth dorsal, and supersedes that process in the articulation of the neural arches in the seventh or eighth dorsal. The four anterior pairs of ribs directly join the sternum, which consists of three sternebers, each more or less completely divided at the middle line into two bones. The first rib is broad, flat, and angularly bent, articulated by the tubercle to the first dorsal diapophysis, and by a ligament representing the head to the centrum of the seventh cervical: its connate sternal portion articulates with the antero-external angle of the manubrium. The second and six following ribs have both head and tubercle, the former abutting against the interspace of their own and antecedent centrums; the tubercle of the rib is attached to the diapophysis of its own vertebra: the second rib, less broad but one-fourth longer than the first, has a short, partly ossified cartilage, which joins the interspace between the first and second sternebers. The third, gaining length, losing breadth, and with more regular curvature, is articulated by its short hæmapophysis to the interspace between the second and third sternebers. The fourth rib is joined to the end of the third sterneber. After the seventh the ribs lose their heads, become shorter, more slender, less curved—gradually to the tenth, which is 9 inches in length—suddenly in the fourteenth, which is a straight style is hardly an inch long. There are two pairs of pelvic bone. The pectoral fins are relatively short and rather obtuse. The scapula is a flat triangular plate, with a convexly curved base, in extent equalling the fore-and-aft range of the five anterior dorsal spines. An obtuse rising near the anterior costa, at its humeral half, developes near the glenoid cavity a small coracoid directed forward. The acromion is much larger, and is produced from a greater extent of the anterior costa in the form of a parallelogram. The ulna developes scarcely any olecranon. There are five digits: the first and fifth are the shortest, each with a metacarpal and two phalanges; the second and third digits are the longest, with five and four phalanges respectively, besides the metacarpal; the fourth digit, intermediate in length between the third and fifth, has a metacarpal and four phalanges.

Conclusion.

The first remark that I am led to make on a review of the cetacean characters above-defined in connexion with those previously recorded is, that they are all gradational, and exemplify steps by which are gained the extreme modifications, especially in the skull and dentition.

Imperfect as may be the cetacean record, it yields several series of differential characters,—as, *e.g.*, in the proportion of the rostral to the cranial part of the skull, from *Physeter simus* to *Physeter macrocephalus* and *Platanista*—in the degree of expansion of the back part of the maxillaries, exemplified, step by step, in *Balæna*, *Delphinus*, *Phocæna*, *Ziphius*, *Euphysetes*, and *Physeter*, again culminating in *Platanista*—in the number of teeth, from zero (*Balæna* and old *Delphinapteri*), through *Monodon*, *Ziphius*, *Euphysetes*, to the multitude of teeth in *Delphinus*, Cuv.

The formation of germs of teeth in parts of the jaws of fœtal or young individuals of species which are edentulous in the full-grown individuals, the examples of which are too well known to need citation here, are, perhaps, amongst the most significant of the gradational modifications, above referred to, being due to deviations in offspring from the characters of parents.

Such departures or variations may have been slight in the first instance, few and far between in the members of a contemporary generation, and rare exceptions to the rule of hereditary likeness; but, occurring in the course of many generations, through long lapse of time, they might lead to "long-snouted" and "short-snouted" breeds, and to others exemplifying the various observed cranial and dental modifications of cetacean structures.

In such conjectural mutations of specific characters may be discerned a fore-ordained law of deviation from primitive type, through the operance of which the ocean has at length become peopled with so many strange modifications of the cetacean structure.

But such instances of exceptional freedom from the trammels of family likeness seem to be independent of external influences. The ocean has none of those diversities of condition which the dry land shows, and is exempt from the few which in fresh waters may be invoked to account for varieties in the species of fish. It is true that the trout (*Salmo fario*) of the mountain-streamlets is small, while that of the wide river or wider lake is large; but no such differences can be invoked to explain the origin of the dwarf *Euphysetes* or the giant *Physeter*: both have alike the unlimited seas for their range.

But the same river may have the pike, the carp, the salmon, the eel, &c.; these modifications of the piscine type exist in waters of the same temperature, same rate of flow, and same nature of bed. Where can we here discern selective influences equivalent to produce such changes of structure? The hypothesis is still less conceivable in regard to the ocean. The various Cetacea of the Indian seas exist in a medium of the same nature, exempt from any influence of the earth beneath them, or of aught that may there live and grow. The external influence or power that could "select" the maxillary wall of the circumnarial basin, *e.g.*, in *Hyperoodon*, *Ziphius*, *Euphysetes*, *Physeter*, *Platanista*, is inconceivable.

But the occasional departure from parental type, manifested by a so-called abnormal or monstrous proportion of the nasal or facial plate of the maxillary, may accord with the idea suggested by the observed steps in a gradation of such deviational developments.

So far the species thereby characterized may be held as evidences of orderly succession and progression due to inherent organic force, operating according to a natural law or "secondary cause," of the precise nature of which we are yet in ignorance. But we may feel assured that the Power which called into being the first cetacean type foreknew and planned, by predetermined degrees and kinds of departure from that type, all its subsequent modifications[1].

But much knowledge of the facts of organization is still needed for successfully grappling with these transcendent questions; and the progress of zoology has been slower in regard to the Cetaceans than to most other orders of animals.

This is due to their medium of existence, to the extreme latitudes at which some of the species have to be sought for, and to the vast bulk which certain species attain[2]. The latter characteristic precludes the preservation and exposition of the requisite specimens in private collections or even in those of associations of the cultivators of natural history willing to carry on the work of advancement of the science at their own cost and to the extent of their means and usually limited incomes.

The diversities of structure exemplifying specific characters in *Balæna*, *Balænoptera*, *Physeter*, *Hyperoodon*, &c., and those which have suggested as many subgeneric divisions and names of the Cuvierian genera of those gigantic animals, are best exemplified in their skeletons, both by modifications of particular bones, and by proportions of the several regions of the skeleton; but the framework of these animals, put together to exemplify their articulations and proportions, require for their exhibition the resources of a National Museum. There, and there only, can an intelligent public and the student of this branch of Mammalogy expect to find the means of contemplating and comparing the characters and structures of the strangest as well as hugest of animals—the most seldom seen, by reason of their ocean haunts—air-breathers, yet living in water—hot-blooded, though ever surrounded by a rapidly refrigerating medium—of man's own class by every essential of organization, but fishes in shape—a recent development of life-form on our planet, and the superseders of the great sea-lizards in their office in the ocean police.

Hitherto the expectations of both student and sightseer have been disappointed. Space (the first essential towards fulfilling this exigency) has been found too costly; at all events the guardians of the public purse have thought it not desirable, as yet, to vote the sums requisite for the galleries, however simple in structure, which are needed for the Cetaceous Department of a Zoological Museum[3].

[1] Owen, 'On the Nature of Limbs,' 1849, p. 86.

[2] I may also add, from aggravating experience, the conflicting claims to the legal ownership of such monsters of the deep when they happen to be cast upon any part of the shores of Great Britain.

[3] See Hansard, 'Debate on Museum of Natural History,' May 19th, 1862, p. 1928.

DESCRIPTION OF THE PLATES.

PLATE III.

Delphinus (Steno) gadamu: diminished to scale.

Fig. 1. Side view.
Fig. 2. Upper view: *b* blow-hole.

PLATE IV.

Delphinus gadamu.

Fig. 1. Side view of skull (wanting back part of cranium).
Fig. 2. Side view of mandible.
Fig. 3. Upper view of mandible: *ss* symphysis.
Fig. 4. Symphysial end, inner view of mandible.
Fig. 5. Bony palate.

All the figures are nearly half the natural size.

PLATE V.

Fig. 1. *Delphinus fusiformis*, side view (diminished to scale).
Fig. 2. *Delphinus lentiginosus*, side view (id.).
Fig. 3. The same, upper view.

PLATE VI.

Fig. 1. *Delphinus maculiventer* (to scale of Plate V.).
Fig. 2. The same, upper view.
Fig. 3. *Delphinus pomeegra* (id.).

PLATE VII.

Delphinus fusiformis.

Fig. 1. Side view of cranium and upper jaw.
Fig. 2. Side view of lower jaw.
Fig. 3. Upper view of cranium and upper jaw.
Fig. 4. Under view of ditto.
Fig. 5. Upper view of symphysis of lower jaw.

All the figures are nearly half the natural size.

PLATE VIII.

Fig. 1. Side view of cranium and upper jaw of *Delphinus pomeegra*.
Fig. 2. Under view of upper jaw of ditto.
Fig. 3. Side view of under jaw of ditto.

Fig. 4. Upper view of symphysis of under jaw.

Fig. 5. Under view of upper jaw of *Delphinus euphrosyne.*

All the figures are half the natural size.

PLATE IX.

Phocæna brevirostris.

Fig. 1. Side view of cranium and upper jaw.

Fig. 2. Upper view of ditto.

Fig. 3. Under view of ditto.

All the figures are nearly half the natural size.

PLATE X.

Euphysetes simus.

Fig. 1. Side view of female.

Fig. 2. Upper view of ditto (drawn to scale).

PLATE XI.

Euphysetes simus.

Fig. 1. Side view of male (to same scale as female, Pl. X.).

Fig. 2. Outline of ditto, with skeleton.

PLATE XII.

Euphysetes simus.

Fig. 1. Side view of skull.

Fig. 2. Back view of skull (rather more than half the natural size).

PLATE XIII.

Euphysetes simus.

Fig. 1. Upper view of skull.

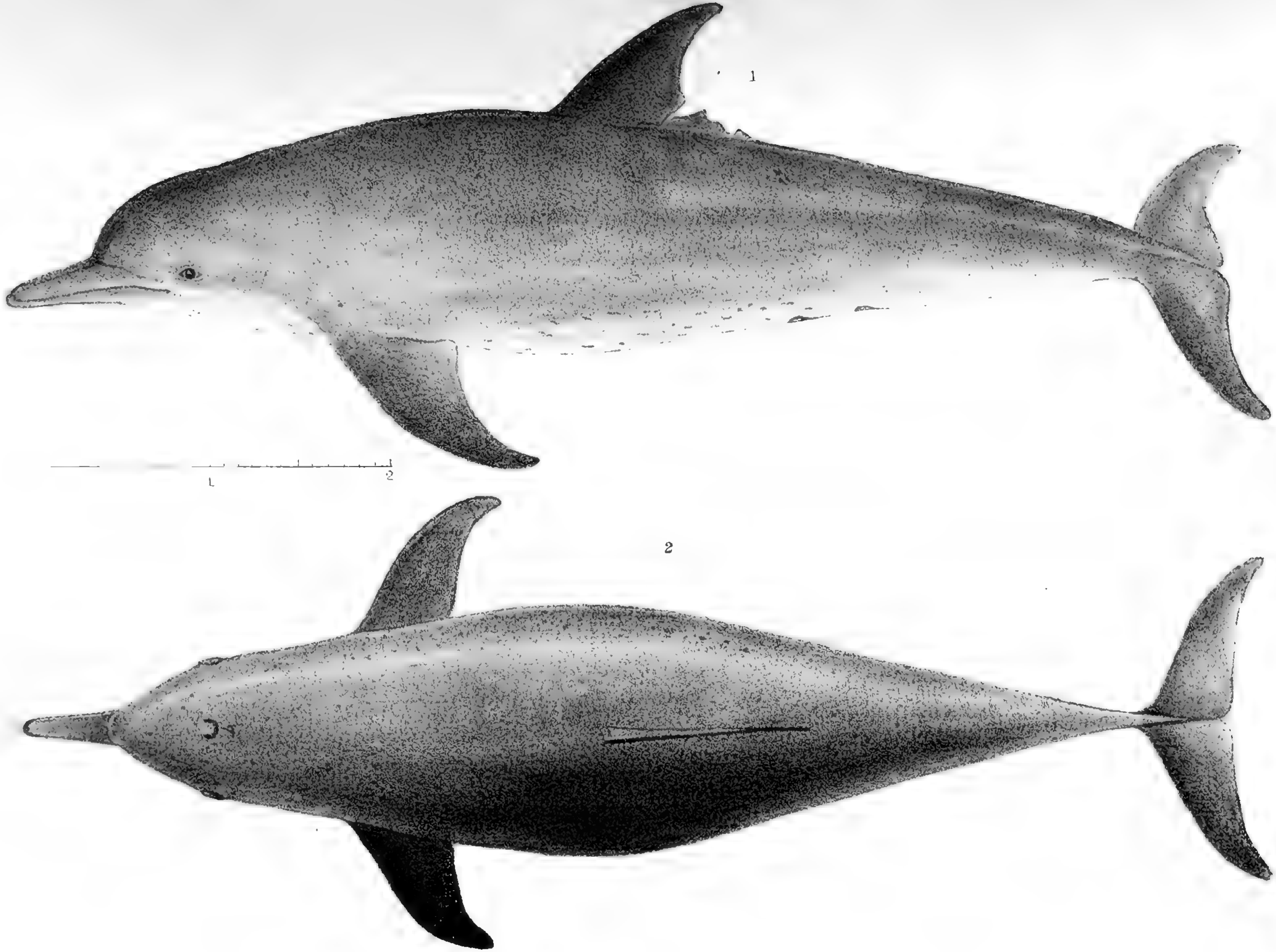
Fig. 2. Under view of ditto (half the natural size).

PLATE XIV.

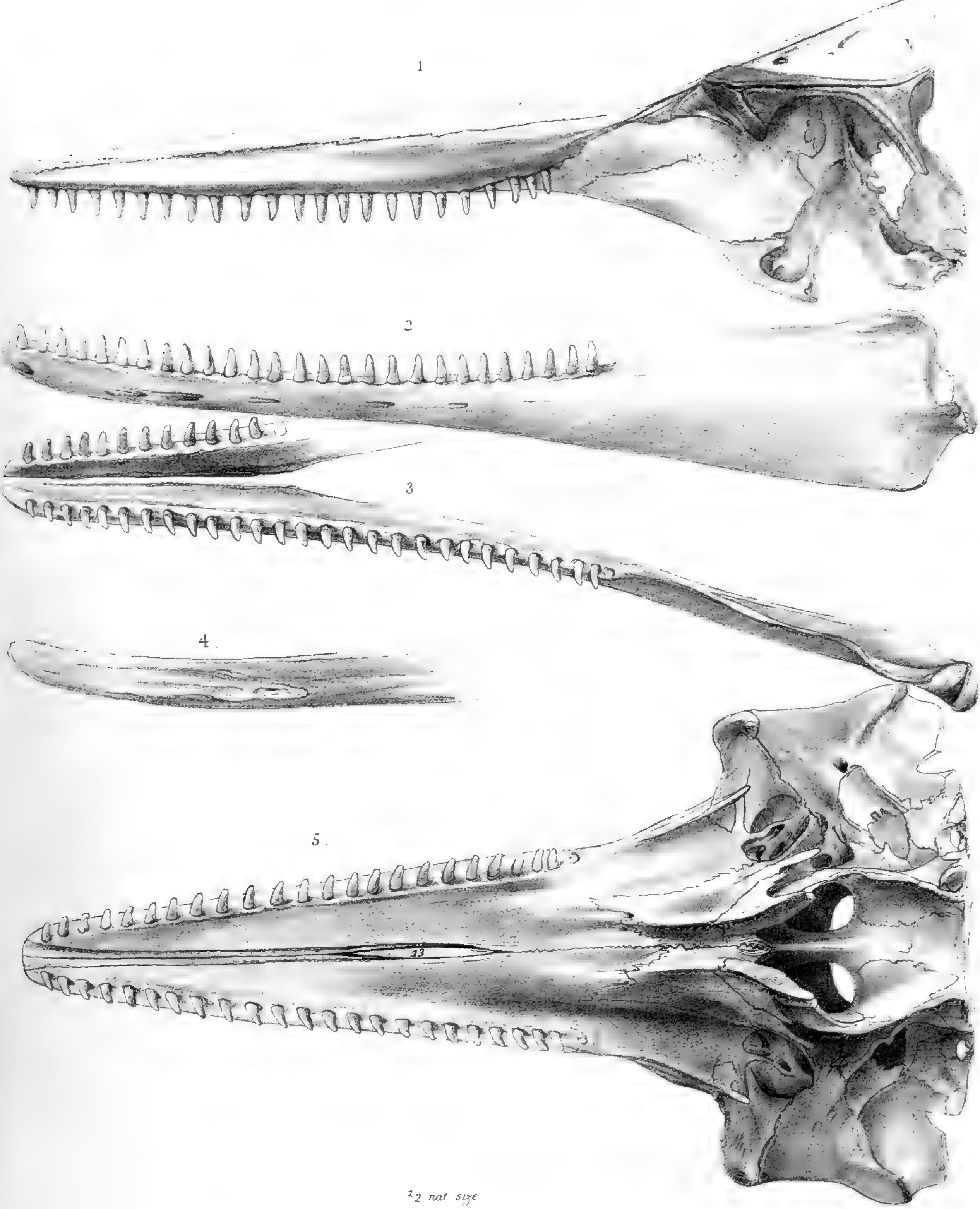
Fig. 1. Section of cranium of *Euphysetes simus.*

Fig. 2. Section of cranium of *Physeter macrocephalus.*

Fig. 3. *Euphysetes breviceps.*



DELPHINUS GADAMU

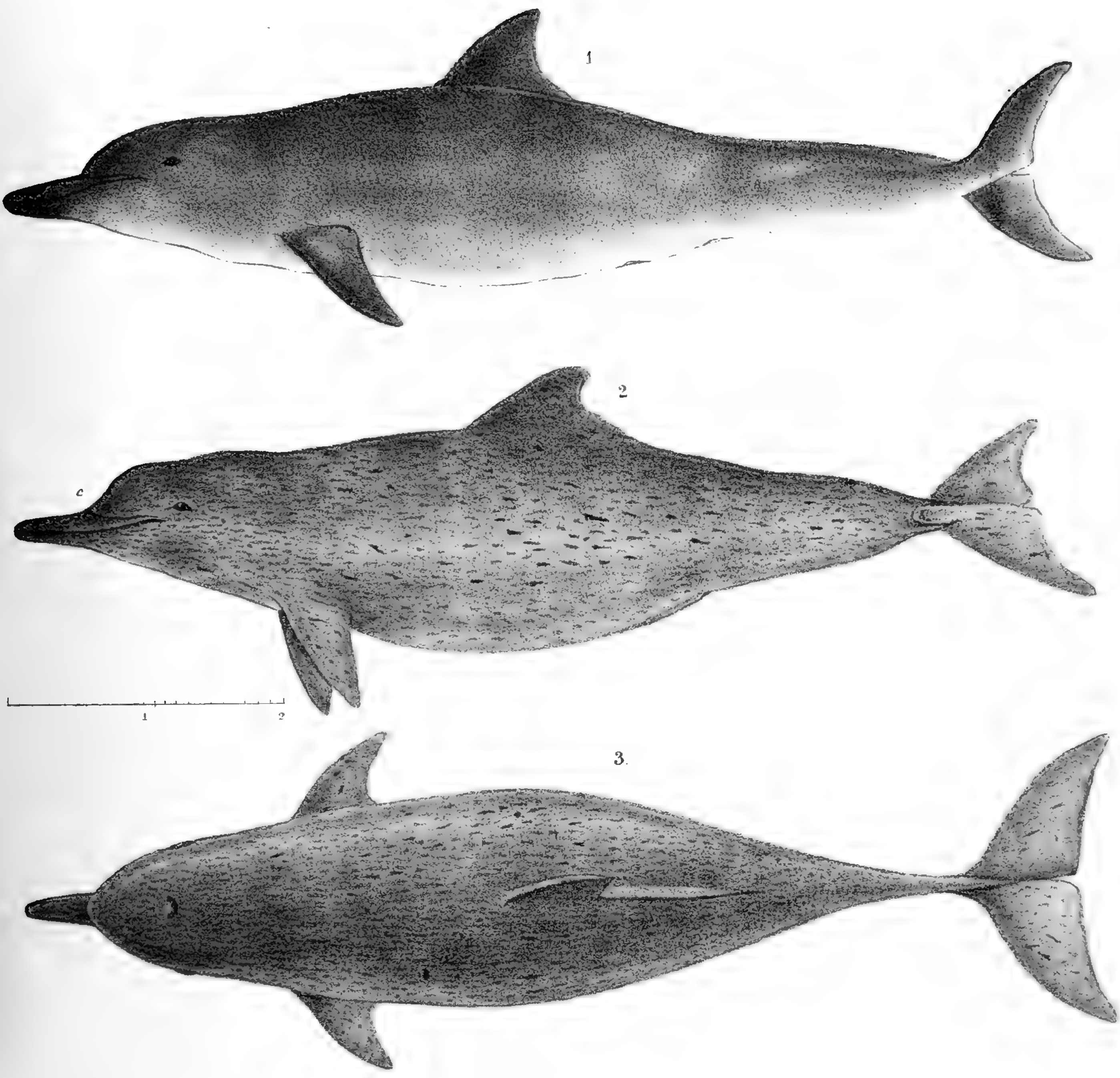


½ nat size

From nat. on Stone by J. Erxleben.

M & N Hanhart imp.

DELPHINUS GADAMU



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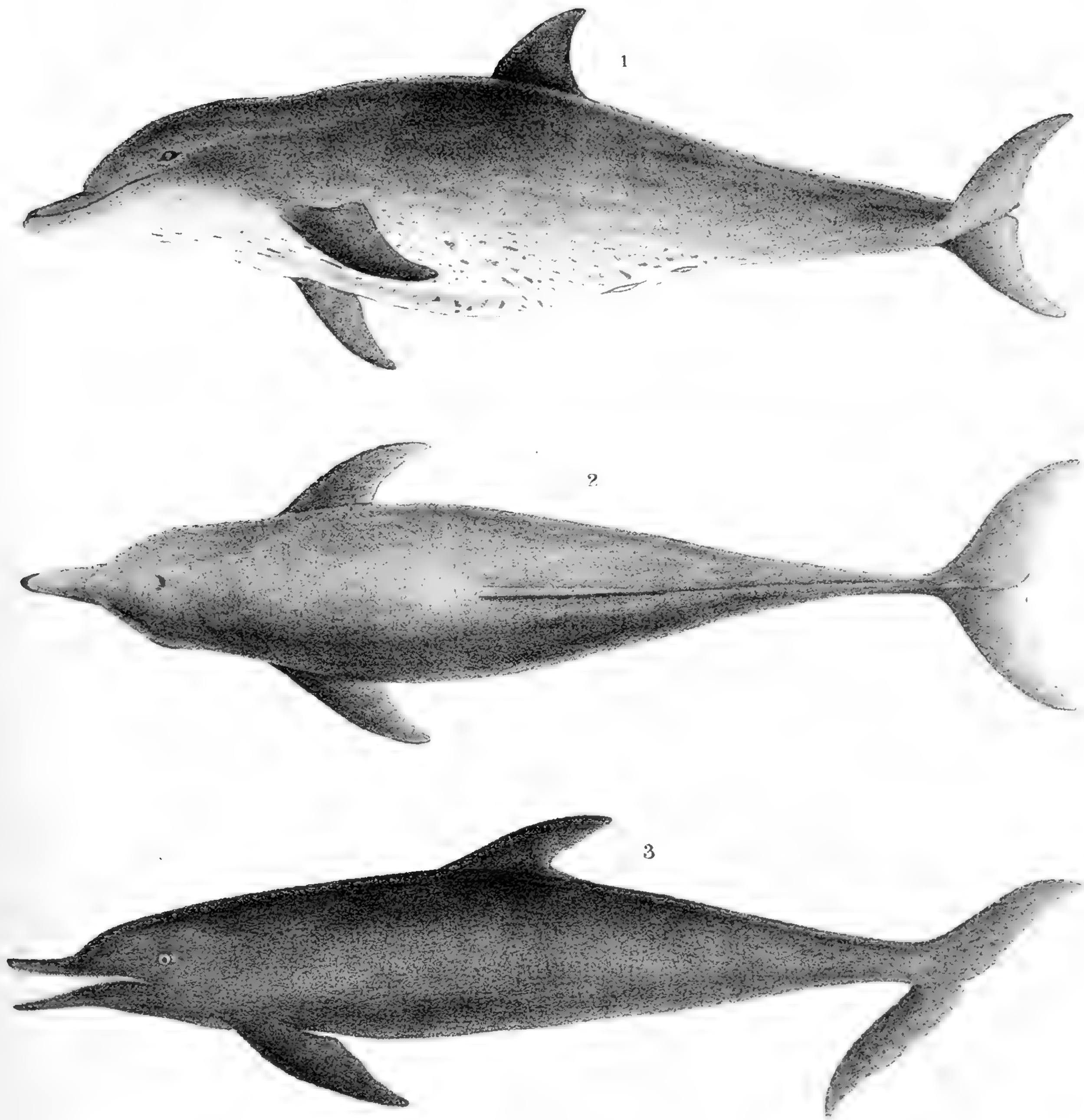

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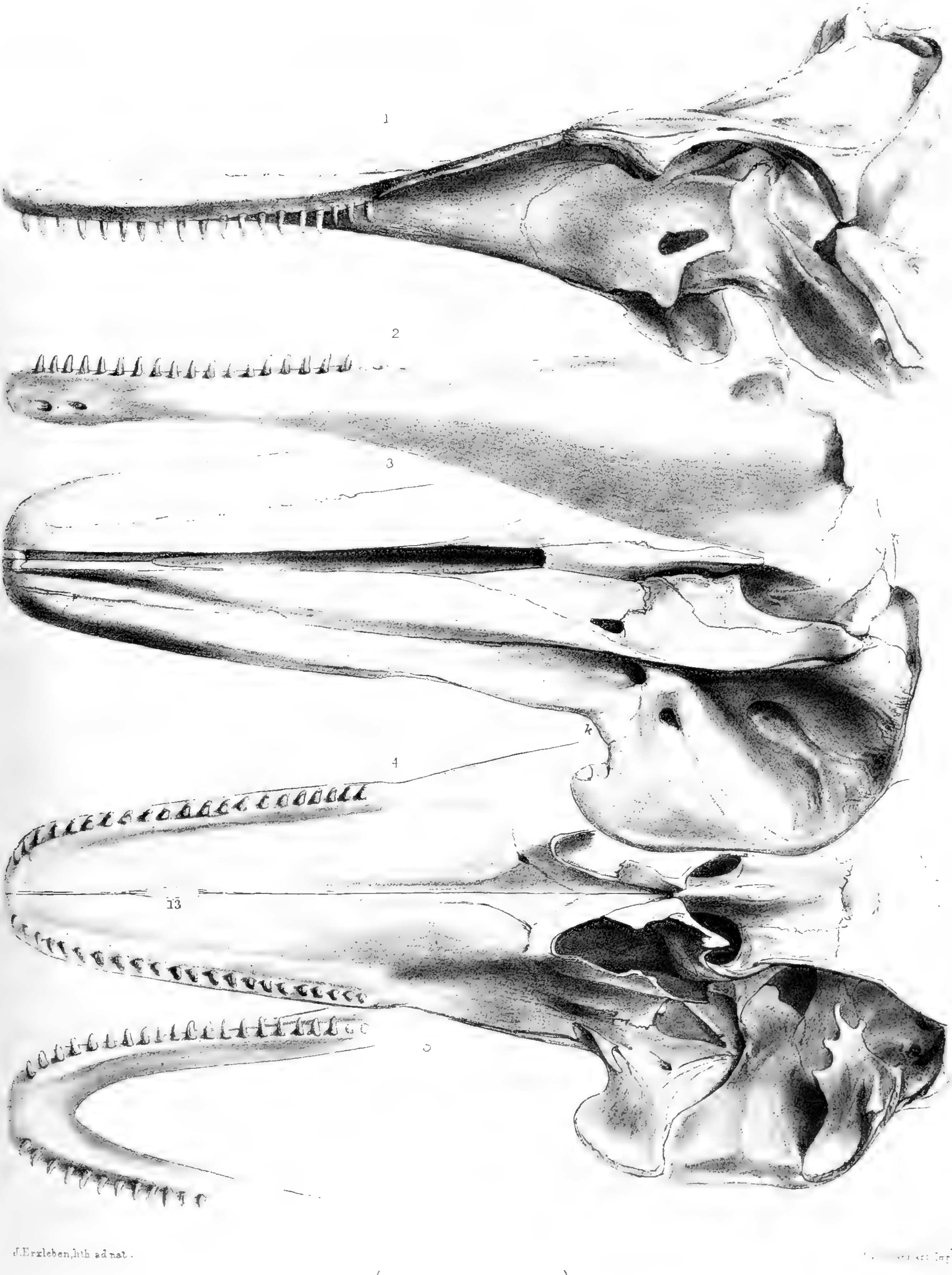
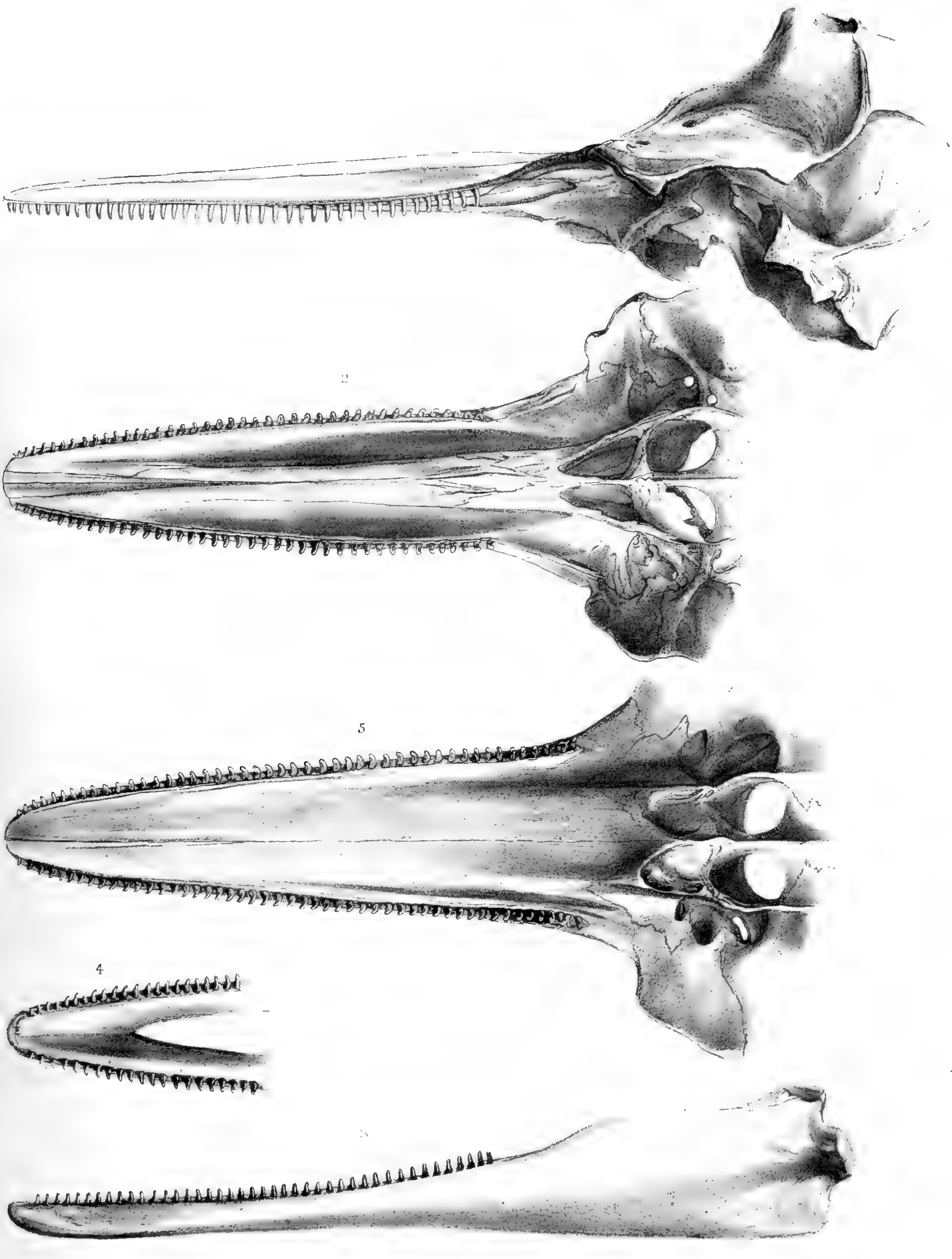
1. 2. DELPHINUS MACULIVENTER. 3. DELP[illegible]



J. Erxleben, lith ad nat.

DELPHINUS (LAGENORHYNCHUS) FUSIFORMIS.



J. Erxleben, lith ad nat.

M & N Hanhart Imp.

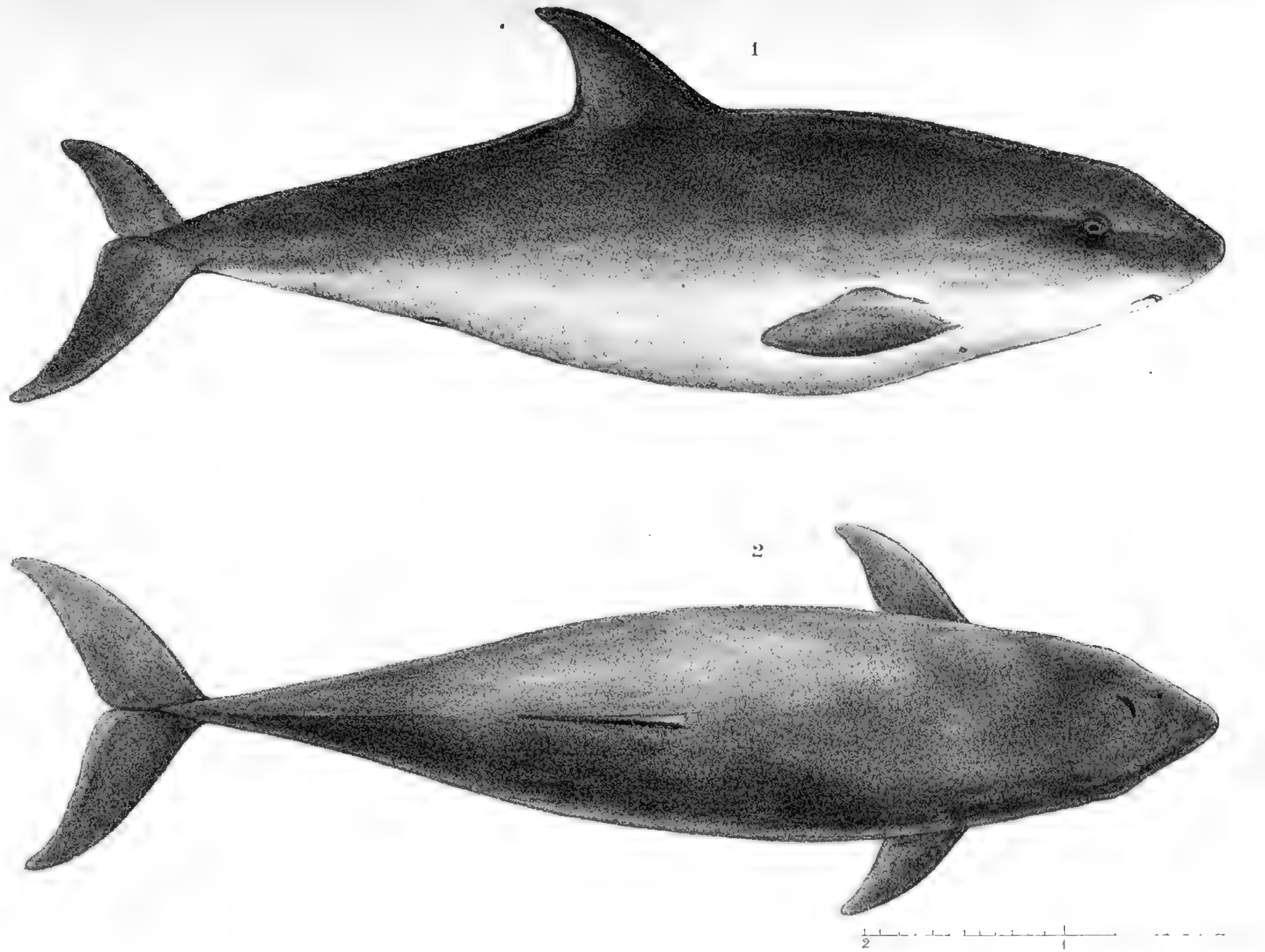
1.4. DELPHINUS POMEEGRA. 5. D. EUPHROSINE.

Willis del et lith

M & N Hanhart imp.

PHOCŒNA BREVIROSTRIS

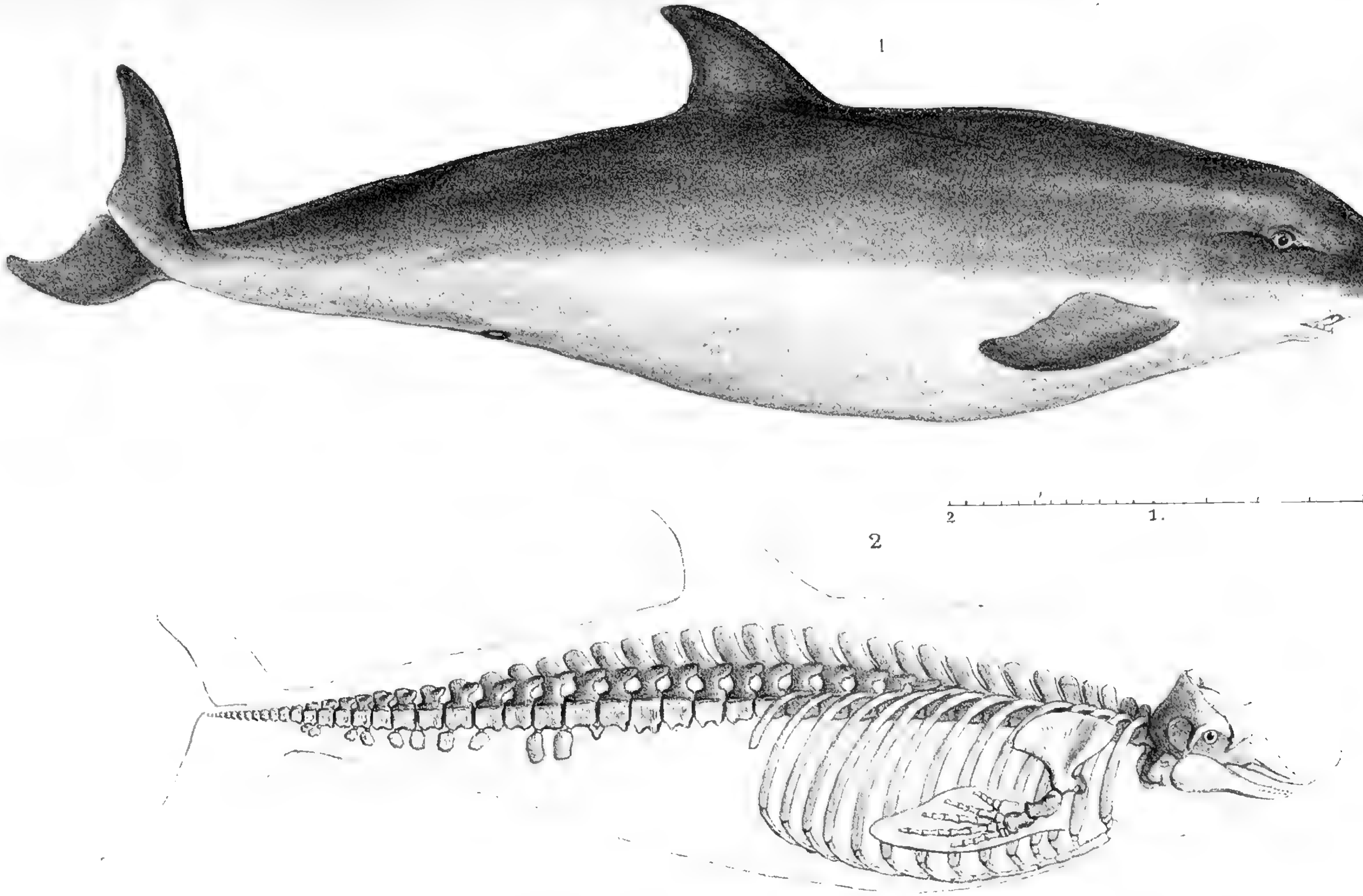
1



2

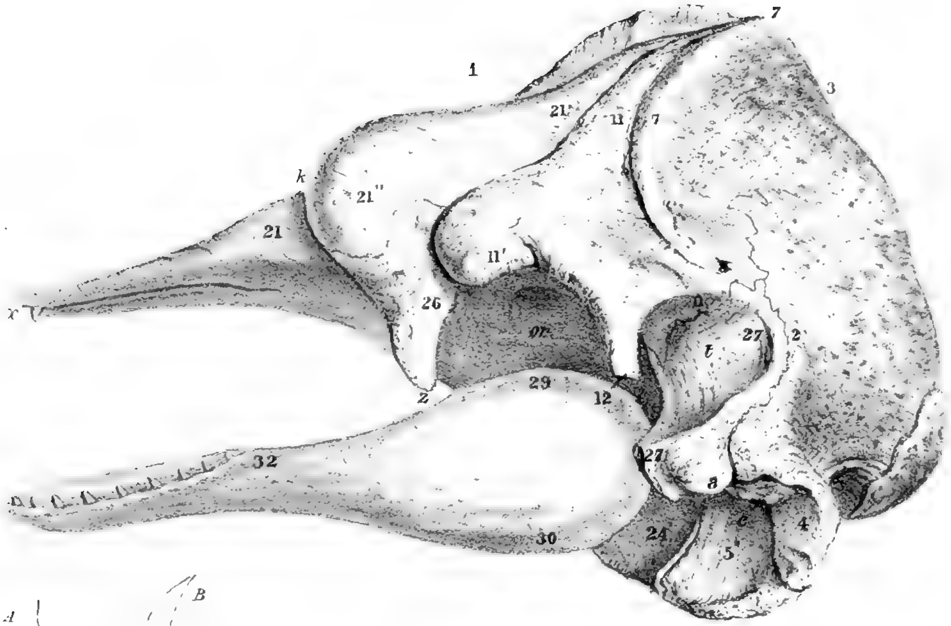
Pitus delᵗ et lith

H. SETIR. ?. MUS.



J. lis. del et. lith

PHYSETER SIMUS



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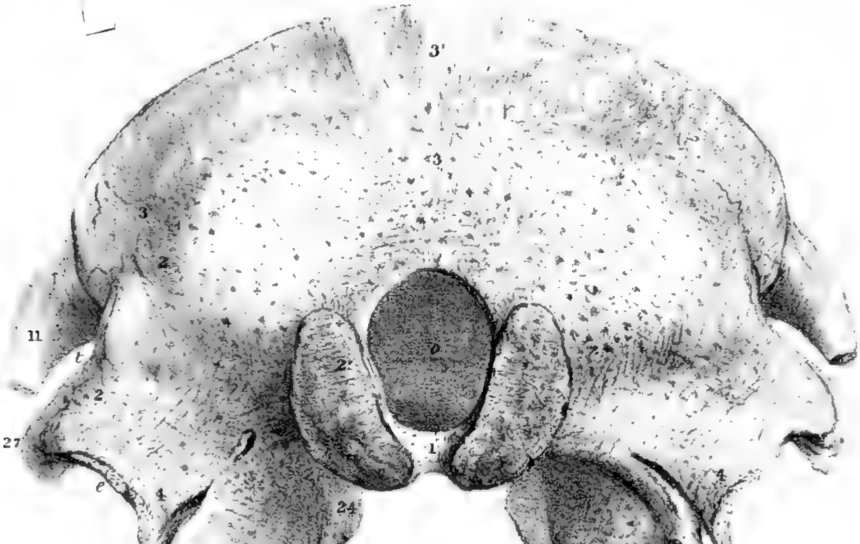
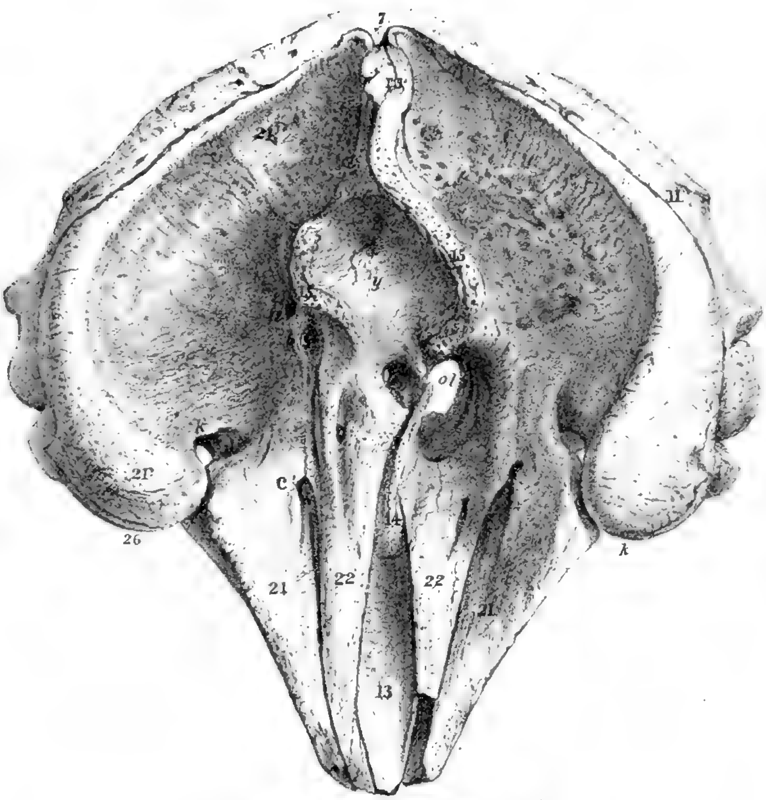


Willis del et lith.

M. & N. Hanhart imp.

PHYSETER SIMUS

1.



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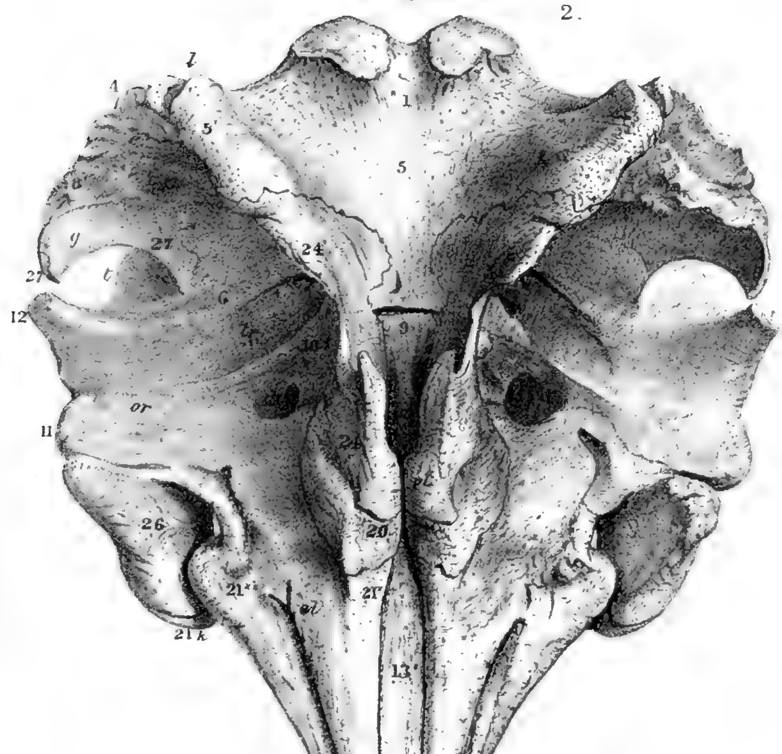


Willis del et lith.

M & N Hanhart imp

PHYSETER SIMUS

R.Owen, del on Stone by J. Erxleben

M & N Hanhart imp

1 PHYSETER SIMUS. 2. PHYSETER MACROCEPHALUS 3 PHYSETER BREVICEPS.

III. *On the Osteology of the Dodo* (Didus ineptus, *Linn.*).

By Professor Owen, *F.R.S.*, *F.Z.S.*, *&c.*

Read January 9th, 1866.

[Plates XV. to XXIV.]

§ 1. *Introduction.*

THE Dodo has long been one of the "curiosities of Natural History," through the rarity and paucity of the material evidences of the bird.

The dried foot in the British Museum, the dried head and foot in the Ashmolean Museum at Oxford, the skull, lacking the lower jaw, and somewhat mutilated, in the Gottorf Museum at Copenhagen, were all the parts of the bird known to the authors of the admirable monograph on the Dodo and its kindred at the date of its publication[1].

Subsequently a portion of the bone of the upper beak has been discovered in the Museum of Natural History at Prague[2].

Such, until the present date, was the sum of the remains of this large, flightless, extinct bird which were known to have reached Europe.

The happy perception, by the Danish Professor J. Reinhardt, in 1843[3], of the resemblance of the beak of the Dodo to that of the tropical Doves, generically separated by Cuvier under the name *Vinago*, on account of their proportionately larger, more strongly arched, and compressed beak than in other Pigeons, and the still closer resemblance, in miniature, of the beak of the Samoan Dove to that of the great Mauritian bird, which led Titian Peale to give to the former the generic name *Didunculus*, directed the ornithologist and ornithotomist to the family in which the most instructive comparisons might be made; and the results of these, so far as relates to to the head and foot and the bones of those parts, published by the authors of the

[1] 'The Dodo and its kindred; or, the History, Affinities, and Osteology of the Dodo, Solitaire, and other Extinct Birds of the Islands Mauritius, Rodriguez, and Bourbon.' By H. E. Strickland, M.A., F.G.S., F.R.G.S., President of the Ashmolean Society, &c., and A. G. Melville, M.D. Edin., M.R.C.S. 4to, London, 1848.

[2] See Annals of Nat. Hist. ser. 2. vol. vi. p. 290 (1850).

[3] "Es war in 1843, dass ich auf den Gedanken kam, dass der Dodo eine anomale Taubenform sei; ich überzeugte mich bald dass diese Auffassung die einzig richtige sei, und fing an eine Arbeit über diesen Gegenstand vorzubereiten. In 1845 wurde ich aber von meiner Regierung beauftragt eine Reise um die Welt mit einem dänischen Kriegsschiff mitzumachen; meine Arbeit musste also vorläufig bei Seite gelegt werden. Schon vor meine Abreise hat ich aber mehrere sowohl dänische wie fremde Naturforscher mit meiner Ansicht bekannt gemacht, und der Beweis das es sich so verhält wird Owen finden können:—

"1. in den Forhandlingar de Scandinaviske Naturforskers Möde, i Kjöbenhavn, 1847, p. 948: und

"2. in Sundevall, Arsberättelse om Framstegen i vertebrerade Djurens Naturalhistoria og Ethnographien, 1845–50, p. 254."—*Letter from* Prof. J. Reinhardt *to* Dr. Albert Günther.

above-cited work, left little doubt of the "striking affinity which exists between this extinct bird and the Pigeons"[1].

Whatever doubt, indeed, may have lingered in the minds of naturalists as to this affinity will probably be finally set at rest by the results of the comparison of the large proportion of the skeleton of the *Didus ineptus* which has at length been transmitted from the island of Mauritius to London, under the following circumstances.

In 1863, I was favoured by Miss A. Burdett Coutts with an introduction to the Bishop of Mauritius, then in this country, and I endeavoured to interest his lordship in aiding or promoting the acquisition, by the British Museum, of the zoological rarities of Madagascar, and especially of any remains of the Dodo which might be discovered in the island of Mauritius, to which his lordship was about to return.

How speedily and successfully the Bishop has fulfilled my latter desire will be shown by the following letter, with which I was favoured in November, 1865.

"St. James, Port Louis,
"October 7, 1865.

"My dear Sir,—when I had the pleasure of conversing with you for a short time in London two years ago, I promised to acquaint you with any facts or discoveries which might come to my knowledge, likely to interest you in connexion with Madagascar. I have not anything as yet to communicate definitely respecting that island in the way of natural history, but I have strong reasons to believe that a discovery has been made here recently which will gratify you very much. Mr. George Clark, who has for many years devoted himself to the work of teaching in this island with great success, is an ardent student of natural history, and has explored many parts of the island in search of information on the subject. From careful observation he was led to conclude that no remains of the Dodo were likely to be found in any of our watercourses, because of their steep descent and the immense rush of water which sweeps down them at times. But he had also frequently expressed his opinion that in certain marshes, with high banks of sand between them and the sea, such remains would probably be found. In one of these places he has found several of the bones of the Dodo (as he believes), and is now forwarding them home for your inspection[2].

At his request, I write these lines to ask for your kind care of his interests in securing any reward which may accrue to him. It would be a great pleasure to me to find that his discovery was really important, and likely to be useful to himself; for he has pursued these and similar investigations with an amount of intelligence, skill, and diligence, in his vacation-times (by no means extensive), which deserves much credit and encouragement.

[1] Reinhardt, quoted by Strickland, *op. cit.* p. 41 (see also p. 70).

[2] This Collection was purchased by the Trustees of the British Museum for the sum of £100.

"The book which you kindly sent me on the Aye-Aye has been read by many, and especially by medical men, with much interest. I entrusted the other copy to Mr. John Douglas for the Society here.

"I remain, my dear Sir,

"Your very faithful Servant,

(Signed) "VINCENT N. MAURITIUS."

"*Professor Owen.*"

This letter was accompanied with the following "Statement" by Mr. George Clark, Master of the Government School at Mahébourg, Island of Mauritius:—

"On the estate called 'Plaisance,' about three miles from Mahébourg, in the island of Mauritius, there is a ravine of no great depth or steepness, which, apparently, once conveyed to the sea the drainings of a considerable extent of circumjacent land, but which has been stopped to seaward, most likely for ages, by an accumulation of sand extending all along the shore. The outlet from this ravine having been thus impeded, a sort of bog has been formed, called 'La Mare aux Songes,' in which is a deposit of alluvium, varying in depth, on account of the inequalities of the bottom, which is formed of large masses of basalt, from three to ten or twelve feet. The proprietor of the estate a few weeks ago conceived the idea of employing this alluvium as manure; and shortly after, the men began digging in it; when they had got to a depth of three or four feet they found numerous bones of large tortoises, among which were a carapace and a plastron pretty nearly entire, as also several crania.

"When I heard of this, it immediately struck me that the spot was one of the most likely possible to contain bones of the Dodo, and I gave directions to the men working there to look out for any bones they might find. Nothing, however, was turned up but a fragment of what I supposed to be the humerus of a large bird. This encouraged me to look further; and my search was rewarded by the discovery of several tibiæ, more or less perfect, two tarsi, one nearly perfect pelvis, and fragments of three others.

"These were found imbedded in a black vegetable mould, the lighter-coloured specimens being near the springs. My reasons for believing these to be remains of the Dodo are:—the certainty that that bird once existed in Mauritius; the similarity of these bones to what the representations of the Dodo which I have seen would lead one to expect, particularly the breadth of the pelvis, the stoutness of the tibiæ and tarsi, and the shortness of the latter; the favourable nature of the spot in which they were found for the haunts of such birds when living—a sheltered hollow with two springs in it; the non-existence, actual or traditional, in Mauritius of any bird to which bones such as these could have belonged; the indubitable antiquity of these bones, proved by the deposit of alluvium which covered them.

"During nearly thirty years that I have inhabited this colony, I have made frequent inquiries of old people as to the finding of the bones of large birds, and have offered liberal rewards for such; and I have consulted with the late Dr. Ayres as to the spots most likely to contain them. We agreed that the floods which sweep the hill-sides and the ravines in the rainy season would be most likely to carry any remains into the sea; and this would doubtless have been the case here, but for the stoppage occasioned by the sand-down. (Signed) "GEORGE CLARK. 1865."

The above "Statement" was authenticated by the following testimony:—

"Having visited the place with Mr. Clark, I can vouch for the truth of the facts herein mentioned. (Signed) "WILLIAM THOMAS BANKS,
"Civil Chaplain, Mauritius."

"The Rev. W. T. Banks, Civil Chaplain at Mahébourg, in this diocese, and Mr. George Clark, Master of the Government School at Mahébourg, are well known to me, and deserving implicit credit for their statements as to matters of fact.
(Signed) "VINCENT N. MAURITIUS. Oct. 6, 1865."

§ 2. *Description of the Bones.*

The bones of the Dodo (*Didus ineptus*, Linn.) discovered by Mr. Clark, under the above circumstances, which have reached me up to the present date (December 20th, 1865) are the following:—

Name.	Number of bones or parts.
Cranium and lower jaw, in parts	14
Vertebræ and pelvis	30
Ribs	22
Sternum	2
Scapular arch, in parts	7
Humerus, ulna, radius	6
Femora	5
Tibiæ	6
Fibulæ	4
Metatarsals	4
Total number of parts of skeleton of the Dodo	100

The known characters of the skull and metatarsus of the *Didus ineptus* served to identify those bones as belonging to that species: the agreement in relative size, colour, condition, and locality left no room for hesitation in referring the other bones in the above list to the same species[1]. They belong, however, to four or five individuals

[1] So determined, subsequent sets of bones transmitted from the Mauritius, and from which I was privileged to select the most perfect specimens for the present memoir, got into the market and were sold by auction since the present memoir was in type, as bones of the Dodo. I have to express my sincere and grateful acknowledgements to those gentlemen into whose hands these lots have fallen, who have forborne their own advantage and refrained from rushing into print with figures from inferior specimens to anticipate the appearance of a memoir notified

varying somewhat in size. With the bones of the Dodo were the end of the lower jaw of a broad-billed Parrot, two bones (radius) of a small Mammal, and part of the skull of a large Tortoise[1].

To the description of the Dodo's bones I now proceed.

§ 2. *Vertebræ.*

The dorsal vertebræ are chiefly represented, in this series of bones, by three which are anchylosed together by their bodies and neural arches (Pl. XVII. figs. 1–5): the posterior articular surface of the body of the last of these vertebræ (ib., fig. 4, *c*) is subquadrate, longer in the vertical than the transverse direction, concave vertically, convex transversely, almost fitting, but being rather too small for, the anterior articular surface of the body of the first of the sacral series (Pl. XIX. fig. 1, *c*). The difference is such as to indicate that only one dorsal vertebra may have intervened; and I conclude that the last of the three coalesced vertebræ is the penultimate dorsal. The anterior articular surface of the foremost of the three (Pl. XVI. fig. 1, *c*) is 11 lines in transverse, and 4 to 5 lines in vertical diameter: it is concave transversely for the middle three-fifths, and convex transversely at the two outer fifths of its extent: it is more or less convex vertically throughout its extent. The bodies of these vertebræ are compressed and wedged-shaped, slightly expanded at their coalesced ends, produced below into subquadrate hypapophyses in the first and second (Pl. XVII. fig. 1, *hy*); while this process is restricted to the fore part (ib. *hy* 3), or may be represented only by a slight anterior production of the lower edge of the wedge, in the third (ib. fig. 5, *hy* 3).

(in the 'Proceedings of the Zoological Society,' January 9th, 1866) as destined "to be published entire in the Society's Transactions," and therefore necessarily awaiting the lithographing of "illustrations," which every true promoter of science for its own sake must have desired to see as complete as the best-selected materials would permit to be given.—R. O., June 1866.

[1] In the quaint print, in folio 3, of the "Narration Historique du Voiage faict par les huict Navires *d'Amsterdam* au mois de Mars l'An 1598. soubs la conduitte de l'admiral Jaques Corneille Necq," &c., the first-named object, No 1, "Sont Tortues qui se tiennent sur l'haut pays, frustez d'aisles pour nage, de telle grandeur, qu'ils chargent ung homme et rampent encore fort roidement, prennent aussi des Ecriuisses de la grandeur d'un pied qu'ils mengent. 2. Est ung oiseau, par nous nommé *Oiseau de Nausée*, à l'instar d'une *Eigne*, ont le cul rond, couvert de deux ou trois plumettes crespues, carent des aisles, mais en lieu d'icelles ont ilz trois ou quatre plumettes noires, des susdicts oiseaux avons nous prins une certaine quantité, accompaigné d'aucunes tourturelles et autres oiseaux, qui par noz compaignons furẽt prins, la premiere fois qu'il arrivoyent au pays, pour chercher la plus profonde et plus fraische Riviere, et si les navires y pourroyent estre sauvez, et retournerent d'une grande joye, distribuant chasque navire, de leur Venoison prins, dont nous partismes le lendemain vers le port, fournismes chasque navire d'un Pilote de ceux qui au paravant y avoyent esté, avons cuict cest oiseau, estoit si coriace que ne le povions asses boviller, mais l'avons mengé a demy cru. Si tost qu'arrivames au port, envoya le Vice-Admiral nous, avecq une certaine troupe au pays, pour trouver aucun peuple, mais n'ont trouvé personne, que des Tourturelles et autres en grande abondance, lesquels nous prismes et tuames, car veu qu'il n'y eust personne qui les effraia, n'avoient ilz de nous nulle crainte, tindrẽt lieu, se laisserent assomer. En sõme c'est un pays abõdant en poissõ et oiseaux, voire tellemẽt qu'il excella tous les autres audit voyage."—*Le Second Livre de la Navigation des Indes Orientales*, fol., 1601.

The hypapophysis of the first of the three expands at its termination (Pl. XVI. fig. 1, *hy*), with the hinder angle bent back to coalesce with the front one of the next hypapophysis, which is somewhat longer, and bent forward with a similar terminal expansion: a full elliptical space is intercepted by this terminal confluence of these hypapophyses (Pl. XVII. figs. 1 & 5, *hy*). Each vertebra shows an elliptical articular cavity (ib. figs. 1 & 5, *p*, p_3) for the head of the rib, near to the anterior articular surface; the long axis of this costal surface is directed from above obliquely downward and forward. The surface of the rib's tubercle cuts obliquely the lower part of the free end of the diapophysis (Pl. XVI. fig. 1, *d*).

The neural arch circumscribes a canal the anterior outlet of which (ib. fig. 1, *n*) is oval with the small end downward, 5 lines in vertical, and $3\frac{1}{2}$ in transverse diameter: the sides of the neural canal slightly project inward above the lower third: the posterior outlet (Pl. XVII. fig. 4, *n*) is more regularly elliptical in form, and rather narrower in proportion to its vertical diameter. The neurapophysis sends off from the outer and fore part of its base a stout process, which expands and divides into zygapophyses (Pl. XVI. fig. 1, *z*) and diapophyses (ib. *d*); the articular surface of the former is of a full oval shape, flat, looking obliquely upward and inward; the diapophyses extend outward and a little backward: the articular surface for the tubercle of the rib is transversely elliptical and nearly flat. The hinder part of the neurapophysis expands into the postzygapophyses: these have coalesced with the præzygapophyses in the succeeding vertebra (Pl. XVII. fig. 2, *z*), as has happened also between this and the third vertebra. In the last of the three vertebræ the postzygapophyses are entire (ib. z_3), and show very slightly concave, oval articular surfaces, looking obliquely downward and outward (ib. fig. 4, *z*). The conjugational foramina, continuously surrounded by bone, are a full ellipse, and large, the anterior one (ib. figs. 1 & 5, *f*) being $5\frac{1}{2}$ lines in vertical diameter; the second (ib. f') is somewhat less: these foramina are also rather larger in one of the specimens than in the other. The length of the three coalesced dorsals is the same in both, viz. 2 inches 3 lines. The neural spines have run together into a continuous ridge in fig. 1, *ns*; in fig. 5 the summit is broken off in both, leaving only the anterior angle of the foremost entire; in both this inclines forward; the hinder border of the third vertebra (fig. 1, *ns*) has the same vertical parallel as the back part of the centrum. The anterior margin of the base of the spine shows a rough surface for the attachment of ligament (Pl. XVI. fig. 1, *ns*). A small foramen behind the base of each of the coalesced zygapophyses (Pl. XVII. fig. 2, *z z*) leads to a canal descending to the neural one, and indicates superiorly the limits of the otherwise continuously ossified neural arches.

In the series of detached vertebræ, one (Pl. XVII. fig. 6 & 7) indicates by its neural spine and hypapophysis a position at the base of the neck. The centrum is barely an inch in length; its anterior surface (ib. fig. 7, *c*) is narrow vertically, broad transversely; both fore and hind surfaces indicate freedom and extent of flexure. The hypapophysis has a broad, bituberculate base (ib. *hy*), but is limited in fore and aft extent to the middle third of the under surface of the centrum: its length is shown in fig. 6, *hy*. The parapophysis (fig. 7, *p*) is slender, and expands at both attachments, with an indication of a terminal surface. The diapophysis (*d*) has a larger costal surface: it sends forward a convex ridge midway between the di- and zygapophysis (*z*). The neural canal (fig. 7, *n*) has wider and more fully elliptical outlets than the hinder dorsal vertebræ, in relation to the greater extent of motion at the fore part of the series. I conclude that a free pleurapophysis (*pl*) existed, indicating the present to be the first of the dorsal series, as shown in Pl. XV. The neural spine is short, broad, obtusely pointed, with a vertically oblong syndesmotic surface (fig. 7) before and behind. Each postzygapophysis (fig. 6, z') supports an anapophysial tubercle (*a*).

A cervical vertebra from a position just in advance of the above has lost the neural spine, but retains the hypapophysis. This process (ib. figs. 8 & 9, *hy*) is compressed and directed obliquely downward and forward for an extent of 6 lines; the extremity is rounded: the length of the centrum of this vertebra is 1 inch 3 lines; the anterior articular surface is longest transversely, and concave in that direction, convex vertically; the proportions and curvatures are transposed in the posterior surface (fig. 9, *c*). The parapophysis (ib. *p*) is continued from the anterior border of the centrum to the middle; it is a depressed plate, confluent with the rib (ib. *d*). The diapophysis forms a short, obtuse projection above its anchylosis with the rib (ib. *pl*): this projects backward 7 lines in length, terminating obtusely, and circumscribing a vertebrarterial foramen (ib. *v*) of a full elliptic shape, $5\frac{1}{2}$ lines in long diameter. The surfaces of the præzygapophyses (*z*) are larger, and look more upward and less inward, than in the preceding and the dorsal vertebræ: they are very slightly concave. Those of the postzygapophyses (fig. 8, z'), with a downward and slightly outward aspect, are in a similar degree convex. The neural canal, as usual in the cervical series, expands at its outlets, most so posteriorly (fig. 9, *n*); the middle of the upper surface of the neural arch is impressed by an elliptical, rough, ligamentous surface, which slightly rising in the middle is the sole indication of a neural spine. The upper surface of each postzygapophysis developes a tuberous anapophysis (figs. 8 & 9, *a*).

The three cervicals that succeed the axis show progressively sinking neural spines, which subside in the six following vertebræ (Pl. XV.). The third cervical has also the hypapophysis (Pl. XXIII. fig. 3, *hy*).

In all the other cervicals of the present series the hypapophysis is wanting, but each parapophysis developes a plate (Pl. XVII. figs. 10 & 11, Pl. XX. fig. 1, *p*) to form the sides of the hæmal canal through which the carotids ran; and the position of such vertebræ in the cervical series is indicated, respectively, by the degree of convergence of these processes, in none of which, where entire, have they met so as to circumscribe the canal: in some of these vertebræ, however, they are mutilated. They differ chiefly in the position and shape of the anapophyses (fig. 10, *a*), which advance from above the postzygapophyses (z'), converging towards the middle of the upper surface of the neural arch, being arrested, save in one instance, at the sides of the ligamentous surface occupying the common position of the base of the neural spine.

In the axis vertebra (Pl. XVII. figs. 12 & 13) the posterior articular surface, concave vertically, and 3 lines in that extent at its middle part, is very convex transversely, being continued upon the sides of the posterior part of the centrum; a thick obtuse hypapophysis (fig. 13, *hy*) descends below this surface: the anterior or odontoid surface presents the usual form in birds; the odontoid process (ib. *x*) has a pit at its apex. The prezygapophyses (fig. 12, *z*), of very small size, project from the outer and fore border of the neural arch, with their articular surface looking outward and slightly upward; a ridge is continued from their back part to the base of the postzygapophyses: the surface (fig. 13, z') in these, $4\frac{1}{2}$ lines in long diameter, is three times the size of the anterior one; it is concave transversely, and looks downward and a little outward. The anapophyses (ib. fig. 12, *a*) are large tubercles rising above the articular surfaces. The base of the neural spine, 9 lines in length (ib. *ns*), is coextensive with the neural arch; the spine rises posteriorly to a height of 6 lines, with a thickness of 2 lines, having a convex upper margin (Pl. XV.).

The relative size and position of the cervical vertebræ, as coadjusted in the position and degree of flexure of the neck represented in Sir Hans Sloane's life-size painting of the Dodo, in the British Museum, are given in Plate XV. with the varying proportions of the pleurapophyses and other processes.

§ 3. *Ribs.* (Plates XV. & XVI.)

The specimens of ribs include both vertebral and sternal portions; that which appears to be the second or third on the right side (Pl. XVI. figs. 7, 7 *a*) is 4 inches 4 lines in length (following the outer curve), and expands to a breadth of 7 lines at its lower part; the interval between the articular surfaces of the head and tubercle is 6 lines. The appendage (ib. *a*) has coalesced with the middle of the hind margin of the shaft. The neck is compressed, with a thin upper margin; the lower one is continued with a curve upon a strong internal buttress-like ridge (ib. *b*), which runs to near the fore part of the flattened body of the rib, where it meets the ridge continued from the tubercle, about 2 inches down the rib: there is a shallow channel between these ridges, contracting to their confluence. The inner surface of the rib is impressed by a deeper and broader channel behind the buttress: the posterior border expands in in the form of a triangular plate, with a base of about an inch in extent, due to the complete confluence there of the epipleural process. The anterior border is thicker, and is almost straight. Towards the sternal end the pleurapophysis contracts and thickens, terminating in a rough syndesmotic elliptical surface, 3 lines by 2 (fig. 7, *f*), for the attachment of the hæmapophysis or sternal rib.

A vertebral rib (ib. fig. 2) which is entire, measures 9 inches in length (following the outer curve). The head and tubercle are at the same distance as in the preceding, but the tubercle is broader. The characters of the body of the rib are very similar; but it is narrower, not attaining a breadth of $5\frac{1}{2}$ lines at its lower end; the narrowing and thickening to the articular surface for the sternal rib is more gradual.

A last vertebral rib is adapted, by the longitudinal extent and partial division of the tubercle, to the vertebra which forms the first of the coalesced series of sacrals; and the body of the rib, instead of preserving the regular outward curve of the antecedent ones, is more suddenly bent soon after it emerges beyond the margin of the ilium; the lamelliform part thence continued is straighter, and, moreover, shows upon its outer surface a flattened facet, indicative of pressure or friction by the movements to and fro of the thigh over a rib in such position. Beyond this surface the rib curves in a way not shown in the other specimens; the distal end has the flat syndesmotic articular surface to which had been attached a hæmapophysis not reaching the sternum. In this last (eighth) free rib there is no epipleural process, nor any definitely marked ligamental surface on the posterior margin indicative of the attachment of such process.

The body of a posterior vertebral rib (Pl. XVI. fig. 10) shows a fracture which has been healed, with some irregular ossific deposit on the inner surface. All the ribs have a pneumatic foramen (ib. figs. 2, 7, 8 *p*) at the fore part of the neck, near the base of the tubercle.

The eight left vertebral ribs (Pl. XV.) and the five right ones do not, either of them, constitute a consecutive series, but have come from different individuals, of different sizes, as exemplified in the third rib figured in Plates XV. and XVI.

The sternal ribs (Pl. XVI. figs. 3 & 12) are characterized by the two facets, nearly or quite meeting at an open angle, into which their sternal end expands (ib. fig. 3, *c*). One of these ribs, which is entire, shows the single, elliptic syndesmotic surface at the opposite end (ib. *b*); it is $3\frac{1}{2}$ inches in length, with a greatest breadth of 5 lines, and is straight. Another and longer specimen (ib. 12) shows a moderate degree of curvature. A third specimen is 6 inches in length: the proximal end has a breadth of nearly half an inch (the penultimate rib in Pl. XV.).

Five successive sternal ribs are indicated by gradational size and curvature, and a sixth, which does not reach the sternum. Before describing this bone I shall proceed with the account of the sacral vertebræ, and the expanded hæmal arches of such as complete the pelvis.

§ 4. *Pelvis.* (Plates XV. & XIX.)

The pelvis of the Dodo is chiefly remarkable for the flatness and great breadth of the posterior half, corresponding with the characteristic proportions of that part of the body in the old woodcuts of the Dutch "Dodaersen"[1]. It includes sixteen coalesced sacral vertebræ, with which the iliac bones are continuously confluent.

[1] See, especially, Bontekoe's figure, copied by Strickland, in the title-page and at p. 63 of the above-cited work.

The first sacral shows the transversely extended and concave articular surface of the centrum (Pl. XIX. fig. 1, *c*); the subcircular pit (ib. *p*) for the head of the rib is behind the middle of the side of the centrum, at its upper part; the inferior surface is ridged lengthwise; and a transverse low but sharp ridge defines the posterior boundary, the depressions in front of which indicate the hindmost origins of the subvertebral muscle (longus colli?). The anterior outlet of the neural canal (ib. *n*) is subcircular in one specimen, vertically elliptic in others, and 3 lines or less in transverse diameter. From the sides of the neurapophyses stretch out the strong buttresses of bone which blend with the under part of the ilia, giving off from the fore part of their base the præzygapophyses (ib. *z*), and from the back part of their apex the surface (ib. *d*), or part of it, for the tubercle of the last moveable rib, the ilium in the latter variety affording the rest of that surface. The fore part of the strong neural spine (ib. *ns*) is roughened by a syndesmotic surface; it rises to a height of 14 lines, curving forward, and is confluent at its summit with the approximated anterior margins of the ilia. A continuous track of bone, forming a smoothly obtuse longitudinal ridge, represents the summits of the succeeding sacral spines (ib. fig. 2, *ns*) to the hindmost vertebra of the series, without any trace of their primitive division; but this track rises, posteriorly, above the shallow channel on each side, in which are the foramina (ib. *o*), indicating most of the constituent vertebræ.

The second sacral vertebra abuts against the ilium by a pleurapophysis (ib. fig. 1, *pl* 2), as well as a diapophysis (ib. *d* 2); but the former is a slender, straight filament, or narrow plate of bone, confluent at both ends.

In the next two vertebræ the pleurapophysis (ib. *pl* 3&4) assumes more breadth and robustness, but is short and straight, abutting against the inner surface of the ilium an inch in advance of the acetabulum. The first of these rib-buttresses inclines forward, and is completely confluent with the ilium; the thicker one (ib. *pl* 4) has retained part of its primitive ligamentous attachment to the ilium: the proportions of both are subject to some variety.

These are succeeded by three or four vertebræ in which the pleurapophysis is not developed, the attachment to the ilia being by diapophyses only (ib. *d d*), which are short slender lamellæ, directed upward and backward; below and between them are the double orifices for the separate motory and sensory roots of the sacro-spinal nerves. In the next vertebra the pleurapophysis (ib. *pl* 8) reappears, longer but more slender than in the fourth sacral, extending obliquely backward, and expanding at its extremity to abut against a prominence on the underside of the ilium, opposite the hind part of the acetabulum, with which prominence the rib has completely coalesced by an expanded end. The under part of all these vertebræ is traversed by a sharp median longitudinal ridge, which is more feebly and interruptedly continued to near the end of the sacral series.

Eight vertebræ, abutting by diapophyses only (ib. *d d*) against the ilia, succeed the one last described; their coalesced bodies are less than half the breadth of those of the preceding vertebræ: they gradually diminish in depth to the last, without loss of breadth. The diapophyses proceed obliquely outward and backward, are lamelliform, about 9 lines in length, and intercept oblong cavities of the same extent and direction, into which open the orifices (ib. fig. 2, *o*) noticed on the upper surface of that part of the pelvis. The articular surface of the body of the last sacral is transversely elliptic, 4 lines by 2 lines, and very slightly convex. The outlet of the neural canal, above it, is circular, and about a line in diameter, the whole vertical extent of the last sacral being 5 lines, while that of the first sacral is 2 inches 2 lines.

The ilium is divided, as usual, into two parts by the ridge on its upper or outer surface (ib. fig. 2, *r*), extending obliquely backward to behind the acetabulum—the anterior division being narrower and concave, the posterior broader and convex but in a minor degree. The anterior (slightly thickened) border of the ilium is curved with the convexity forward, extending 8 or 9 lines in advance of the fore part of the neural spine of the first sacral vertebra. The ilia almost meet above that of the second and third sacrals, with which they coalesce, and then diverge to the oblique boundary ridge, which is thence continued, in some with an angular bend, more directly outward. At this angle the bone is so confluent with the sacrum that the orifices leading to the ileoneural canals[1] are almost or quite obliterated. These canals are, here (ib. *i i*), the longitudinally extended cavities intercepted between the fore parts of the ilia and the continuous coalesced sacral spines and diapophyses, widening to their anterior outlets. The extent of that part of the ilium in advance of the acetabulum is 3 inches 8 lines; the breadth at its middle part is 2 inches. As the ilium approaches the acetabulum it increases in thickness, and is grooved at the outer margin by a vessel which leaves impressions of its ramifications upon the upper concave surface of the bone (ib. fig. 2, 62). The acetabulum (ib. *a a*) is circular, 11 lines in the diameter of its outlet, 9 or 10 lines in that of its inner circumference, being widely open, as usual in birds, towards the cavity of the pelvis; the trochanterian surface (ib. *t t*) above the acetabulum is elliptic, with the long axis lengthwise, 9 lines by 6 in its diameter, with its upper border sharp and produced; the anterior border (ib. *b*) of the acetabulum is slightly produced; the position of this articular cavity is about midway between the fore and hind ends of the pelvis. The oblique external ridge of the ilium terminates in the outer margin of the broader part of the bone (ib. *r'*), 7 lines above the sharp and prominent margin of the trochanterian surface (ib. *t*). The ilia have diverged from each other for the extent of an inch and a half behind the beginning of the boundary line (ib. *r*), which interval is occupied exteriorly by lateral ossification from the neural spines to the diapophyses of that part of the sacrum: the mesial borders of the ilia (ib. fig. 2, 62') slightly converge to the fifteenth sacral vertebra, where they are separated by an interspace of 1 inch, and then again diverge to the last sacral; they coalesce with the diapophyses (ib. fig. 2 *d d*).

[1] Owen, 'Anatomy of Vertebrates,' 1866, vol. ii. p. 32.

The inner or under surface of the ilium is thickened into a kind of buttress (ib. fig. 1, *e*), terminating behind the ischiadic foramen. The breadth of the iliac bones and intervening sacrals, 1 inch behind the acetabulum, is 5 inches; at the back part of the pelvis it is 4 inches. The outer border of the posterior part of the ilium (ib. fig. 2, *g*) projects as an obtuse ridge above the ischiadic foramen and the succeeding expanded and confluent part of the ischium (ib. 63), which is vertically concave externally: the ilium, ischium, and pubis (ib. fig. 1, 64) have completely coalesced around the acetabulum. The pubis, which in this part is 7 lines thick, contracts as it becomes free to a diameter of 4 lines; it is smooth and convex below, and has been broken off near the acetabulum on both sides; the fracture shows its pneumatic structure. The ischium, as it recedes from the acetabulum, contracts to a trihedral column, with a vertical diameter of 4 lines; it is concave outwardly, convex inwardly, and suddenly expands below, about an inch from the acetabulum, to form part of the posterior boundary of the obturator foramen (ib. fig. 1, *f*), which is 9 lines in length, and is situated one half in advance of, and the other half beneath, the ischiadic foramen (ib. *m*). This latter is oval, with the large end forwards, 1 inch 3 lines by 10 lines in its principal diameters. Behind this foramen the ischium is confluent with the ilium for an extent of 2 inches, or perhaps rather more, as the posterior margin of the pelvis is not entire in any of my specimens. The inner surface of the ischium forms a low, obtuse longitudinal ridge towards the pelvic cavity, losing thickness as it recedes from the acetabulum. The chief pneumatic foramina in the pelvis are on the inner surface, above the acetabulum, behind the trochanterian articulation, and behind the iliac confluence of the last sacral pleurapophyses,—also at the hinder part of the ilium, on each side of the transverse buttress (ib. *e*) near its posterior junction with the ischium. The prærenal fossa (between *pl* 4 & *pl* 8, fig. 1) is deep and subdivided by the diapophysial plates: the postrenal fossa is wide and shallow.

§ 5. *Sternum.*

Of this instructive and determinative bone there are two specimens, the one most entire (Pls. XV., XVI. fig. 4 4, & XVIII.) measuring in a straight line, from the costal process to the hind border, 7 inches. The extreme breadth between the lateral processes (Pl. XVI. *h*) is $4\frac{1}{2}$ inches; from this diameter the bone contracts anteriorly to a breadth of $3\frac{1}{2}$ inches at the costal processes (ib. *d*), and posteriorly it contracts more rapidly to an obtuse, horizontally flattened apex (Pl. XVIII. fig. 3). The anterior border of the sternum (Pl. XVI. fig. 4.) is widely and rather deeply emarginate at the middle (*e*), less deeply so on each side: the breadth of the mid notch (*b e b*) is 1 inch 9 lines, that of each side notch (*b d*) is 1 inch 2 lines. The sternum is deeply hollowed above (Pl. XXIII. fig. 4), correspondingly convex beneath (ib.); the keel (*s*) is low and thick, commencing by a pair of broad obtuse ridges (Pls. XVI. fig. 4, & XVIII. fig. 1, *r r*) from the mesial ends of the outer walls of the coracoid grooves (ib. *b′*), which gradually rise from the surface of the bone as they extend backward, converging to form the beginning of the keel about 2 inches from the anterior emargination (*e*): the keel gains a depth of $\frac{3}{4}$ of an inch at the middle of the sternum, then gradually sinks to the level of the bone, as it extends backward, at $1\frac{1}{2}$ inch from the hind end (Pl. XVIII. fig. 3), a little increasing in thickness as it subsides: its free border describes a pretty regular convex curve (Pl. XV.); it is thick, flat, partially canaliculate: the sides of the base of the keel expand, to be continued gradually into the body of the sternum (Pl. XXIII. fig. 4). Behind the costal surface (Pl. XVIII. *c*), on each side, extends a lamelliform process (Pls. XV. & XVIII. *h*), $\frac{1}{2}$ an inch in breadth, upward and a little outward, slightly expanding to its free termination, which, however, is not entire in either specimen: the longitudinal extent of this characteristic process, where it is best preserved, is 1 inch; it is conjecturally restored in Plate XV.; it answers to the ectolateral process (*h*) of the gallinaceous sternum (Pls. X. & XIV. fig. 3): there is no trace of an entolateral process (ib. *i*). The thin margin of the Dodo's breastbone, behind the ectolateral process (Pls. XV. & XVIII. *h*), is entire and uninterrupted to the obtuse apex, and the body of the sternum is imperforate: the notch (*f′*) behind the process (*h*) represents the ectolateral notch of the gallinaceous sternum (Pl. XXIV. figs. 1 & 3, *f′*). The costal border (Pl. XVIII. fig. 2, *c*) is 1 inch 9 lines in extent, and 6 lines across its broadest part; it shows articular surfaces for five sternal ribs, of which the four posterior (2–5) are bilobed, the anterior one (*c* 1) simple, and limited to the outer half of the border; the second sternum shows some variety in this respect: the deep interspaces, in both, are perforated by pneumatic foramina. The costal process (*d*)[1] in advance of these surfaces expands, as it rises upward and a little outward and forward, to the extent of nearly an inch; the hinder and outer side is impressed by a concavity, continued from the costal border; the inner side is smooth and convex: it is not quite entire on either side. The coracoid grooves (Pl. XVI. fig. 4, *b b′*) are small in proportion to the sternum, and are divided from each other by an interspace of about an inch; the outer wall of the groove (*b′*), 9 lines in extent, is moderately produced and convex; it appears to be a continuation of one of the initial ridges (*r*) of the keel: the inner wall of the groove (*b*) is deeper, and is formed by the obtuse angle of the anterior border of the sternum, between the medial and lateral emarginations. External to each coracoid groove is a large elliptical pneumatic foramen (*p*) or depression. There is no episternal process. On the convex outer surface of the body of the sternum the "pectoral" ridge (Pl. XVIII. fig. 1, *k*)[2] is feebly indicated, extending from the outer end of the coracoid groove backward and inward to near the posterior third of the keel. The concave surface of the sternum (ib. fig. 2) shows a number of small pneumatic foramina, chiefly along the middle line to near the posterior third. Behind the costal border the

[1] Called "hyosternal" in the Geoffroyan determination of parts of the bird's sternum.

[2] The intermuscular ridges ('pectoral,' 'subcostal,' 'carinal') are, with other parts of the bird's sternum, here named as defined in my 'Anatomy of Vertebrates,' vol. ii. pp. 16–23.

substance of the sternum gradually increases in thickness from the sharp lateral margins to the middle, above the base of the keel, and shows there a fine pneumocancellous texture (Pl. XXIII. fig. 4).

§ 6. *Scapular Arch.* (Plates XV. & XX.)

This consists of the scapula (Pl. XX. figs. 6, 7, 8 & 9, 51), coracoid (ib. figs. 4 & 5, 52), and clavicle (ib. 58), the latter ending in a point and here tied by ligament to its fellow, to form a furculum. I have received the elements of this arch in three conditions:—one in which the bones, though of full size, are separate; a second, in which the scapula and coracoid are confluent, but the clavicle distinct; a third, in which the three bones are confluent at the ends converging to the humeral articulation. The scapula (ib. figs. 6 & 7, 8 & 9, 51), 3 inches 7 or 8 lines in length, has the usual sabre-shaped body, slightly expanding and decurved at its free extremity, the breadth of which is 7 lines: it terminates obtusely: varieties of shape are shown in figures 6 & 8. The outer surface of the bone, at the two posterior thirds of its extent, is slightly concave and marked by muscular attachments; the inner surface of that part is smooth and slightly convex: the bone increases in breadth, with some diminution of thickness, towards the articular end, and is remarkable for sending off from the lower border, at 7 or 8 lines from that end, a short process (ib. 51); between this process and the articulation the breadth of the bone is little more than 3 lines; the breadth of the articular end is 9 lines. Nearly one-half of it is occupied by the almost flat, subcircular humeral surface (fig. 8, *a*), with a diameter of 4½ lines, and directed upward, outward, and a little forward. From this is continued an oblong, much narrower coracoidal surface, beyond which the acromial process (fig. 6, *c*) extends forward, curving toward the coracoid, and terminating obtusely.

The coracoid (ib. figs. 4, 5, 8 & 9, 52), averaging a length of 3 inches 7 lines, expands to a breadth of 1 inch 3 lines at its sternal end (52), of which the articular surface (*e*) occupies an inch; the non-articular part forms the outer angle (*m*), and extends in advance of the pneumatic foramen (Pl. XVI. fig. 4, *p*) at that part of the breast-bone: the outer border which extends from this free angle to the body of the bone, into which it subsides, at one-third of the extent of the bone, is sharp; the inner border is obtuse to near the inner angle (Pl. XX. figs. 4 & 5, *n*). The outer surface of the expanded sternal end is smooth and convex; the inner surface is flatter and more irregular, perforated by pneumatic foramina; the diameter of the subcylindrical part of the shaft is 4 lines: the extremes of difference in the distal expansion of the coracoid are shown in figs. 4 & 8, 52, Pl. XX. A muscular ridge and rough surface (ib. fig. 9, *r*) mark the back part below the middle of the shaft. The bone then expands to its upper articular end, which is obliquely truncate from within outward: it shows, first, the oblong surface for the scapula, which is extended upon the inner prominence of that end; next, the larger and full oval surface for the humerus (*h*), from which the thick, obtuse, inner continuation of the scapular end projects inward, forward, with a slightly upward curve, and shows the narrow oblong surface for the articulation and ultimate confluence of the clavicle (58). The coracoid unites with the scapula at an angle of 100°.

The clavicle (ib. figs. 4 & 5, 58), at its scapular end, is slightly expanded, compressed, with an obtuse recurved termination articulating with the above-named surface of the coracoid, and in one instance coalescing therewith, and by extended ossification with the "acromion scapulæ" (ib. figs. 8 & 9). As the clavicle descends it curves slightly and contracts to a point. The angle at which the pair meet is shown in figs. 4 & 5.

§ 7. *Bones of the Wing.* (Pls. XV. & XX. figs. 12–17.)

Of the humerus the series contains two specimens, both measuring 4 inches 3 lines in length, one right, and the other left (Pl. XX. figs. 12–14), but differing slightly in their proportions and in colour—one being of the olive-brown tint with which most of the bones are stained, the other black. The articular head (ib. *a*) is an elongate oval convexity, with the larger end toward the radial side, prominent toward the back and rather flattened toward the front of the bone, which there swells out beyond the base of the articular surface. The radial tubercle is small, and descends from the radial end of the head for about 5 lines; the pectoral process (ib. *b*) is triangular, obtuse, short, and bent, or directed toward the front side of the bone: the ulnar tuberosity (ib. *c*) is more produced in that direction; it is oblong, obtuse, with its base impressed by a large pit both above (fig. 12, *h*) and below—the lower one (ib. *g*) being the deepest, and perforated by a pneumatic foramen; the convex, broad, ulnar border of this tuberosity has two slightly produced processes, an upper or posterior (ib. fig. 12, *c*) and a lower and internal (ib. *g*), which is the smallest. The breadth of the proximal end of the humerus, across the tuberosities, is 1 inch 5 lines, beyond them the bone contracts to a smooth subcylindrical shaft, showing at the back part of the proximal third a longitudinal ridge (fig. 12, *r*), half an inch in length; it gradually expands at the distal third to a breadth of 10 lines, where the articulations offer the usual avian characteristics of the elbow-joint. The head of the humerus is occupied by a fine cancellous structure: into the large vacuity below this, crossed in the section figured (Pl. XXIII. fig. 5) by a transverse slender bar of bone, the small pneumatic foramina at the bottom of the wide and deep fossa for the axillary air-cell open. The part of the hollow proximal end giving off the pectoral and other processes for the attachment of muscles is strengthened by similar abutments. The pneumatic cavity of the main part of the shaft of the humerus is simple, with a compact wall thicker than at the ends of the humerus, but not exceeding that which is characteristic of the long air-bones in birds. The portion of the distal end chiefly serving for muscular attachments and the antibrachial articulation are also cancellous.

The *radius* (Pls. XV. & XX. fig. 15) is a straight and slender bone, 3 inches 1 line in in length, and 2 lines in chief diameter of the shaft. The proximal articular surface is subcircular, 3 lines in diameter, moderately concave; the distal end expands to the same extent, but is compressed, as usual.

The *ulna* (Pls. XV. & XX. figs. 16 & 17) is 3 inches 1 line in length, of the usual ornithic character, with a well-defined, narrow, elliptic, rough muscular depression, 8 lines in length (fig. 16, *c*), extending upon the shaft from below the anterior or palmar angle of the proximal articular surface. This bone has no pneumatic foramen; the orifice for the medullary artery is above the middle of the same palmar surface, the canal inclining distad. The shaft of the bone is nearly straight; the back or anconal surface, which is slightly convex, shows feeble impressions of the attaching ligaments of the alar plumes, which are represented in all the figures of the entire or living bird. A second ulna is 3 inches 3 lines in length.

There was no carpal or pinion bone in the collection of remains submitted to me: this part of the wing is conjecturally restored in dotted outline in Plate XV.

§ 8. *Bones of the Leg.* (Pls. XV., XXI., XXII. & XXIII.).

Of the five *femora* in the above defined series of remains of the Dodo, two measure 6 inches 3 lines in length; one (Pl. XXI.) is 6 inches 4½ lines; the shortest is a little under 6 inches, with proportionate differences in the diameter of the shaft. All of them show a small pneumatic foramen (Pl. XXI. figs. 1 & 2, *p*) on the inner side of the anterior ridge of the great trochanter (ib. *c*), and on the same transverse line with the head of the bone. This part shows an oblong depression (ib. figs. 2 & 3, *a*) for the "ligamentum teres" at the upper and back part. The articular surface on the same aspect of the neck (ib. fig. 3, *b*), adapted to the trochanterian prominence of the pelvis (Pl. XIX. *t*), is well-defined. The trochanter (Pl. XXI. fig. 1, *c*) rises, ridge-like, above the level of the head, and is continued from behind the middle of the articular surface on the neck, forward, with a convex outline upon the fore and outer part of the shaft, where it gradually subsides; a narrow intermuscular ridge (ib. fig. 1, *r*), inclining to the middle of the fore part of the shaft, is continued from the trochanterian one. The small trochanter (ib. fig. 3, *d*) is a small subcircular tuberosity, in some specimens a ridge, 3 to 4 lines in length, on the inner side of the shaft, about an inch below the head. The muscular impressions on the fore part of the bone are well defined. A minute medullary canal (ib. fig. 3, *m*) perforates the middle of the back part of the shaft; the popliteal fossa (ib. fig. 3, *o*) shows a few small pneumatic orifices; a triangular rough flat surface divides the fossa from the outer condyle. Above the fibular depression (ib. fig. 3, *g*) there is a well-defined, slightly raised, rough surface (ib. *k*) for the head of the ectogastrocnemius muscle. The ridge (ib. *n*) extending to the back part of the inner condyle is not sharp; the rotular groove (ib. fig. 1, *p*) is deep and moderately wide, with the inner boundary, formed by the narrow anterior part of the inner condyle (ib. fig. 5, *e'*), most produced. The breadth of this end of the longer femora is 1 inch 9 lines; the character of the distal articular surface is shown in Pl. XXI. fig. 5.

The head, neck, and great trochanter (Pl. XXIII. fig. 6) are occupied by a pneumatic cancellous structure, with a thin compact wall on the upper part and sides: this begins to gain thickness at the under part of the neck and at the lower and back part of the trochanter, the compact wall acquiring a thickness of a line at the beginning of the shaft, where the cancellous structure is confined to the outer side of the pneumatic cavity; this structure gives way to a few delicate filaments of bone crossing the cavity of the major part of the shaft, and is not resumed until the bone expands to form the distal condyles (ib. fig. 7).

The five *tibiæ* of *Didus* in the same collection range in length from 8 inches 8 lines to 9 inches. The procnemial ridge (Pl. XXII. figs. 1, 2, 4, *p*) is a triangular plate, with the base longest and the apex rounded off: it inclines outwardly, and does not extend much more than half an inch from the level of the proximal end of the bone: the length of its base rather exceeds an inch: on its inner side a triangular muscular surface is well defined by an irregular inferior line or ridge (ib. fig. 2, *n*). The ectocnemial process (ib. figs. 1, 3, 4, *e*) is thicker, shorter, and terminates roughly and obtusely. There is a low, narrow ridge (ib. fig. 2, *g*), about half an inch in length, on the inner side of the proximal end of the shaft, beginning about 9 lines below the articular surface at that end. The fibular ridge (ib. figs. 1 & 3, *h*), beginning 1 inch 8 lines from the proximal end, extends about 2 inches down the outer side of the shaft. The epicnemial ridge (ib. figs. 1 & 4, *k*) is obtuse, and but little produced above the upper articular surfaces or condyles (*t d*) of the tibia: the breadth of that end of the bone, in the longest specimen, is 2 inches 3 lines. The tendinal canal at the fore part of the distal end is bridged by bone (ib. fig. 1, *l*), and is situated on the inner half of that aspect of the shaft; the lower opening is subcircular and close to the anterior end of the inner lower condyle (ib. *a*), which is more produced forward than the outer one (ib. *b*). Their hind ends project very little beyond the level of that aspect of the shaft of the tibia. An intermuscular ridge (ib. fig. 1, *r*) strengthens into a tuberosity (r') at the inner side of the tendinal groove.

The cancellous structure in the tibia is limited to an extent of about half an inch below the proximal articular surfaces (Pl. XXIII. fig. 8), and to about an inch and a half from the distal end of the line (ib. fig. 9): the shaft is occupied by a large air-cavity, with a compact wall of half a line in thickness at the upper third, gradually increasing to about a line at the lower fourth, until the cancellous structure is reestablished; the transverse direction of a plate of this structure indicates the extent of the original distal epiphysis of the tibia (fig. 8).

The *fibula* (Pl. XXII. figs. 6–8) presents the usual ornithic characters of the bone: it varies from 4 inches 4 lines to 4 inches 6 lines in length, with a greatest proximal breadth of 8 lines. No adequate gain would result from a detailed description or comparison of this bone; and the rest of the bones of the foot have received every requisite attention in this way in the excellent work on the Dodo and its kindred, already quoted. A longitudinal section of the *metatarsus*, taken in the direction from side to side (Pl. XXIII. fig. 10), shows the loose cancellous texture of the common epiphysis of the three long metatarsals, and the remnant of their contiguous coalesced walls reduced to a thin lamella of bone. As the moiety of the bone figured is the posterior one (of the left metatarsus), the usual oblique position of the middle metatarsal (*iii*), with its proximal end nearer the back part and its distal end nearer the fore part of the coalesced series, produces a corresponding direction of the section, with narrowing and termination of the exposed part of the medullary canal about one-third from the distal end of that metatarsal. The medullary canal of the outer metatarsal (*iv*) is wider and descends lower before the breaking up of the inner surface into decussating lamellæ or filaments, than that of the inner metatarsal (*ii*): the peripheral compact wall of the inner is twice the thickness of that of the outer metatarsal. I may remark that the more posterior position of the middle metatarsal at its proximal end, from which and the corresponding part of the common epiphysis the calcaneal process is developed, is related to the greater share taken by the middle toe in the act of walking and scratching. I will only remark that of the four metatarsals of as many Dodos in the present series, one exceeds by a line the length of that figured in plate xi. *op. cit.*, and one falls short thereof to the same trifling amount.

§ 9. *Skull.* (Plates XV. & XXIII. fig. 1.)

Of the skull of the Dodo, the series of bones transmitted to me include the cranial part with the detached upper mandibular bone (more or less mutilated) of two mature birds, and the lower mandible of three individuals. In the latter the dentary elements (Pl. XXIII. fig. 1, 32), confluent at the "gonys," are distinct from the hinder halves of the rami formed by the confluent, or perhaps connate, articular, surangular and angular elements (ib. 31): if the "splenial" were ever distinct, it has coalesced with the dentary, where its upper boundary is indicated by a linear groove or series of small foramina.

In size, shape, and all other characters of these important evidences of the specific character of the remains from the Mahébourg morass[1], they agree with those of *Didus ineptus* detailed in the 'Proceedings of the Zoological Society' for January 11th, 1848 (part xvi. pp. 2–8), and in the work entitled "The Dodo and its Kindred," pp. 76–96.

The occipital condyle (ib. 1) presents the same hemispheroid or reniform shape, with the median vertical notch or depression above. The upper margin of the foramen magnum is broad, as it were excised, with the sides slightly prominent. The superoccipital foramen is present in both specimens, as in the one originally described (Proc. Zool. Soc. part xvi. p. 2). This foramen also exists in Owls and Parrots, but not in all Pigeons; the *Didunculus* (Pl. XV. fig. 2) shows no trace of it; I have also failed to find it in the skull of a Crown-pigeon (*Goura coronata*). The superoccipital ridge is defined by the subsidence of the surface beneath it being continued directly from the upper, almost flat, smooth surface of the cranium: the middle part of the ridge is more produced than

[1] "La Mare aux Songes."

the angles. In the great breadth of the occipital surface compared with its depth, in its flatness from side to side, and its aspect backward and a little upward, *Didus* most resembles *Dinornis.* The basioccipital curves downward, and unites with the basisphenoid in developing the pair of larger tuberosities (Pl. XXIII. fig. 1, 5), which terminate about ½ an inch below the occipital condyle. There is nothing of this structure in the Columbine cranium. In one of my Dodo's skulls there is a pair of small tubercles between the larger basioccipital ones; these are not developed in the other cranium. The basisphenoid is subquadrate, and flattish below, impressed by a shallow median longitudinal channel.

The hypoglossal nerve escapes by two small foramina on each side of the base of the condyle; external to these is the vagal foramen; still more external is the depression (ib. *a*) perforated below by the entocarotid, glossopharyngeal, and sympathetic, above by the tympanic vein. The entocarotid canal opens into the hind part of the sella or pituitary fossa: the vagal canal begins within the skull, above the hypoglossal foramina. The paroccipital carries the posterior surface of the skull downward and outward to a much greater degree than in any Dove, but to a less degree than in *Dinornis.* The Eustachian tubes impress the outer and fore part of the basisphenoid.

The temporal fossæ (Pl. XV.), in the present specimens, show the same contraction in proportion to their depth by which the original skull of the Dodo, compared with that of the *Dinornis*, 'Proc. Zool. Soc.' (1848, p. 3), differed from the larger extinct wingless bird. In the approximation of the postorbital process to the mastoid, *Didunculus* shows a closer resemblance to *Didus* than does *Goura*, in which the temporal fossa, besides being narrow, is shallow. The temporal muscle appears to spread its origin above the fossa upon the sides of the cranium, forward half an inch in advance of the postfrontal process, and backward to the outer angle of the superoccipital ridge.

The parietal region is broad, flat, and short, as in *Dinornis*, not convex as in Doves; it is also impressed at its middle part by a shallow transverse groove, continued outward and forward of less depth and definition, so as to mark off the convex interorbital part of the swollen frontals.

The outer side of the mastoid is convex, smooth, overhanging the tympanic cavity, and sending off a short process, the base of which is defined in one cranium by a transverse ridge in front of the anterior articular cup for the tympanic bone. A similar process is developed in *Didunculus*, not in *Goura*, where it is barely indicated.

The presphenoid is compressed, but thickened and rounded below, where the palatines and pterygoids at their junction with each other abut against it: the pterygoid sends off a short process from the middle of its hinder border; but this is not met by a corresponding "pterygoid process" of the basisphenoid as in *Didunculus.*

The frontals are broad and convex, rising abruptly (as in *Didunculus*) above the coalesced cranial ends of the nasals and premaxillary (Pl. XV.); in *Didus* the breadth greatly exceeds the length of the interorbital frontal convexity, as compared with

Didunculus, and the convexity reigns in the transverse as well as the antero-posterior direction; in *Didunculus*, however, it is less concave transversely than in *Goura*. In the breadth or thickness of the interorbital septum *Didus* resembles *Apteryx* and *Palapteryx* and shows the same pneumatic cancellous structure. The posterior olfactory chambers are partially divided, as in *Dinornis*, by an upper median septum; each compartment, which is 7 lines across and an inch in length, is perforated posteriorly by an olfactory foramen more than a line in diameter, from which grooved impressions of ramifications of the nerve diverge upon the hind and upper wall of the chamber: external to the olfactory foramen is a longer one for the passage of a vein into the fore and inner part of the orbit.

The cranial ends of the nasals and nasal process of the premaxillary (Pl. XXIII. fig. 1, 22) are flat, depressed, thin plates; the latter at its junction with the frontal is 6 lines broad, partially divided by a median groove above and a ridge below, and by short linear fissures from the nasals: the forward extension of these bones is feebly indicated by linear grooves terminating at the outer margins of the nasal branch of the premaxillary, about 4 inches from its vertical end. The proportion of the base of the upper mandible attached to the frontal contributed by the nasals is the same as that indicated in the 'Proc. Zool. Soc.' *l. c.* The nasal branch of the premaxillary presents a full elliptical transverse section where it quits the maxillary processes, losing both depth and breadth as it recedes to join the nasals; here it retains its breadth, viz. 6 lines, but continues to be thinned off vertically to the plate above named joining the frontal. The under surface of the narrower part of the stem is angular, the upper one being gently convex.

"Where the nasal and maxillary processes diverge, there is a deep groove externally, terminating in a canal directed forwards into the rostral part or body of the premaxillary"[1]. This part is subdecurved, pointed, roughened by irregular vascular perforations and grooves, with a sharp alveolar border, which describes a sigmoid curve lengthwise, and with a deeper concavity of the palatal surface than in *Dinornis* or *Didunculus*. Moreover the concavity is partially divided lengthwise by a median ridge. The palatal surfaces of the maxillary processes and maxillaries are narrow and very convex transversely, intercepting a long narrow palato-nasal fissure. The outer side of the maxillary process is deep vertically and slightly concave lengthwise—a structure not known in *Didunculus* or any Dove, and related, like most other deviations from the Columbine cranial characteristics, to the provision of unwonted strength of beak in the Dodo. The maxillary branches of the premaxillary have completely coalesced with the maxillaries, as these have with the palatines; and the halves of the upper mandible here swell out laterally and more so vertically, the maxillaries rising to combine with the outer divisions of the nasals, and sending back a short process from their lower and lateral part to join the malar. The inner surface of the maxillary process (Pl. XXIII. fig. 1, 22*) is smooth and slightly convex vertically; both upper and lower borders are obtuse and thick.

[1] Proc. Zool. Soc. *l. c.* p. 5.

The palatines arch outward from their posterior attachments, are broad and smooth mesially; the margin here is angular, with a slightly produced obtuse apex, divided by a channel on the under surface of the palatine from the outer convex border; the upper and outer ridge extends forward to the maxillary; the inner one subsides before reaching that bone. "The palatines form the posterior boundaries of the naso-palatine aperture, and approximate each other at both ends, but more closely posteriorly, yet here without meeting; whilst in *Didunculus* they coalesce before receiving the abutment of the pterygoids.

"The tympanic bone is subquadrate, with the four angles produced, and the upper and hinder are bifurcate, forming the double condyle for the mastoid articulation"[1]. There is a larger pneumatic foramen, communicating with the tympanic cavity, between the articulating cavities for these condyles.

The brain is singularly small in the present species of *Didus*: and if it be viewed as an index of intelligence of the bird, the latter may well be termed *ineptus*. The length of the cranial cavity (Pl. XXIII. fig. 1, *v c*) is 1 inch 8 lines, its extreme breadth 1 inch 6 lines, its greatest height 1 inch (and this is at the cerebellar fossa). The most remarkable feature in the cranial structure of *Didus* is the disproportionate size of the brain-case to the important part of the neural axis it contained and protected: some approximation to this condition is made by *Dinornis*[2], the Owls, and a few large Cockatoos, *e. g. Microglossum aterrimum*; but it is fully paralleled only by the Elephant among air-breathing vertebrates, as may be seen by comparing the section Pl. XXIII. fig. 1 with the figures of a similar section quoted below[3].

Not only was the brain of very small proportional size in the present large extinct bird, but the division of the cranial cavity appropriate to the cerebrum proper is less in proportion to that for the cerebellum and optic lobes, at least in vertical and longitudinal diameters, than in any other known bird.

In the Elephant the thickness of the pneumatic diploë between the fore part of the cerebral cavity and that of the outer cranial wall equals the longitudinal diameter of the cavity containing the cerebral hemispheres: in *Didus* it exceeds that diameter. The thickness of the pneumatic diploë above the cerebral cavity equals the vertical diameter of that cavity in *Didus*: the diploë gradually decreases in thickness as it approaches the foramen magnum. The disposition of the osseous lamellæ forming the cells or cavities of the diploë is very different in the Elephant and Dodo: they extend for the most part vertically between the outer and inner tables of the skull in the proboscidian mammal, leaving long and narrow interspaces; in the heavy ground-bird they form a congeries of small subequal and subspherical air-cells, and this structure obtains in the basal and lateral walls as well as in the superior or "roofing" wall of the cranial cavity. The

[1] Proc, Zool. Soc. *l. c.* p. 6.

[2] Zool. Trans. vol. iv. pl. 24. fig. 4.

[3] Odontography, pl. 146. fig. 1; Anat. of Vertebrates, vol. ii. p. 439. fig. 296.

extent of this cancellous structure at the sides of the cranial cavity may be known by the ratio of the breadth of that cavity to the breadth of the cranium, which is 3 inches and 8 lines at the broadest part of the brain, viz. the prosencephalon. It would seem, at first sight, as if the poorly developed brain of the Dodo had needed, on some account, unusual protection; but the true explanation rests on the size, weight, and power of the bill, and the concomitant necessity for adequate extent of attachment of the facial to the cranial part of the skull, and of the muscles from the trunk destined to sustain and wield the long and heavy-beaked head. The cerebrum of the Dodo does not greatly, and by no means proportionally, exceed the size of that part of the brain in the Crown-pigeons (*Goura*). If the great Ground-dove of the Mauritius gradually gained bulk in the long course of successive generations in that uninhabited thickly-wooded island, and, exempt from the attacks of any enemy, with food enough scattered over the ground, ceased to exert the wings to raise the heavy trunk, then, on Lamarck's principle, the disused members would atrophy, while the hind limbs, through the increased exercise by habitual motion on land, with increasing weight to support, would hypertrophy.

In the long course of generations subject to this slow rate of change, there would be nothing in the contemporaneous condition of the Mauritian fauna to alarm or in any way to put the Dodo to its wits; being, like other Pigeons, monogamous, the excitement, even, of a seasonal or prenuptial combat, might, as in them, be wanting: we may well suppose the bird to go on feeding and breeding in a lazy, stupid fashion, without call or stimulus to any growth of cerebrum proportionate to the gradually accruing increment of the bulk of the body. Whatever part of the brain was concerned in regulating or controlling muscular actions, might, indeed, be expected to show some concurrent rate of increase with the growing mass of the voluntary contractile fibres; and the size of the cerebellar division (Pl. XXIII. fig. 1, *n o*) of the cranial cavity accords with the generally accepted physiology of the superincumbent mass of the epencephalon. The lateral depression at the fore and under part of the side of the postcerebral division of the cranial cavity indicates that the optic lobes, like the eyes, remained almost stationary during the progressive acquisition of the bulk that distinguishes the Dodo from the largest existing Doves.

The proportions of *Didus*, *Pezophaps*, *Casuarius*, *Rhea*, *Dromaius*, *Struthio*, *Aptornis*, *Cnemiornis*, *Palapteryx*, *Æpyornis*, *Dinornis*, &c. among terrestrial birds, of *Notornis* among the lake-haunting Coots, and of *Aptenodytes* and *Alca impennis* among sea-birds, point to the disuse of wings in flight as the main condition of increase of size in species of birds—the next condition being absence of lethal enemies during the years requisite for such course and rate of growth.

Let foes arise from whom a power of flight is the main condition of escape, and the wingless giants of the feathered class soon succumb. Among the genera above-cited, *Aptornis*, *Cnemiornis*, *Æpyornis*, *Palapteryx*, *Dinornis*, *Didus*, and *Pezophaps*, with the largest of the Auks, have thus passed away, while *Notornis* and *Apteryx* are on the verge of extinction through the rapid increase of population in the small island to which they are restricted. In sparsely peopled continents, such as Africa, South America, and Australia, brevipennate giants may still range the deserts, pampas, and unfrequented wilds. The ascertained recent advent of Man in New Zealand, New Britain, Ceram, Banda, Salwattie, Mauritius, Rodriguez, significantly points to the conditions under which have come to pass, in lapse of time, so strange an anomaly as a bird with the specially modified instruments of flight reduced below the power of exerting that mode of locomotion, yet, as a bird, retaining the conditions of the respiratory and tegumentary systems of the volant class, of which it has become a degenerate member. With the cessation of the chief of those conditions, viz. the absence of enemies, such birds necessarily perish.

Refraining, however, from further indulgence in an easy and seductive vein of speculation, I would recall attention to the notable protuberance in the cranial cavity of the Dodo (Pl. XXIII. fig. 1, *o*) developed towards the upper part of the vertical tentorium, contracting at its lower part into the ridge dividing the prosencephalic from the mesencephalic chamber. In the latter are the orifices for the issue of the trigeminal nerve, the larger and posterior (ib. *tr*) giving passage to the third and second divisions, and answering to the combined foramen ovale and rotundum of mammals, and the smaller and anterior foramen dismissing the first or orbital division of the fifth nerve. At the upper part of the mesencephalic fossa the narrow groove for the lateral venous sinus impresses and defines the back part of the tentorial protuberance, above which it bifurcates, the lower branch bounding or defining the wall of the superior semicircular canal and the upper part of the primitive acoustic capsule. Below this arch is an oblong cerebellar fossa (ib. *n*) which appears to have received veins from the cranial diploë. Beneath this fossa, and just behind the mesencephalic chamber, is the multiperforate internal auditory depression. Next behind this is the outlet for the vagal nerve and entojugular vein. Below this are the small precondyloid foramina. There is a falcial ridge, low and thick, indicating the division of the prosencephalic chamber into lateral compartments for hemispheres; and this ridge shows a narrow groove as for a small longitudinal sinus. A transverse linear groove abruptly defines the fore part of the ridge.

The vertically expanded anterior part of the premaxillary (ib. fig. 1, 22) has a large pneumatic cavity communicating by a reticulate wall with the cells of a cancellous structure, larger than those of the cranial diploë. The maxillary branch of the premaxillary (ib. 22*) consists of a light open-work air-diploë, with a very thin outer case of bone. The short symphysis mandibulæ shows a small cavity, surrounded by more minutely cancellous structure and thicker compact walls, especially at the upper and hinder parts.

Although some characters have been too much insisted on (*e.g.* the "superoccipital foramen") as exemplifying the affinity of the Dodo, the more essential characters of the skull relate to its true Columbine character, while the deviations from that part of the skeleton of volant Doves are explicable in the adaptive developments needed for the wielding of long, powerful, massive mandibles, serving most probably to enable the bird to subsist on some proportion of animal diet, in addition to such vegetable food as it might gain from the ground. Such indiscriminate feeding doubtless rendered its flesh less palatable than that of the winged Pigeons of the Mauritius to the Dutch navigators of the sixteenth and seventeenth centuries.

But the affinities of *Didus* will be more fully and decisively brought out in the comparison of the, in this respect, more instructive and light-giving parts of the skeleton.

§ 10. *Comparison of the Skeleton.*

The dorsal region of the vertebral column shows, in some birds, a confluence of certain vertebræ: I have observed four to be so welded together by both centrums and neural spines in *Phœnicopterus*, viz. the second to the fifth dorsal inclusive, leaving the sixth free, which articulates with the first costigerous sacral vertebra. In *Platalea* three dorsals coalesce in advance of the antepenultimate free vertebra. In the smaller diurnal birds of prey five dorsal vertebræ are usually confluent, leaving one free vertebra for the lateral movements of the trunk between such dorsal "sacrum" and the pelvic one. In Vultures, Plovers, Bustards, Cranes, *Psophia*, *Cariama*, *Palamedea*, the Penguins, and in all flightless land-birds save the Dodo, no such anchylosis takes place. The *Columbidæ* are the species in which the dorsal vertebræ, homologous and the same in number with those of *Didus*, undergo the process of confluence into one mass of bone: they are the three which immediately precede the last (moveable) dorsal vertebra; and of these the two anterior develope, in *Goura* and *Didunculus*, hypapophyses closely corresponding in shape and proportion with those in the Dodo.

The chief difference which *Didus* offers in the present region of the vertebral column from that of *Columbidæ* is in the greater number of the vertebræ or segments which are typically completed by bony hæmapophyses articulating with pleurapophyses and directly with their mass of coalesced and expanded hæmal spines constituting the sternum. Of these typical thoracic segments there were five in *Didus* (Pl. XV.); *Didunculus* (ib.) shows four; *Goura* three. In both existing genera these segments are succeeded by a single one, anchylosed to the fore part of the sacrum, but with the pleurapophysis long and moveable, with its hæmapophysis terminating in a point before reaching the sternum, and extensively connected with the antecedent hæmapophysis or sternal rib: in both genera two dorsal vertebræ in advance of the typically complete one have moveable pleurapophyses terminating freely in a point, with no hæmapophyses other than the costal processes of the sternum may represent. In *Goura*, which has six pairs of moveable or thoracic ribs, the second pair belong to the first of the three anchylosed dorsal vertebræ: in *Didunculus*, which has seven pairs of thoracic ribs, the second pair belongs to the free dorsal immediately in advance of the anchylosed mass. Supposing *Didus* to have had one pair of ribs behind, and two pairs in front of those that directly articulate with the sternum, as the vertebra Pl. XVII. fig. 7 indicates, it would have had eight pairs of thoracic ribs; and I think this excess of one pair beyond the formula in *Didunculus* to be very probable in the large-bodied, small-winged extinct Ground-dove.

As far as the series of Dodo's neck-vertebræ under my observation exhibit such characters, the proportion of those with neural spines, or with hypapophyses, or both, is the same as in the *Columbidæ*. In this family, as in most birds, the greater part of the series want both processes. The cervical parapophyses, descending to form the sides of the carotid canal, do not meet, coalesce, and circumscribe it in any cervical vertebra of *Goura* or *Didunculus*; and not any of the vertebræ of *Didus*, which I have yet received, shows such circumscription of the hæmal canal. The majority of the cervicals in *Didus* (those, viz., that lack both neural spines and hypapophyses) are broader and more massive in proportion to their length than in the winged Doves. The third cervical in *Didus* has both the above processes, as in *Columbidæ*: the characters of the axis vertebra in the same family are closely repeated in that of the Dodo. In the Raptores the axis vertebra is shorter in proportion to its length, and a greater pro portion of the cervical vertebræ at both ends of the series have both neural spines and hypapophyses.

The ribs of the Dodo are as broad, in proportion to their length, as in Doves, but are relatively longer in proportion to the dorsal region, encompassing a more capacious thoracic-abdominal cavity. The ribs of the Vulture are more expanded than in *Didus*, especially where they afford the extensive attachment to the epipleurals. But I shall not dwell further on the comparative characters of this part of the skeleton, as more decisive ones of the affinity of *Didus* are afforded by other parts.

In comparing the sternum of the Dodo with that of Doves of flight, the first well-marked difference is in the adaptive development of the keel in the last (Pl. XV. fig. 2, *Didunculus*), and in the provision for the concomitantly broader coracoids, the grooves for which meet and run into each other across the fore part of the bone in existing *Columbidæ* (Pl. XXIV. fig. 2, *b*); consequently the inner or upper wall of the confluent grooves forms a median prominence (ib. *e*) at the front margin of the sternum, contrasting with the wide notch at that part of the bone in the Dodo (Pl. XVI. fig. 4). The next difference, as compared with *Goura* and most Pigeons, is the absence of the entolateral processes (Pl. XXIV. fig. 3, *i*) in the Dodo's sternum: but *Didunculus* singularly exemplifies its nearer affinity to *Didus* by a like absence of those processes; only the sternal margins behind the ectolateral processes (ib. fig. 1, *h*), instead of converging with a slight convexity to an obtuse apex, as in Pl. XVIII., describe a concavity, through an expansion of the posterior truncate end of the breast-bone. The sternum of *Didunculus* may be said to show one pair of posterior notches (Pl. XXIV. fig. 1, *f*), that of other Pigeons two pairs (ib. fig. 3, *f f'*); but the sternum of *Didus*, which is relatively broader, shows no other trace of the anterior notch (Pl. XVIII. *f*) than is afforded by the rounded angle at which the ectolateral process (*h*) rises from the bone. Although the costal margin is relatively shorter in Doves of flight than in the Dodo, again an intermediate condition is manifested by *Didunculus* as compared with *Goura*, in which latter Dove there are articular surfaces for three sternal ribs (Pl. XXIV. fig. 3, c 1, 2, 3), whilst in *Didunculus* there are four (ib. fig. 1, c). *Didunculus* also exhibits, more strongly than *Goura*, the obtuse ridges (ib. fig. 2, r) converging like buttresses from the outer wall of the coracoid groove to the fore part of the keel, where they subside. In *Didunculus* there is a pneumatic foramen exterior to the coracoid groove, corresponding with p, fig. 4, Pl. XVI., which I do not find in the sternum of *Goura*; but in the Crown-pigeons the pneumatic foramina along the middle line of the upper surface of the sternum are conspicuous; they are confined to the fore part of that surface in *Didunculus* (Pl. XXIV. fig. 1).

In the direction of the ectolateral processes *Goura* (ib. fig. 3, h) is intermediate between *Didunculus* and *Didus*. The pectoral ridge on the outer surface of the sternum, continued backward from the outer end of the coracoid groove, is adaptively better marked in Pigeons of flight than in the Dodo; and the pair of ridges are more nearly parallel in their backward course, not so convergent as in *Didus*. In *Goura* the subcostal ridge is better marked than in *Didunculus*. In no Dove of flight is the body of the sternum so broad and hollow as in *Didus* (Pl. XXIII. fig. 4); in this respect the Vulture more nearly resembles the Dodo, as it does also in the more convex anterior contour of the keel: but the vulturine sternum does not lose breadth as it extends backward: it is a square-shaped shield in birds of prey, shorter in proportion to its breadth, with a greater extent of costal process and margin, and with the ectolateral processes, when they exist, extending backward as far as the hinder border of the bone. In the thorough quest of resemblances to the Dodo's sternum which I have made through the class of Birds, I came upon an unexpected superficial likeness to it in the sternum of a Night-jar (*Podargus humeralis*). The ectolateral processes (Pl. XXIV. fig. 4, h) rise behind the moderately extended costal borders, c; and beyond them the body of the sternum converges to an obtuse end, with a contour similar to that in *Didus*. Moreover the coracoid grooves are divided from each other by a free concave border, less deep and extensive, indeed, than in *Didus*, but as free from any trace of episternal projection. The ectolateral processes, however, are extended backward to beyond the sternal body; and this part usually shows a pair of small entolateral notches, f', of which one was present on one side in the specimen figured.

Through the reduction of the coracoids in all flightless birds, there is an interval between their sternal articulations: this is long and concave in the Dodo, but is longest and most deeply concave in *Apteryx*; it is long but almost straight in *Rhea*; in *Casuarius* and *Dromaius* it is narrow but deeply notched; in *Struthio* it developes a short episternal process. In no Grallatorial sternum with both ecto- and ento-lateral processes (as e.g. *Otis*, *Œdicnemus*, *Charadrius*) do the former project, as in *Didus* and the Rasores, immediately behind the costal margin, but they are continued, parallel with the keel, from the outer and posterior angle of the sternum, distant from the costal margin. In old Plovers the entolateral process joins the contiguous angle of the sternal body, and converts the inner notch into a foramen.

In the breast-bone of the Dodo we plainly discern the Columbine modification of the Gallinaceous type, simplified in the minor development of those parts relating adaptively to the power of flight, and expanded and excavated for the support of the larger gizzard with its heavier grindstones[1].

In comparing the pelvis of *Didunculus* and *Goura* (Pl. XXIV. fig. 5) with that of *Didus* (Pl. XIX. fig. 1), the correspondences are:—in the general shape, proportions and disposition of the ilia; in the articulation therewith of the last pair of moveable ribs, and of the short straight confluent pleurapophyses of the three succeeding sacral vertebræ; then follow, as in *Didus*, three vertebræ without pleurapophyses, these reappearing in the next two with their extremities converging to abut against a prominence of the inner surface of the ilium in the same relative position. The difference here is in the two equal and more slender rib-buttresses, in place of the single stronger one, which is the more common structure in *Didus*; but in *Goura* I have noted an instance in which it agreed with the *Didunculus* on the left side, and with *Didus* on the right, in the last-specified character. In the Crown-pigeons, also, there is an indication of the transverse ridge marking off the under part of the centrum of the first sacral from the rest, and those that follow are less expanded than in the Dodlets; moreover in *Didunculus* they show a median canal instead of a ridge, while the ridge is feebly indicated here and there and there is no canal in *Goura*. In neither *Didunculus* nor *Goura* do the sacral centrums behind the last rib-abutments diminish in breadth so suddenly as in *Didus*: in both the winged Pigeons the hinder part of the pelvic cavity is relatively deeper and narrower than in *Didus*; in both, also, the upper and anterior concave tracks of the ilia are deeper; and in *Didunculus* the mesial borders do not attain the neural crest, but leave a pair of open longitudinal canals at that part of the pelvis; in *Goura* those margins reach the neural crest, but do not overtop it at any part. In *Goura* the acetabula are more in advance of a median position than in *Didunculus*, *Columba magnifica*, or *Didus*. Although the ischiadic foramina are completed by terminal confluence of the ilium and ischium in

[1] The habit of the Dodo to avail itself of extraneous crushers to a gallinaceous or struthious degree, is attested by the following fruit of the extensive research of the learned and conscientious author of the Article Dodo, in the 'Penny Cyclopedia:'—

"About 1638, as I walked London streets, I saw the picture of a strange fowle hong out upon a cloth; and myselfe with one or two more then in company went in to see it. It was kept in a chamber, and was a great fowle, somewhat bigger than the largest Turkey-cock, and so legged and footed, but stouter and thicker and of a more erect shape, coloured before like the breast of a young cock feasan, and on the back of a dunn or deere coulour. The keeper called it a Dodo, and in the end of a chymney in the chamber there lay a heap of large pebble-stones, whereof hee gave it many in our sight, some as big as nutmegs, and the keeper told us shee eats them (conducing to digestion)." Sir Thos. Brown's Works (Wilkin's Edition, 4 vols.: London, 1836), vol. i. p. 369; vol. ii. p. 173.

Dromaius and *Casuarius*, yet the length of those foramina (which are unclosed) in *Struthio* and *Apteryx*, concomitant with the greater relative length of the pelvis, shows the difference of *Didus* from the cursorial Brevipennates in this part of the skeleton. The ischia of the winged Pigeons resemble those of the Dodo; but the inner longitudinal ridge is more strongly marked in *Didunculus*: in the *Goura* it is less developed than in *Didus*; the bone is longer also in proportion to its breadth, and the ischiadic foramen is longer and narrower: the proportions of that in *Didunculus* are more like those in *Didus*. In *Didunculus* the pubis coalesces with the ischium behind the small obturator foramen, but leaves a second or posterior elongate ischio-pubic vacuity. The greatest amount of resemblances with the pelvis of the Dodo is found in that of different members of the Dove-tribe.

In comparing the pelvis of the Dodo with that of the Vulture (Pl. XXIV. fig. 6), we find in the latter that the first two confluent sacral vertebræ supporting moveable ribs are succeeded by several with short abutting ribs, the extent of this part of the sacrum being nearly one-half of the whole, instead of one-fourth as in *Didus* and the Doves. The reappearance of rib-abutments after four ribless sacrals is in the posterior third of the sacrum, and they are continued to the end of that bone from the last four vertebræ of the series, constituting a very marked difference, both as to number and the character of the vertebræ in the sacral part of the pelvis.

With regard to the iliac bones, the anterior concave track occupies two-thirds of the extent of the bone in *Vultur*, not one-half as in *Didus* and most Doves; the breadth of the posterior parts of the ilia with the intervening sacrum in the Vulture is relatively less than in the winged Doves, and differs in a greater degree from that characteristic part in the sacrum of *Didus*. In *Ciconia* the antacetabular part of the pelvis is relatively longer, and the iliac bones are more expanded anteriorly. In *Platalea* the proportions are more nearly those in *Didus*. In *Otis* the ilia touch the fore part of the sacro-spinal ridge, but leave both posterior and anterior apertures of the ilio-neural canals widely open. In *Œdicnemus* and *Charadrius* they are grooves, the ilia not reaching the sacral spines. The external concavity of the ilium is longer, narrower, and deeper, in most waders, than in *Didus*. In *Eudyptes* and *Aptenodytes* the ilia are more expanded anteriorly, but the whole pelvis is narrower and longer than in *Didus*. The Gar-fowl (*Alca impennis*)[1], *Uria*, *Podiceps*, and *Colymbus*, all show still longer and narrower proportions of the pelvis.

In the Doves of flight the proportions and relative position of the three compartments of the cranial cavity differ from those in the Dodo. Both the pros- and mesencephalic ones are proportionally larger than the epencephalic; and the mesencephalic compartment lies more directly below the prosencephalic one. A very thin stratum of finely cellular diploë divides the two tables of the skull along the medial line of the upper surface: it is thicker between the orbits. The falcial ridge at the inner surface

[1] Trans. Zool. Soc. vol. v. pl. 51.

of the prosencephalic roof resembles that in *Didus*. The tentorial ridge bifurcates halfway down, the front portion dividing, almost horizontally, the pros- from the mesencephalic compartment, the hinder and more obtuse ridge dividing, almost vertically, the mes- from the epencephalic compartment. The angle of bifurcation is slightly produced and obtuse, but represents very feebly the tentorial tuberosity (Pl. XXIII. fig. 1, *o*) in the Dodo: from it, in *Goura*, is continued backward the arch of bone formed by the superior semicircular canal, above which is the groove for the venous sinus, as in *Didus*. The internal auditory fossa is less deep than in *Didus*: above it is a similarly vertically oblong cerebellar pit. The nerve-foramina correspond with those in *Didus*: the entocarotid canal opens into a rather deeper sella in *Columba palumbus*.

On comparing the cranial cavity, as exposed by a vertical longitudinal section in the Dodo (Pl. XXIII. fig. 1), with that of a Dinornis similarly exposed[1], the first difference is the smaller proportional depth of the diploë in the larger wingless bird, which is not greater over the prosencephalic than over the epencephalic compartment; next may be noticed the larger relative size of the former compartment, indicating the larger cerebrum of the Dinornis, then the absence of the tentorial tuberosity, the sharper and more produced superior part of the tentorial ridge arching transversely between the cerebrum and cerebellum, the smaller internal auditory fossa, and the deeper sella: the mesencephalic compartment, or cavity for the optic lobe, is less in proportion to the prosencephalic compartment than in *Didus*; it holds, however, a similar relative position: finally, the cerebellar pit, above the internal auditory fossa, is wanting in the Dinornis.

The Dodo agrees with the Doves in possessing a slender furculum, forming an acute angle: it resembles *Columba galeata*, more especially, in the halves of that bone being united by ligament below, and forming separate styles or "clavicles."

The humerus of the Goura closely repeats most of the characters described in that of the Dodo; but its length is proportionally greater, being 3 inches 9 lines, nearly equal to that of the sternum or pelvis, whereas the humerus of the Dodo is little more than half the length of either sternum or pelvis. The processes for the attachment of the muscles are, nevertheless, fully as strongly developed in *Didus* (Pl. XX. figs. 12 & 14) as in the volant Doves (Pl. XXIV. figs. 8 & 9, *Goura*); that, indeed, which is a ridge (*r*) on the back part of the shaft in *Didus*, is a mere rough surface in *Goura*, and does not show in *Didunculus*. The pneumatic fossa, which varies in depth in the two humeri of the Dodo, is in both relatively larger and shallower than in *Goura*. The pectoral process is thinner, but relatively rather more produced, in *Didunculus*. The humerus in *Œdicnemus*, *Otis*, and *Charadrius* has a more longitudinally extended, thinner, and more produced pectoral ridge than in *Didus* and the *Columbidæ*; there is a more marked ectocondyloid tuberosity, which in *Charadrius* becomes a pointed process.

There is nothing to be gained by giving the details of the more striking differences

[1] Trans. Zool. Soc. vol. iv. pl. 24. fig. 4.

which the humerus presents in Penguins, Auks, and birds of prey, as compared with that bone in the Dodo; but a few words may be recorded of the comparison of the humerus of the Dodo with that of the flightless bird of New Zealand, so nearly approaching to it in size, which bird is described in the 5th volume of the 'Transactions' of the Society under the name of *Cnemiornis* (p. 395, pl. 66. figs. 7–10). In that extinct species, although the humerus is 5½ inches in length, the parts indicative of the forces by which it was worked are comparatively feebly developed. The ulnar tuberosity is narrower, thicker, more obtuse, and its base has neither the upper nor lower excavation; it rises above the articular head, which is less prominent and narrower than in *Didus*; the pectoral ridge is shorter and situated lower down upon the shaft, not on the same level with the radial tuberosity as it is in *Didus*; the distal articulation is of the same size as in *Didus*, but neither the radial nor the ulnar convexity is so prominent or well-defined.

The ulna of the Dodo is shorter absolutely, and much more so proportionally, than in the Goura and most other volant Doves. In these it exceeds the humerus by about one-fourth its own length; in *Didunculus* (Pl. XV.) it is a little longer than the humerus; in the Dodo (ib.) it is shorter than the humerus. The length of the ulna in *Goura coronata* is 4 inches 6 lines; it is more bent than in the Dodo; the quill-tubercles, seven or eight in number, are more prominent; nevertheless the rough depression for the insertion of the chief flexor is less deep and less defined. The plumed winglet of the Dodo would seem, therefore, to have been frequently and forcibly moved.

In comparing the femur of the Dodo with that of the largest Dove, the bone appears gigantic. The length of the femur in *Goura coronata* (Pl. XXIV. fig. 11) is but 3 inches 3 lines, and it is more slender in proportion to its length than in the Dodo; it, however, repeats the few characteristics, if they may be so termed, of the Dodo's femur. It has the pneumatic foramen in the same position, perhaps proportionally larger; it has the same large oblong surface for the ligament at the head of the bone; the great trochanter has the same form and disposition, but is not quite so much produced anteriorly; there is a slight depression instead of a ridge for the trochanter minor; the fore part of the inner condyle is relatively thicker and less produced. The femur in *Otis* and *Œdicnemus* has a thicker and shorter trochanter major, a more narrow and shallow rotular channel; it is shorter in comparison with the tibia, and more especially with the metatarsus, than in *Didus* and the Doves.

The femur of *Aptornis otidiformis*[1] is of the same size as that of the Dodo; but it has no pneumatic foramen, the head is more hemispheroid and inclined forward, the ligamentous pit is deeper and more circular, the supracervical articular surface is not defined from that of the head, there is a wider and deeper depression at the fore part of the proximal end of the femur, and a more prominent tuberosity on the back part; the ridge continued from the back part of the shaft to that of the inner con-

[1] Trans. Zool. Soc. vol. v. pl. 65. fig. 3.

dyle is more produced and sharper in *Aptornis*, the fore part of the same condyle is less produced.

The femur in *Cnemiornis*[1] and *Dinornis*[2] is much thicker, in proportion to its length, than in either *Aptornis* or *Didus*. In *Pezophaps* the great trochanterian ridge rises higher above the neck, and the shaft has a more uniform thickness, with the inner contour less concave, than in *Didus*.

The characters which have been noted at the proximal and distal ends of the tibia of *Didus* are repeated in those of the tibia of the Goura. The difference in size is more marked than in the femur; the length of the tibia of *Goura coronata* is 4 inches 7 lines, and its shaft is more slender, in proportion to its length (Pl. XXIV. fig. 13), than in *Didus* (Pl. XXII.). The tendency to a trihedral form of the shaft is less marked in *Goura*; the anterior prominences of the distal condyles are thicker in proportion to the intervening fossa.

In the Vulture the fibular ridge is more parallel with the long axis of the shaft than in *Didus*; the tendinal canal is less cylindrical, has an oblique course from the middle of the anterior surface towards the inner condyle; the fore parts of both distal condyles are less produced and less convex; the distal end is narrower from before backwards in proportion to its breadth; both extremities of the bone are less expanded in proportion to the shaft than in the Dodo.

In the great Plover (*Œdicnemus crepitans*) the tibia, as in other Grallæ, is longer in proportion to its thickness than in *Didus*; the epicnemial process rises higher above and projects further in front of the condylar surfaces before it divides into the pro- and ectocnemial plates; and these are relatively more produced. The fibular ridge is shorter in proportion to the length of the tibia, is more prominent, and more parallel with the axis of the shaft. The distal condyles project further backward than in *Didus*. The tibia in *Charadrius*, *Otis*, *Tantalus*, *Grus*, *Ciconia*, *Mycteria*, *Porphyrio*, opposes similar or equivalent differences to those in *Œdicnemus*, against the affinity of *Didus* to any of those Grallæ.

In the comparison of the tibia of this extinct flightless bird with that of the *Cnemiornis*, the wonderful development of the plates and processes at the proximal end of the bones in the New Zealand bird is strikingly manifested. In *Cnemiornis* the fibular ridge runs in a line with the shaft, and does not incline from above obliquely forward as in *Didus* and the Doves; the ridge on the outer side of the distal fourth of the bone is stronger and sharper in *Cnemiornis*; the tendinal canal is transversely elliptical, medial in position, with a slight inward inclination; the intercondyloid fossa is much wider in *Cnemiornis*. The differences, indeed, in all the characters of the tibia, as compared with *Didus*, in the Vultures, Plovers, Penguins, and terrestrial flightless birds tend to render more instructive and convincing the resemblances which Pigeons present in the same characters to the extinct Mauritian bird.

[1] Trans. Zool. Soc. vol. v. pl. 65. fig. 1. [2] Ibid. fig. 5.

§ 10. *Conclusion.*

The affinities or place in nature of the Dodo being thus determined by the characters of its skeleton, but few words remain to be said on the bearings of present knowledge of this species upon other zoological generalizations.

The researches and observations of naturalists have been carried out to such an extent as to support the conclusion that the *Didus ineptus* does not now live in any part of the world, and that it never existed save in that part of which the island of Mauritius may be a remnant. Consequently the species there originated; and the most intelligible conception of its mode of origin is that to which I have alluded in the description of the brain-case (p. 70).

The Dodo exemplifies Buffon's idea[1] of the origin of species through departure from a more perfect original type by degeneration; and the known consequences of the disuse of one locomotive organ and extra use of another indicate the nature of the secondary causes that may have operated in the creation of this species of bird, agreeably with Lamarck's philosophical conception of the influence of such physiological conditions of atrophy and hypertrophy[2]. The young of all Doves are hatched with wings as small as in the Dodo: that species retained the immature character. The main condition making possible the production and continuance of such a species in the island of Mauritius was the absence of any animal that could kill a great bird incapable of flight. The introduction of such a destroyer became fatal to the species which had lost such means of escape[3]. The Mauritian Doves (*Columba nitidissima* and *C. meyeri*) that retained their powers of flight continue to exist there.

As I have no reason to offer why one kind of Pigeon should have retained and another lost its powers of flight, nor am able to adduce a particle of evidence of the hypothetical degrees of diminution of the wing-bones to their stunted proportions in *Didus*, any more than in *Dinornis*, I feel that in the foregoing remarks I lay myself open to the rebuke of fellow-labourers who may think with the able authors who last treated of the present subject.

They warn their readers to " beware of attributing anything like *imperfection* to these anomalous organisms, however deficient they may be in those complicated structures which we so much admire in other creatures. Each animal and plant has received its peculiar organization for the purpose, not of exciting the admiration of other beings, but of sustaining its own existence. Its perfection, therefore, consists, not in the number or complication of its organs, but in the adaptation of its whole structure to the external circumstances in which it is destined to live. And, in this point of view, we shall find that every department of the organic creation is equally perfect, the

[1] Histoire Naturelle, &c., 4to, tom. xiv. " Dégénération des Animaux : " 1760.

[2] Philosophie Zoologique, 8vo, 1809, tom. i. chaps. 3, 6, & 7.

[3] Agreeably with the principle of the " contest for existence " by which I explained the extinction of the species of *Dinornis*, Trans. Zool. Soc. vol. iv. p. 14, 1851.

humblest animalcule or the simplest conferva being as completely organized with reference to its appropriate habitat and its destined functions as Man himself, who claims to be lord of all. Such a view of the creation is surely more philosophical than the crude and profane ideas entertained by Buffon and his disciples" [1].

Nevertheless the truth, as we have or feel it, should be told. In the end it may prove to be the more acceptable service. The *Didus ineptus*, L., through its degenerate or imperfect structure, howsoever acquired, has perished. What have the stigmatizers of Buffon to offer in lieu of his theory as applied to the origin of this species of bird? They begin by asking, "Why does the whale possess the germs of teeth which are never used for mastication? and why was the Dodo endowed with wings at all, when those wings were useless for locomotion? This question," they own, "is too wide and too deep to plunge into at present." They nevertheless proceed to remark, "These apparently anomalous facts are really the indications of laws which the Creator has been pleased to follow in the construction of organized beings; they are inscriptions in an unknown hieroglyphic, which we are quite sure mean *something*, but of which we have scarcely begun to master the alphabet. There appear, however, reasonable grounds for believing that the Creator has assigned to each class of animals a definite type or structure, from which He has never departed, even in the most exceptional or eccentric modifications of form. Thus, if we suppose, for instance, that the abstract idea of a Mammal implied the presence of teeth, and the idea of a Bird the presence of wings, we may then comprehend why in the Whale and the Dodo these organs are merely *suppressed*, not wholly *annihilated*"[2].

This notion of type-forms or centres, unfortunately, has not merely relation to abstract biological speculations or theories, but to practical questions on which the true progress of Natural History vitally depends. If such types do exist, the National Museum, it is argued, may be restricted to their exhibition: and so our legislators and the public were assured by the Professor of Natural History in the Government School of Mines[3], when the question was before the "House" four years ago. I have let slip no suitable occasion[4] to combat and expose what has seemed to me to be both an erroneous and mischievous view, most obstructive to the best interests of the science; and, standing alone

[1] Strickland and Melville, 'The Dodo and its Kindred,' 4to, 1848, p. 34.

[2] *Op. cit.* p. 34.

[3] See letter in 'The Times' of May 21st, 1862, advocating the limitation of the National Museum of Natural History to "six rooms," signed Thomas H. Huxley, F.R.S.

[4] Reply to the above in 'The Times' of May 2nd, 1866, and in both editions (1861, 1862) of my 'Discourse on the Extent and Aims of a National Museum of Natural History.' "Some naturalists urge that it is only necessary to exhibit the type-form of each genus or family. But they do not tell us what is such 'type-form.' It is a metaphysical term, which implies that the Creative Force had a guiding pattern for the construction of all the varying or divergent forms in each genus or family. The idea is devoid of proof; and those who are loudest in advocating the restriction of exhibited specimens to 'types' have contributed least to lighten the difficulties of the practical curator in making the selection." (Ed. 1862, p. 24; see also pp. 26–34.)

as I seemed to do on this point in the array of evidence before the "Parliamentary Committee on the British Museum," I was glad to find my views on type-forms adopted and paraphrased by the President in his Address to the British Association at the meeting at Nottingham[1], in the present year.

DESCRIPTION OF THE PLATES.

PLATE XV.

Fig. 1. Side view of the skeleton of the Dodo (*Didus ineptus*, L.), with an outline of the bird as represented in the oil-painting presented to the British Museum by Edwards, Naturalist and Librarian of the Royal Society, to whom it had been given by Sir Hans Sloane, P.R.S., with the statement that the painting had been made, of the natural size, from a living specimen of the Dodo, in Holland. The bones represented in profile, of the natural size[2], testify to the accuracy of the form and proportions of the Dodo given in the painting.

Fig. 2. An outline of the Samoan Dove or Dodlet (*Didunculus strigirostris*, Peale; *Gnathodon strigirostris*, Jardine[3]) of the natural size, from a specimen living in 1865 in the Gardens of the Zoological Society of London, with a view of the skeleton corresponding with that of the Dodo.

PLATE XVI.

Fig. 1. Front view of the fourth (or first of the three confluent) dorsal vertebræ (centrum and neural arch).

Fig. 2. Vertebral rib, or pleurapophysis, of the same vertebra, front view.

Fig. 3. Sternal rib, or hæmapophysis, of the same vertebra: *a*, outer side; *b*, upper or pleural end; *c*, lower or sternal end; *d*, front margin; *e*, inner surface.

Fig. 4. Front view of sternum, or connate mass of hæmal spines, including that of the same (fourth dorsal) vertebra.

Fig. 5. Inner surface of an anterior pleurapophysis, with coalesced appendage, *a*.

Fig. 6. Oblique view of ditto, ditto.

[1] "The doctrine of typical nuclei seems only a mode of evading the difficulty. Experience does not give us the types of theory; and, after all, what are these types? It must be admitted there are none in reality. How are we led to the theory of them? Simply by a process of abstraction from classified existences. Having grouped from natural similitudes certain natural forms into a class, we select attributes common to each member of the class, and call the assemblage of such attributes a type of the class. This process gives us an abstract idea; and we then transfer this idea to the Creator, and make Him start with that which our own imperfect generalization has derived." (Address, &c., by William R. Grove, Esq., Q.C., M.A. 8vo, London, 1866: p. 31.)

[2] The scapular arch is rotated in advance of the ribs to show the character of the anterior dorsal vertebræ.

[3] See also Gould, 'Birds of Australia,' part 22 (March, 1846).

Fig. 7. Anterior pleurapophysis with appendage, *a*, front view: *c*, capitular end; *d*, tubercular end; *f*, hæmal end; 7 *a*, outer surface; 7 *b*, inner surface.

Fig. 8. An anterior pleurapophysis, front view.

Fig. 9. Posterior surface of the upper end of a posterior pleurapophysis: 9 *a*, body and lower end of ditto.

Fig. 10. Part of a pleurapophysis which has been broken and healed.

Fig. 11. Lower end of a posterior dorsal pleurapophysis, with connate rudiment of appendage, *a*.

Fig. 12. Hæmapophysis.

PLATE XVII.

Fig. 1. Fourth, fifth, and sixth dorsal vertebræ, anchylosed, side view.

Fig. 2. Ditto, ditto, upper view.

Fig. 3. Ditto, ditto, under view.

Fig. 4. Ditto, ditto, back view.

Fig. 5. Ditto, ditto, mutilated, of another Dodo.

Fig. 6. Anterior dorsal vertebra, side view.

Fig. 7. Ditto, front view; *pl*, outline of heads of floating rib.

Fig. 8. Penultimate cervical vertebra, side view.

Fig. 9. Ditto, back view.

Fig. 10. Middle cervical vertebra, upper view.

Fig. 11. Ditto, under view.

Fig. 12. Axis, or second cervical vertebra, upper view.

Fig. 13. Ditto, under view.

PLATE XVIII.

Fig. 1. Under view of sternum.

Fig. 2. Upper or inner view.

Fig. 3. Back view.

PLATE XIX.

Fig. 1. Under or inner view of pelvis.

Fig. 2. Upper or outer view of pelvis.

PLATE XX.

Fig. 1. Middle cervical vertebra, upper view.

Fig. 2. Fifth cervical vertebra, upper view.

Fig. 3. Fourth cervical vertebra, under view.

Fig. 4. Right coracoid and clavicle.

Fig. 5. Left coracoid and clavicle.
Fig. 6. Right scapula, outer view.
Fig. 7. Right scapula, inner view.
Fig. 8. Left moiety of scapular arch, outer view.
Fig. 9. Ditto, inner view.
Fig. 10. Upper articular end of right coracoid.
Fig. 11. Lower ditto.
Fig. 12. Left humerus, anconal or back surface.
Fig. 13. Left ditto, ulnar or inner surface.
Fig. 14. Left ditto, palmar or front surface.
A. Ditto, proximal or upper end.
B. Ditto, radial side of upper half.
C. Ditto, distal end.
Fig. 15. Right radius.
Fig. 16. Right ulna, inner or radial side.
Fig. 17. Right ulna, outer or ulnar side.

PLATE XXI.

Fig. 1. Left femur, front view.
Fig. 2. Ditto, inner view.
Fig. 3. Ditto, back view.
Fig. 4. Ditto, upper end.
Fig. 5. Ditto, lower end.

PLATE XXII.

Fig. 1. Left tibia, front view.
Fig. 2. Ditto, inner view.
Fig. 3. Ditto, back view.
Fig. 4. Ditto, upper end.
Fig. 5. Ditto, lower end.
Fig. 6. Left fibula, outer view.
Fig. 7. Ditto, inner view.
Fig. 8. Ditto, upper view.

PLATE XXIII.

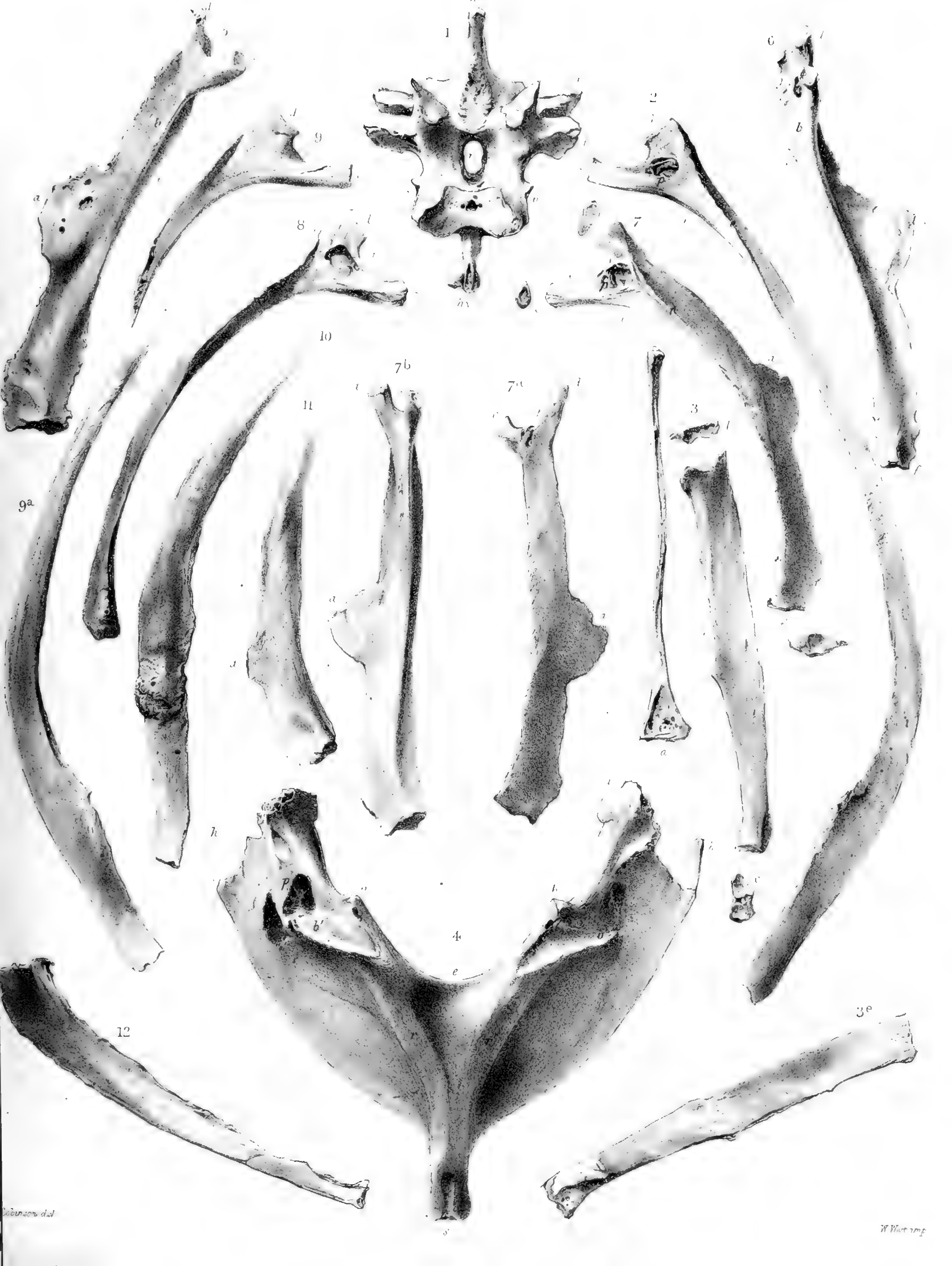
Fig. 1. Longitudinal vertical section of mutilated skull.
Fig. 2. Ditto of third cervical vertebra.
Fig. 3. Ditto of lower cervical vertebra.
Fig. 4. Transverse vertical section of sternum.

Fig. 5. Longitudinal section of humerus.
Fig. 6. Ditto of upper end of femur.
Fig. 7. Ditto of lower end of femur.
Fig. 8. Ditto of upper end of tibia.
Fig. 9. Ditto of lower end of tibia.
Fig. 10. Ditto of metatarsus.

PLATE XXIV.

Fig. 1. Sternum of *Didunculus*, upper view.
Fig. 2. Ditto, front view.
Fig. 3. Sternum of *Goura*, upper view.
Fig. 4. Sternum of *Podargus humeralis*, under view.
Fig. 5. Pelvis of *Goura*, under or inner view, half natural size.
Fig. 6. Pelvis of *Gyps* (Vulture), under or inner view, half natural size.
Fig. 7. Left moiety of scapular arch, *Goura*.
Fig. 8. Left humerus of *Goura*, anconal surface.
Fig. 9. Left humerus of *Goura*, palmar surface of upper end.
Fig. 10. Left humerus of *Goura*, palmar surface of lower end.
Fig. 11. Right femur of *Goura*, front view.
Fig. 12. Right femur of *Goura*, back view of upper end, and back view of lower end.
Fig. 13. Right tibia and fibula of *Goura*, front view.

All the figures are of the natural size, save when otherwise expressed. The letters are explained in the text.



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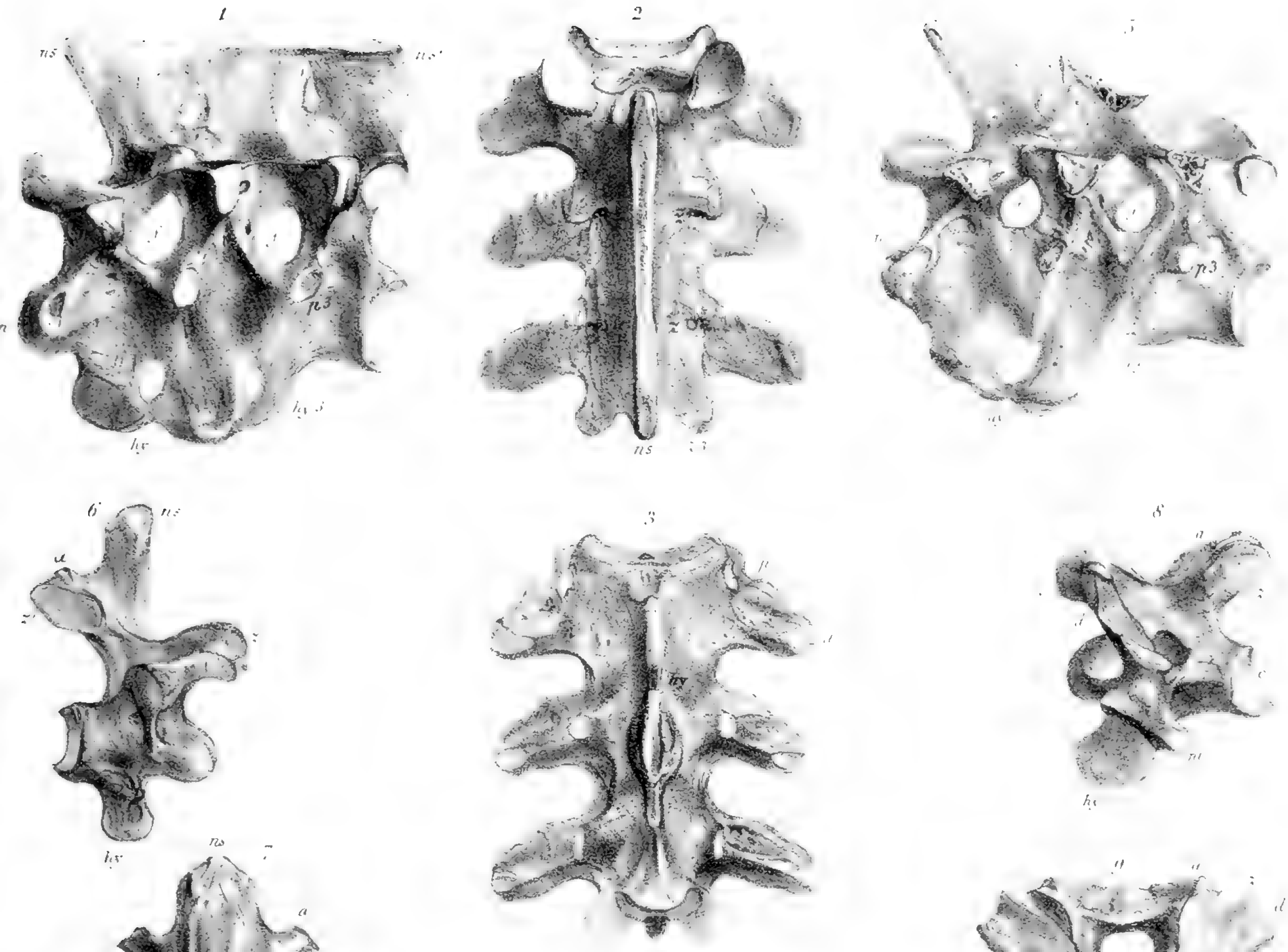

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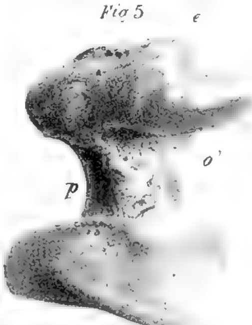


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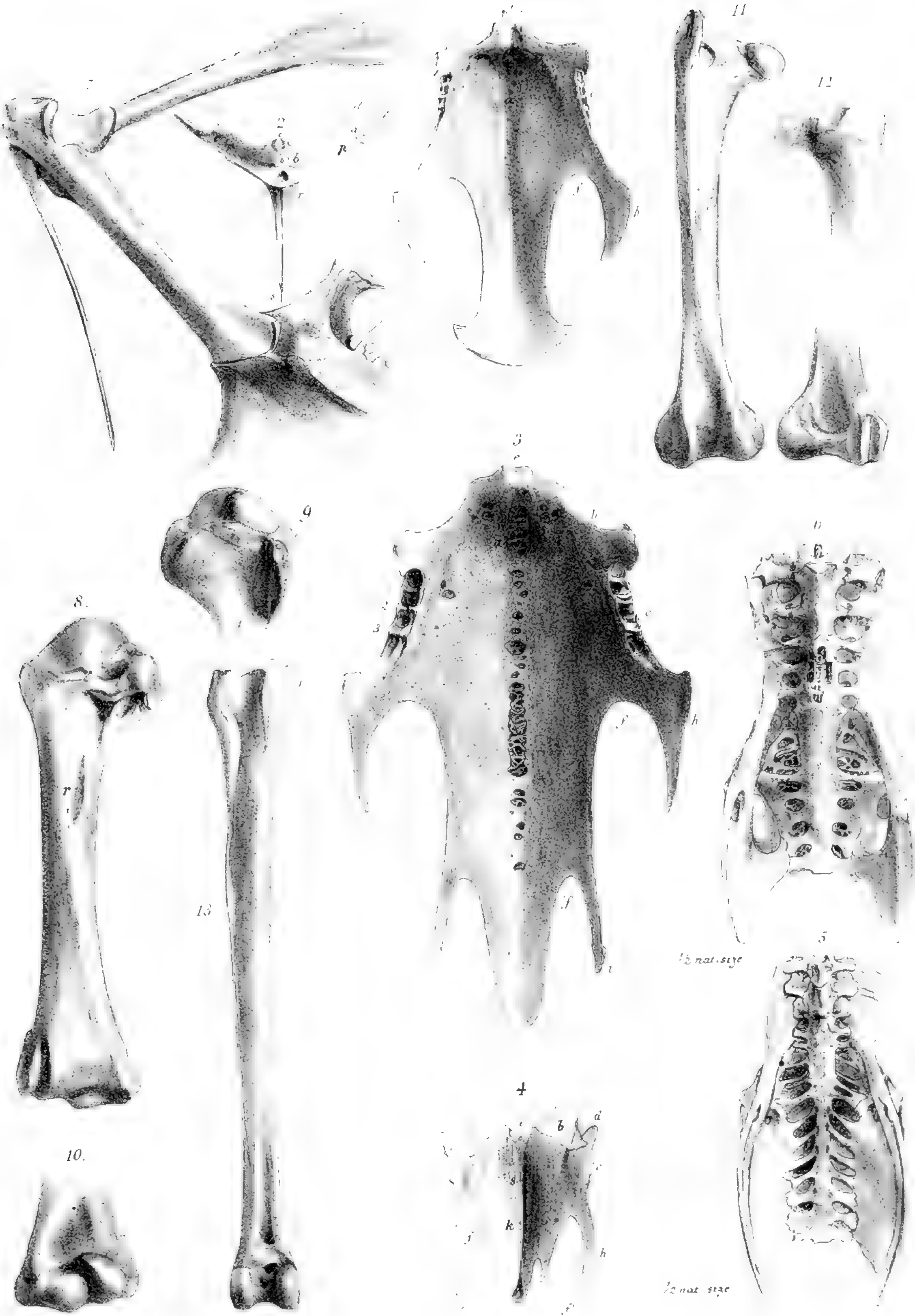

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IV. *Description of the Skeleton of* Inia geoffrensis *and of the Skull of* Pontoporia blainvillii, *with Remarks on the Systematic Position of these Animals in the Order* Cetacea. *By* William Henry Flower, *F.R.S., F.R.C.S., F.Z.S., &c., Conservator of the Museum of the Royal College of Surgeons of England.*

Read November 22nd, 1866.

[Plates XXV. to XXVIII.]

I. *On the Skeleton of* Inia geoffrensis.

Of the several species of Cetaceans which are inhabitants of the waters of the Amazon and its great tributary streams, one has particularly attracted the attention of zoologists on account of certain peculiarities of its external conformation and of its skull and teeth, the only parts of its structure hitherto described.

The *Inia*, so called by M. Alcide d'Orbigny, from the name by which the animal is known to one of the Indian tribes of Bolivia, is chiefly characterized by the long, narrow, and almost cylindrical rostrum, furnished with scattered, stout and crisp hairs, by the broad, long, and obtuse pectoral fins, by the dorsal fin reduced to a mere ridge, and especially by the development of a large lobe on the inner side of all the posterior teeth.

The species is mentioned by Spix and Martius* as *Delphinus amazonicus*; but for the most complete account of its external characters, habits, and geographical distribution we are indebted to d'Orbigny, who described it under the name of *Inia boliviensis*†. He also gives a figure of the animal, and a side view of a skull which he brought home and deposited in the Museum at the Jardin des Plantes, with some details of the teeth. I will quote from this memoir two observations—the first referring to the habits, the second to the structure of this singular Cetacean:—"Toutes ces observations nous font regarder cette espèce comme ayant des mœurs beaucoup plus terrestres qu'aucune des espèces connues."—"Tous ces caractères réunis à une dorsale peu apparente, nous font proposer la formation d'un nouveau genre, qui établerait le passage entre les sousous [*Platanista*] et les stellères" [*Sirenia*].

* Reise in Brasil. t. iii. pp. 1119 & 1133 (1831). Von Martius states that his *Delphinus amazonicus* agrees very closely with Desmarest's description of *D. geoffroyi*, and even suggests that it may possibly belong to the same species. His description of the teeth is sufficient to determine the animal spoken of; but he says "pinna dorsalis distincta, elata." Perhaps he has here confounded it with some of the other species of fresh-water dolphins of the Amazon, the existence of which he did not suspect. The rude little figure he gives (fig. 34) more resembles *Delphinus fluviatilis* (Gervais) of Castelnau's Voyage than the *Inia*.

† Nouv. Ann. Mus. Paris, tom. iii. p. 23 (1834).

In the Zoology of d'Orbigny's 'Voyage en Amérique méridionale,' "Mammifères," by d'Orbigny and Gervais (1847), more careful figures both of the upper and lateral surface, and of the teeth, of the same skull are given (pl. 22), but unaccompanied by any further description. It is, however, suggested that the animal belongs to the same species as a stuffed and painted specimen received at the Paris Museum from the Musée d'Ajuda at Lisbon among the spoils of Napoleon's Peninsular campaign, and described by de Blainville in the Article "Dauphin" in the 'Nouveau Dictionnaire d'Histoire Naturelle,' t. ix. p. 151 (1817), as *Delphinus geoffrensis*, and subsequently by Desmarest* as *D. geoffroyi*.

In a later notice by Professor Gervais, in the Zoology of Castelnau's 'Expédition dans les parties centrales de l'Amérique du Sud,' "Mammifères," p. 90 (1855), this supposition is confirmed, and the name *Inia geoffrensis* definitively adopted. In this notice some further details are given respecting the original skull brought home by d'Orbigny; and a new figure of the external appearance of the animal is added, differing chiefly from that of d'Orbigny in the position of the pectoral limb.

A few years ago that enterprising naturalist Mr. H. W. Bates obtained at Ega two skulls, which are now in the British Museum. Of one of these, Dr. Gray has given the dimensions †.

According to information received from my friend Dr. Peters, there is in the Anatomical Museum at Berlin a skull brought home by Natterer. No description of this, however, has been published.

In the early part of the present year Mr. Edward Bartlett, while collecting zoological specimens on the upper Amazon, above Nauta, succeeded, after encountering many difficulties, in obtaining a complete animal, the carefully prepared skeleton of which has now been purchased for our National Collection. For the opportunity of examining and describing this rare and interesting specimen, before it was deposited in the Museum, I am indebted to the kindness of Dr. Gray.

The skeleton is that of a young animal, the epiphyses being not united to the bodies of the vertebræ from the axis to the tenth caudal; but the arches have completely coalesced with the bodies throughout the spinal column. The head of the humerus still retains its epiphysial condition. The total length of the living animal, judging from the skull and vertebræ, and allowing for the intervertebral spaces, would be but little more than 5′, the skull being 16·4″. The specimen obtained by d'Orbigny is stated to have measured $2^{m}\cdot4 = 6' \; 8''$ Eng., and its skull is $0^{m}\cdot48$ or 19″. The skulls collected by Mr. Bates indicate animals of still larger size, the one being 19·4″, the other 20·7″ long. The skull at Berlin, as Professor Peters has informed me, is $19\frac{1}{2}''$ Eng. in length. Martius states the length of the animal to be from 7 to 8 feet. Finally, Castelnau gives $2^{m}\cdot80$ or 8′ 4″ as the length of an individual taken at Nauta.

* Mammalogie, p. 512 (1822).

† Catalogue of Seals and Whales in the British Museum, p. 227 (1866).

As *Inia* has always been supposed to have certain affinities with *Platanista*, I have in the following description compared the different bones with those of that singularly modified Cetacean on the one hand, and of several of the ordinary *Delphinidæ* on the other. Fortunately the Museum of the College of Surgeons contains a skeleton of the Gangetic Dolphin of nearly corresponding age with the subject of the present communication, and I have also had frequently to refer to Eschricht's valuable memoir upon the species*.

The leading features of the skull have already been made known by d'Orbigny and Gervais; but I am able to add some further details regarding its structure.

A comparison of the two skulls at the British Museum sent by Mr. Bates, with the present example, shows only such differences as might be expected from the greater age of the former, such as a more marked development of the ridges and prominences in proportion to the size of the brain-case. The postnarial prominence especially is more elevated and angular in the older specimens. The teeth differ somewhat in number, as will be mentioned further on.

The principal dimensions of the three skulls are as follows:—

	Collected by		
	Mr. Bates, *a.*	Mr. Bates, *b.*	Mr. Bartlett.
Extreme length	20·7″	19·4″	16·7″
Length of rostrum (from anterior end of premaxillary to bottom of antorbital notch of maxillary)	13·5	12·7	11·0
From anterior end of premaxillary to lower edge of nasal bones	16·7	15·7	13·6
From anterior end of premaxillary to hinder edge of palate	15·7	†	12·6
Greatest breadth, across zygomatic processes of squamosals	9·4	8·1	7·0
Breadth of foramen magnum	1·4	1·2	1·3
Breadth of the occipital condyles	3·2	3·0	2·9
Breadth across antorbital processes of frontals	6·1	5·3	4·5
Breadth of rostrum at base (bottom of antorbital notches of maxillaries)	4·2	3·5	3·1
Breadth of rostrum at middle	1·4	1·2	1·1
Mandible, length	18·2	17·0	14·2
Length of symphysis	9·8	9·4	7·3
Greatest breadth across the posterior ends of the rami	8·7	7·3	6·5
Height of ramus at coronoid process	3·9	3·4	2·9

The want of symmetry so prevalent in the skulls of Dolphins is but slightly marked. It can, however, be detected in a slight twist to the right of the hinder part of the narrow median space between the premaxillary bones, and in the greater elevation on the same side of the postnarial prominence of the frontal bones. Both maxillary and premaxillary bones extend backwards to an equal extent on the two sides.

In the cranium of the young specimen which forms the subject of the present commu-

* "Om *Gangesdelphinen*," Trans. Roy. Dan. Acad. 1851. Translated in Ann. & Mag. Nat. Hist. for March 1852.

† Broken.

nication (see Plates XXV. & XXVI.), the elements of the occipital bone have completely coalesced with each other and with the basisphenoid, and partially with the parietals. The foramen magnum is subcircular, the greatest vertical and transverse diameters being exactly equal; but it is rather broader above than below. Its plane is nearly vertical when the skull is held horizontally. The condyles are large and prominent; they do not meet below by a space of ·7″. In the middle line on the supraoccipital, just above the margin of the foramen magnum, is a deep triangular depression, continuous with a broad and shallow median groove which ascends nearly to the vertex, and with lateral grooves which pass outwards above the upper edge of the condyles to the concave surface of the exoccipitals. In the lower part of the median groove the surface of the bone is very rough, being channelled out for a plexus of blood-vessels; and there are several rounded perforations, one of them as much as ·1″ in diameter, by which these vessels would apparently communicate with the interior of the cranial cavity. Corresponding to this groove, on the inner side, is a median bony ridge, but there is no transverse tentorial ossification. The lateral boundaries of the supraoccipitals are raised into strong narrow ridges, on the summit of which the occipito-parietal suture is situated. These are nearly parallel until they come opposite to the posterior angle of the maxillaries; then they rapidly converge, enclosing a triangle with a truncated apex which projects forward into the high postnarial eminence of the frontals.

The temporal fossa, as noticed by d'Orbigny, is very much larger in proportion to the size of the cranium than in any other Dolphin, except *Platanista*, not only occupying a larger space on the lateral surface of the skull, but being prolonged forward at the expense of the orbit. Its form is that of a long oval, with the small end turned forwards. Its posterior nearly semicircular boundary is formed by the ridge, before spoken of, at the junction of the occipital with the squamosal and parietal. The superior border, continued forwards from the latter, is a nearly straight, sharp, thin crest, projecting outwards and upwards, 3″ long, and averaging more than half an inch in height, formed by the maxillary uniting with the edge of the frontal, and posteriorly with the parietal. The inferior border is formed by a long and strong zygomatic process of the squamosal, approaching, but not equalling, that of *Platanista* in size, and a triangular pointed postorbital process of the frontal, ·7″ in length, and directed backwards and downwards, but which does not meet the process of the squamosal, by a space equal to its own length. In *Platanista* there is no space or postorbital process, the anterior end of the prodigiously developed zygomatic process of the squamosal reaching so far forward as even to be lodged in a hollow in that part of the orbital plate of the frontal from which such a process is usually developed.

The bones which enter into the formation of the temporal fossa resemble in their number and arrangement those of the true Dolphins rather than of *Platanista*. The parietal appears in the shape of a wide arch, receiving in its concavity the squamosal, and articulating for a space of ·6″ with the well-developed alisphenoid, thus completely shutting off the squamosal from the frontal; whereas in *Platanista* the last-named bones unite for a considerable distance below the pointed anterior end of the somewhat triangular parietal, and the alisphenoid does not appear in the fossa at all.

The orbit, in its structure, as well as its size, is intermediate between that of *Platanista* and *Delphinus*. Its antero-posterior diameter is 1″. The malar bone is shorter and more thick and tuberous than in the Dolphins generally, and contributes chiefly to the formation of the prominent rounded antorbital eminence. The ends of the styliform processes are unfortunately broken off; but the portions that remain adhere to the form prevalent among the *Delphinidæ*. In the larger skull in the British Museum this process on one side is 1″ long, and appears to have a free, natural, rounded termination, not uniting, by a very considerable interval, with the zygomatic process of the squamosal. If this is constantly the case, *Inia* presents, in this respect, a remarkable exception to all other Dolphins. There is no distinct lachrymal bone.

The upper surface of the facial portion of the skull behind the rostrum is longer and narrower than in the *Delphinidæ* generally. It is distinctly bounded on each side by the sharp, straight, and nearly parallel crest before spoken of as forming the upper margin of the temporal fossa. Within these crests, on each side, the narrow upward prolongations of the maxillaries are deeply hollowed. Their hinder edge extends an inch further back than the anterior apex of the supraoccipital, and they curve inwards round the top of the premaxillaries to articulate with the nasals, and enter for a small space, between these bones and the premaxillaries, into the formation of the lateral boundaries of the narial opening. It is the narrowness and excavation, combined with the straightness and elevation of the outer borders, of the maxillaries, which gives the peculiar character to the upper surface of the skull of *Inia* as compared with that of *Delphinus*. The difference is only one of arrangement of the same parts; there is nothing superadded like the extraordinary outgrowths upon the maxillæ of *Platanista*.

Immediately behind the narial opening is a somewhat square-shaped elevation, rising vertically in front, sloping behind, and hollowed out and overhanging at the sides, formed chiefly of the frontal bones, and suggestive of the peculiar elevation of this part so characteristic of the Ziphioids. The nasal bones are applied to the front wall of this elevation, but do not reach the top of it. In general form they are irregularly quadrilateral, prominent and thick near their longest, straight, inner border, where they meet each other in the middle line, and deeply hollowed and notched in their upper and lower margins. Their shorter, but straight and thick, outer border articulates with the maxillary. Above and below they are bounded by the frontal, on which they rest. The greatest length of each bone is ·9″, the greatest breadth ·7″. They present no marked deviation from bilateral symmetry. Attached to the upper outer angle of each, and lodged in the groove between the frontal and maxillary, is a minute oval bone, ·25″ long, apparently originally distinct, though now partially united with the nasal; and their inferior internal angles rest upon a median single triangular piece, ·3″

broad and ·25″ high, distinctly separated by a suture from the frontals. It will be seen from the above description that the nasals are extremely different from those of most of the *Delphinidæ*, in which they are generally reduced to irregular, oval, unsymmetrical nodules. *Phocæna*, however, differs from its allies in this respect, and closely approximates to *Inia*. In *Platanista* also the nasal bones are well-developed flattened plates; but they partake of the great elongation, narrowness, and lateral distortion which pervades this region of the skull.

The opening formed by the junction of the anterior nares is 1″ long, and the same width posteriorly. It is bounded laterally and in front by two very prominent, rounded, longitudinal elevations, formed by a thickening of the premaxillaries, like that seen in this region in *Phocæna* and *Beluga*, but considerably more marked. No part of the maxillaries comes to the surface in the middle line in front of the narial aperture as in many of the *Delphinidæ* (e. g. *Globiocephalus*).

The rostrum is exceedingly long and narrow, and, except at its base, much compressed. The diminution of its breadth takes place rapidly for the first fourth of its length, but for the remaining portion only very gradually. The bone of which it is composed is of dense texture; and, even in this young subject, the sutures between the premaxillaries and maxillaries are almost obliterated. The width of the premaxillaries scarcely alters through their entire length, their outer boundaries being parallel, and the general diminution in the breadth of the rostrum taking place solely at the expense of the maxillaries. There is a narrow interval throughout in the middle line between the premaxillaries, and the subjacent cavity for the median ethmoid cartilage is not filled up with bone as in many of the *Ziphiinæ*.

On each side of the inferior surface of the rostrum (Plate XXVI. fig. 1) the alveolar tract, marked by the row of deep and distinctly separated tooth-sockets, extends from the apex to $1\frac{1}{2}''$ from the bottom of the antorbital notch. Between these tracts the palatine surface is quite flat, and in the anterior three-fourths slightly raised above their level. At the middle of the rostrum it is only ·4″ wide, but gradually expands posteriorly. Between the two maxillary bones, in the median line is a narrow fissure, in which, 1″ behind the middle of the rostrum, a thin strip of the vomer appears, and continues visible as far as the posterior edge of the palate.

The remarkable conformation of the bones of the hinder part of the palatial region in the Gangetic Dolphin has been well described by Eschricht, who pointed out that the great lamella of bone which continues backwards the palatine portion of the maxillaries, and passes outwards and upwards to articulate with the squamosals and frontals, is really the pterygoid, and not the palatine as Cuvier supposed *. The easily separable condition of the bones of the young *Platanista* skull in the Museum of the Royal College of Surgeons has enabled me to confirm Eschricht's view; for on removing this plate the true palatine is seen, forming as usual the greater part of the anterior and

* Ossemens Fossiles, 4me édit. (1836) tome viii. p. 130.

outer wall of the nasal passage, but not entering in the slightest degree into the composition of the free surface of the bony palate.

In this disposition of the palatine and pterygoid bones *Platanista* stands alone among Cetaceans; even *Inia* presents no approximation to it. There are, however, in the latter genus some peculiarities in this region by which it may be distinguished from the ordinary Dolphins.

Behind the posterior pair of teeth the palate loses its flatness, and begins to rise to a ridge in the middle line and slope away at the sides towards the roof of the orbits. The summit of the ridge is formed by the vomer, which is quite uncovered in the middle line by the palate-bones. The inner edges of these bones, applied to the surface of the vomer, are distinctly marked, and posteriorly are ·4″ distant from each other. The suture between them and the maxillaries is completely obliterated, so that their limits forwards and outwards cannot be definitely stated. As in the ordinary Dolphins, the palatines have each an outstanding, nearly vertical, plate running outwards and backwards, unattached posteriorly, and forming the upper part (in the natural position of the skull) of the outer wall of the chamber which lodges the great post-palatine air-sinus. This plate is slightly developed and very thin, perforated by numerous large lacunæ, and, owing to the non-development of the outer reflected portion of the pterygoids, is completely free along its inferior edge.

The pterygoids are comparatively simple, and also very thin and lacunated. As usual, the upper or attached portion forms a ridge along the side of the cranium, continuous posteriorly with the ridge on the side of the basisphenoid, which forms the inner wall of the cavity for the lodgment of the ear-bones. This portion articulates by nearly the whole of its inner edge with the hinder expanded part of the vomer, and externally with the alisphenoid and orbitosphenoid. From its anterior part springs the recurved descending plate which bounds externally the posterior nares, and, then turning inwards and backwards, forms the anterior wall of these passages below the palatines. This last-named plate of the pterygoid forms the hinder part of the bony palate; anteriorly it lies on the hinder free edge of the inferior surface of the vomer, but does not quite cover it to the middle line; behind the vomer it diverges rather more from its fellow, leaving a gap of from ·1″ to ·2″ in breadth. Posteriorly each terminates by a concave free margin. The third portion of the pterygoid, which exists in all ordinary Dolphins (excluding the *Physeteridæ*), and which when present completely conceals that last described, being reflected from its hinder and inner edge outwards and upwards to meet the edge of the projecting plate of the palatine, and so close in the postpalatine sinus below, is wanting in *Inia*, or only represented in the osseous cranium by some small irregular body-excrescences. The result is that the cavity for the sinus is widely open below. It might be conjectured that this plate, being thin, brittle, and much exposed to injury during the process of cleaning the skull, had been broken away. It is certainly possible that such is the case;

but as the adult and apparently perfect skull from Ega, in the British Museum, shows a precisely similar condition to that above described*, it is probable that, if ossification takes place at all, it is of a very imperfect character.

Both petro-tympanic bones are unfortunately absent from the skull. The fossa at the base of the cranium for their lodgment is shallow, and the aperture left in the cranial wall by their removal large, compared with that in an ordinary Dolphin. It is irregular, circular, and averages 1″ in diameter. In the largest skull in the British Museum these bones are present, and enter considerably into the formation of the cranial wall, the inner and upper surface of the petrosal being seen in the interior of the cerebral cavity, on a level with the internal surface of the other bones†.

One circumstance in which the petro-tympanic bones of *Inia* differ from those of *Platanista* is their loose connexion with the rest of the cranium; for they are only attached by ligament, as in *Delphinus*, and not locked in their place by a process of the mastoid. In general form the tympanic bullæ resemble those of *Delphinus*, though they are larger than in a member of that genus of corresponding size, and have their anterior (Eustachian) extremity rather more prolonged and pointed, though to a far less degree than in *Platanista*. Their antero-posterior length in the adult skull is 1·65″, their greatest breadth 1·1″.

The mandible presents a remarkable miniature resemblance to that of a Cachalot. It differs from the mandible of all the true *Delphinidæ* by the great length, narrowness, and shallowness of the symphysial portion, which includes three-fourths of the tooth-bearing part of the rami. The consequence is that the hinder parts of the rami diverge much more rapidly from each other than in the true Dolphins. The coronoid process is unusually elevated. The lower jaw of *Platanista*, as is well known, presents all these characters, but in a much more exaggerated degree.

The characteristics of the teeth have been well described by d'Orbigny and Gervais. They are distinguished from those of all other Cetaceans by the peculiar and very

* In the smaller skull in the same Collection nearly the whole of the pterygoids have been destroyed.

† After noticing that in certain Delphinoids the aperture left between the hinder edge of the alisphenoid, the exoccipital, basioccipital, and basisphenoid is exceedingly small, so that the tympano-periotic is still more shut out from the cranial cavity than in *Balæna*, Professor Huxley remarks that "in *Platanista* the aperture is large, and the periotic appears in the interior of the cranial cavity in the ordinary way" (Elements of Comparative Anatomy, 1864, p. 276). This is certainly the case in the two small *Platanista* skulls in the Museum of the College of Surgeons, upon which the observation was founded; but it is worthy of note that in a large and apparently aged skull of an individual of the same genus in the British Museum the periotic bones are completely shut out of the cerebral cavity by the excessive development of the proper cranial bones, and communicate with it only by a narrow passage fully an inch in length. Whether this difference depends on age or on species I cannot at present determine; but it shows that the relative position of these bones to the rest of the cranium may vary, even in most closely allied forms.

marked rugosity of the surface of their crowns*, and especially by the broad, rounded lobe, developed on the inner side of the base of the crown of those situated in the posterior part of both upper and lower jaws (see Plate XXVI. figs 1, 2 & 3). In the anterior two-thirds they are simple, conical, and slightly incurved. They gradually increase in size from the front of the jaws until the fourth from the posterior end of the series, after which they diminish again. Unlike those of most Dolphins, the teeth are implanted by large and generally somewhat twisted and flattened fangs (in the hinder teeth very wide transversely), which fit so tightly into deep alveoli that it is almost impossible to extract them, even in the dried skull, without injury to the bone. When the mouth is shut they fit closely into the interspaces of the opposite series; but there is little sign of attrition to be seen anywhere on their surface.

The number of the teeth in the different specimens of *Inia* examined shows a considerable range of variation, presuming that they all belong to one species. In the one now described there are $\frac{\text{R. 26 L. 26}}{\text{R. 25 L. 27}}=104$. The larger specimen in the British Museum from Ega has $\frac{28-28}{26-27}=109$, and also two minute rudimentary teeth in the gum behind the last in the left maxilla. In the smaller skull from the same place there are $\frac{29-26}{28-27}=110$. In the skull in the Paris Museum, brought by d'Orbigny, there are, according to Gervais, $\frac{33-33}{33-33}=132$; but in the type specimen in the same museum, taken from Lisbon, the number is given by de Blainville as $\frac{26-26}{26-26}=104$. In the Berlin skull the teeth are $\frac{34-32}{33-32}=131$†. Von Martius in his diagnosis of the species gives $\frac{28-28}{29-29}=114$.

The bones of the hyoid apparatus scarcely differ from those of the ordinary Dolphins. Their general form is shown in the figures (Pl. XXVI. figs. 4 & 5) at half their natural size. The basihyal and thyrohyals are not yet united by continuous ossification. The stylohyals are thick, subcylindrical, slightly curved, and somewhat flattened towards the ends.

	''
Antero-posterior diameter of the basihyal	1·0
Transverse diameter	1·3
Length of thyrohyal	2·0
Greatest breadth	0·6
Distance between the outer extremities of the thyrohyals	3·4
Length of stylohyal	2·7
Greatest thickness	0·4

The spinal column (Pl. XXV. figs. 1 & 2) appears complete to the end of the tail, and consists of but 41 vertebræ, the smallest number known in any Cetacean‡. Of these,

* Some Dolphins of the genus *Steno* of Gray present a similar though far less marked rugosity; and indications of it are seen in young specimens of *Orca* and *Pseudorca*.

† Peters, in a letter.

‡ As the bones had been separated from each other adncleaned at the time that they came into my hands for

7 belong to the cervical, 13 to the thoracic, and 21 to the lumbo-caudal region. When the vertebræ are placed in order, with their bodies in contact, the whole column measures 38·8″.

The cervical region, as in *Platanista*, occupies a larger proportional space than in most other Cetaceans, being 3·3″ long, or $\frac{85}{1000}$ of the whole column. In a common Porpoise, measured for the purpose of comparison, it is but $\frac{30}{1000}$. All the vertebræ are distinct, as in *Platanista*, *Beluga*, and *Monodon* alone among toothed Whales.

The atlas (Pl. XXVII. fig. 1), very large for the size of the animal, greatly resembles that of *Platanista*, but is higher in proportion to its breadth. Its neural arch is strong, and has on its upper surface a slight longitudinal ridge representing the spine. The base of the arch is not perforated as in many Cetaceans, and the groove for the sub-occipital nerve is but slightly marked. On each side, between the anterior and posterior articular surfaces, are two rounded eminences, the rudiments of an upper and lower transverse process. In *Platanista* there is only a single intermediate process (which Eschricht considers to represent the lower process), but it is developed to a much greater length. In *Beluga* both processes are present as in *Inia*, and upon corresponding parts of the surface of the bone. As in the other Odontoceti having a free atlas, there is a strong process developed from the hinder edge of the lower arch of the bone, which passes under and articulates with the inferior surface of the axis (see Pl. XXV. fig. 2). This is bifid at the extremity, and much more powerfully developed than in the young *Platanista* which served for comparison.

The axis has a massive body, and a high neural arch. There is no distinct odontoid process, but only a general (though strongly marked) prominence of the anterior surface of the body, especially towards its lower margin. On the under surface of this there is a large rounded articular facet for the inferior process of the atlas. This is continuous at the sides with the anterior articular facets, and would indicate a tolerably free motion between the first two bones of the neck. In *Platanista* this anterior projection of the body of the axis is still more strongly marked, forming a process quite comparable with the "odontoid" of other Mammalia. In *Beluga* it is almost wanting. The other processes of this vertebra differ somewhat in detail from those of *Platanista*. The spinous process is broad and bifid; the posterior zygapophyses are much less prominent, and their surfaces look more backwards. A proper transverse process can scarcely be said to exist. There are, however, instead of the single, conical, backward-directed process of *Platanista*, slight rudiments of an upper and a lower process, with a groove between them, on the hinder surface of the lateral wings of the bone which support the great articular facets for the atlas. The posterior epiphysis of the body was not ankylosed.

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description, I must admit the possibility of some of them being lost; but the circumstances under which the skeleton was prepared render this, at the least, extremely improbable. When it arrived in this country the vertebræ were all united by their natural ligaments. Unfortunately they were not counted when in this state.

The remaining five cervical vertebræ are compressed in the antero-posterior direction, but less so than in most Cetaceans. They do not present the peculiar depression and transverse extension characteristic of the cervical vertebræ of *Platanista*, but their bodies are nearly circular in outline, and the height of the neural canal bears a more considerable proportion to its breadth. The bodies increase but very slightly in thickness from before backwards. The arches are wide and low, their sides meeting above at very obtuse angle, and so narrow in the antero-posterior direction as to leave spaces between them about equal to their own breadth. They increase but very slightly in height from the third to the seventh, and possess but a mere rudiment of a spine, scarcely recognizable in the third, and but ·2″ in height in the seventh. The anterior and posterior articular facets of the arches are well developed in all, and have their usual relations.

The transverse processes are, as usual, two on each side, upper and lower; the upper springs from the arch, the lower from the body of the vertebra. In the third vertebra these two are very near together, and approximate at their ends so as to enclose an oval foramen or canal ·2″ in its greatest diameter. On the left side this canal is completely surrounded by bone; on the right side it is not quite completely inclosed. In *Beluga* similar rings are formed by the transverse processes of this vertebra. also in the *Platanista* described by Eschricht, though in the College specimen there is but a single broad imperforate transverse process. In the fourth vertebra the processes are wider apart, short, and obtuse, and of about equal length; a small elevation rises from the side of the body of the bone, midway between them. In the fifth vertebra they are still wider apart, owing to the upper one, which is short and conical, rising higher on the side of the arch. The lower process is much larger, stouter, rounded at the end, and directed backwards. Although upwards of $\frac{1}{2}''$ long, it was evidently not fully developed in this immature individual, being tipped with cartilage. The prominence of this process, contrasting with the almost rudimentary condition of all the others, is a marked characteristic of the cervical region. In *Platanista* and *Beluga*, as in most other Mammalia, it is the sixth vertebra which has the most largely developed inferior transverse process, in the former very remarkably so. It is worthy of note, however, that the Dugong (*Halicore*) agrees with *Inia* in this respect, as well as in many other of the characters of the neck-vertebræ.

In the sixth vertebra, both upper and lower processes are small and conical. In the seventh vertebra the upper process is more developed; the lower one still exists, but in quite a rudimentary state; behind it is a shallow excavation for the head of the first rib. The laminæ of the arch of this vertebra are wider than in the others; its spine, as before said, is slightly higher; and the posterior surface of its body is transversely extended.

The thirteen thoracic vertebræ measure in length when placed in close contact 12·5″. Their bodies increase at first rapidly, then more gradually in length—the first measuring ·5″, the sixth ·9″, and the last 1·2″. Their arches are surmounted by rather long, erect, and (especially in the hinder part of the region) very broad spines truncated at the top. The antero-posterior breadth of these processes presents a constant relation to the length of the body, being always nearly equal with it, and forms rather a remarkable feature in the general aspect of the vertebral column. The height of the spine of the first thoracic vertebra is scarcely inferior to that of the others, which are almost precisely equal. In the sixth, from the inferior edge of the body to the junction of the laminæ of the arch measures 1·6″; the spine above this point is 2·2″. Distinct articular facets or zygapophyses are developed on both the anterior and posterior edges of the arches as far as the ninth vertebra, and on the anterior edge only of the tenth and eleventh. These, as usual, are broad and wide apart at the commencement of the series, and gradually become narrow and approximated as they shift from the sides to the summit of the progressively diminishing neural arch.

The so-called oblique processes (metapophyses of Owen) begin to separate themselves from the transverse processes at the fifth or sixth vertebra, and gradually pass upwards and inwards on the anterior edge of the arch towards the prozygapophyses, which they supersede on the twelfth vertebra. Owing to the comparatively slight development both of these processes and the zygapophyses, the thoracic vertebræ of *Inia* are not locked together in the manner which distinguishes those of *Platanista*.

It remains only to speak of the processes for the articulation of the ribs, which offer some interesting peculiarities. In all the ordinary *Delphinidæ* the anterior ribs are articulated by their tubercle to a well-developed transverse process standing out from the side of the arch, and by a long neck to the hinder edge of the body or root of the arch of the antecedent vertebra. There is usually no indication of any articular surface for the head of its own rib on the front edge of the body of the vertebra. At about the middle of the series the heads suddenly cease to be developed, and the rib is only attached by its tubercle to the end of the transverse process, still arising from the arch, but gradually lengthening and becoming lower in its point of origin, till at the end of the series it springs rather from the body of the vertebra than from the arch, and is in a line with the transverse processes of the lumbar vertebræ. This arrangement, departing considerably from that found in the ordinary mammal, occurs in *Delphinus*, *Phocæna*, *Orca*, *Globiocephalus*, *Beluga*, *Monodon*, and their immediate allies—in fact, in all the *Delphinidæ* which have ossified costal ribs. In the remarkably aberrant *Hyperoodon* and *Physeter* a totally different arrangement takes place in the hinder part of the dorsal region, which, however, is equally peculiar among the Mammalia. The upper transverse processes springing from the arch (diapophyses, Owen) suddenly cease, and the rib retains its connexion with the body only: the articular surfaces of the latter push out a process (which, on Owen's system, would be called a parapophysis), at the end of which the rib is attached, and which becomes the transverse process, being continuous serially with the transverse processes of the lumber region. In the first case, the transverse process on the body of the last dorsal vertebra is arrived at by a gradual lowering of the transverse process of the arch of the first; in the second it is a new process, first appearing on the body rather abruptly, as the process on the arch ceases, but for the space of two or three vertebræ coexisting with it, as in the cervical region: or, to explain the case in other words, the anterior ribs in both have an upper and a lower connexion with the vertebræ; in the first instance they lose their lower connexion by the non-development of their neck and head, but the gradual lowering of the transverse process brings the headless rib again in connexion with the body, by the intervention of a long straight process; in the second instance they always retain their lower connexion, but the development of a process out of the articular surface of the body, with concurrent shortening of the neck of the rib, and disappearance of the upper process of the vertebra, produces an exactly similar result.

In *Inia* the mode of attachment of the ribs is, as far as I know, peculiar among Cetaceans, being intermediate between the two distinct forms above described, and far more resembling that which obtains in the Sirenia and the terrestrial mammals. The anterior vertebræ have as usual a tolerably well-developed, thick and rounded transverse process, springing from the arch at the junction of the pedicle with the lamina, and pointing upwards and forwards, with a large articular facet at its extremity; this process gradually becomes shorter, till in the seventh vertebra little more than the articular facet remains on the side of the arch. On each side of the body of the first vertebra are two distinct articular facets, each receiving part of the head of the first and second ribs respectively. The same occurs in the two following vertebræ, though the facets are less distinctly marked, the head of the rib apparently articulating chiefly to the intervertebral substance in front of its own vertebra. In the fourth, and more distinctly in the fifth and succeeding vertebræ, there is a strongly-marked articular facet on the anterior edge of the body, while that on the posterior edge has entirely disappeared (a condition, it will be observed, never found in the true *Delphinidæ*). Hereafter each rib is solely articulated to its own vertebra, and its lower attachment becomes moved by degrees from the anterior edge to the middle of the body. As far as the seventh vertebra the rib has a double attachment; but in the eighth the upper and lower articular surfaces (that on the arch and that on the body) have coalesced, though the part that originally belonged to the transverse process and that on the body are distinctly recognizable. This coalescence, however, becomes more complete; and, by the diminution of its upper part, the articular facet, at first elongated vertically, becomes oval in the opposite direction in the eleventh vertebra, and also begins to rise out from the body as a short thick process. This process is somewhat elongated and flattened in the twelfth, and notably so in the thirteenth vertebra; and at the same time the articular surface becomes gradually reduced in size, corresponding with that of the head of the rib. We have thus among the toothed Whales a third method by which the transformation from the first thoracic vertebra with its doubly attached rib, to the last with its singly attached rib, is effected, not in this case by the disappearance of either the lower or the upper attachment, but by their gradual coalescence.

In *Platanista* the attachment of the ribs is again different in detail, being something between that found in the true *Delphinidæ* and in *Inia*. Each of the first seven ribs is attached to the transverse process of its own vertebra and to the body chiefly of the preceding vertebra; but the transverse processes differ from those of the *Delphinidæ* in being very short, and in being more rapidly transferred down to the bodies; indeed this takes place as early as the sixth vertebra, and before the disappearance of the articular facet for the head of the rib, leading to a blending of the two articulations in one as in *Inia*.

The remaining vertebræ (lumbo-caudal) are twenty-one in number. In accordance with the usual (and most correct custom) of reckoning the caudal region of the Cetacea as commencing with the first vertebra which bears a chevron bone*, there are but three, or at most four, vertebræ, which can properly be called lumbar. The uncertainty rests upon the difficulty of determining, in a skeleton of which the bones are all separated, and in which, owing to its immaturity, the articular surfaces and processes are not very distinctly marked, to which of the vertebræ the first (always very small) pair of hæmapophyses was attached. I think, however, that there can be little doubt that the fourth of the vertebræ behind the thoracic region did bear such bones, not only from indications on its own surface, but also because the facets on the hinder edge of the under surface of the fifth are too strongly pronounced to be the attachments of the small first pair. Taking, then, the true lumbar vertebræ at only three, *Inia* presents

* As a uniform system of nomenclature in enumerating the vertebræ of Cetacea is very desirable, it is to be regretted that Eschricht and Reinhardt, in their most recent works on Cetology, should have given the weight of their high authority to reckoning as the last of the lumbar vertebræ the one immediately preceding the first chevron bone, and which has commonly been regarded as the first caudal. The only reason given for this change is, that "the anus, which may justly be said to mark externally the limits between the abdomen and the tail, is situated directly beneath the first chevron bone" [1]. This, however, does not prove the case; for if we look at the skeleton of any terrestrial mammal in which the distinction between the different regions of the vertebral column is definitely marked, we may see that the commencement of the caudal region is situated some way *in front* of the position of the anus. We ought rather, according to this criterion, to reckon two or three of the vertebræ in the Cetacea commonly called lumbar to the region of the tail,—a view further strengthened by the fact that, in the ordinary mammals, the chevron bones, when present, begin generally not on the first, but on the second or third caudal vertebra. Such a division would, however, be quite impracticable.

Each chevron bone belongs essentially to the vertebra in front of it. This is most clearly seen when they are small, as in the commencement of the series. In the skeleton of a *Physeter* that I lately examined, the first is even ankylosed to the posterior edge of the body of its proper vertebra, and has no connexion with that behind it. It is quite certain that any vertebra bearing a chevron bone cannot consistently be regarded as one of the lumbar series. We may therefore conveniently reckon the first vertebra which is so distinguished as the commencement of the caudal region.

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[1] Recent Memoirs on the *Cetacea*, published by the Ray Society, 1866: Eschricht and Reinhardt on the Greenland Whale; p. 105; and Reinhardt on *Pseudorca crassidens*, p. 204.

an extraordinary deviation from all other Cetaceans, among which the number, though certainly very variable, is usually considerable, ranging from eight in *Platanista* and *Physeter* to twenty-four in some of the *Delphini* and *Lagenorhynchi*. On the other hand, in the Sirenia, the lumbar region of the vertebral column is, as in *Inia*, extremely restricted.

The three lumbar vertebræ are very remarkable for the great antero-posterior breadth of their processes, both spinous and transverse. The bodies are large, being respectively 1·3″, 1·4″, and 1·5″ in length; their extremities are subcircular, and, as usual in the Cetacea, the middle of the side below the origin of the transverse process is much contracted, so that the median line of the under surface forms a sharp ridge, from which a strongly marked arterial groove runs outwards and backwards to the hinder edge of the root of the transverse process. The spinous processes resemble those of the posterior dorsal region; the first two are slightly curved forwards, the last is nearly vertical and somewhat smaller. The oblique processes (metapophyses) are short, flat, rounded projections from the upper part of the laminæ of the arch, very closely approximated to each other. The transverse processes rise from the whole length of the side of the body; they are of nearly equal length, but increase in breadth, especially by the development of a considerable angular process on the middle of their anterior border, most conspicuous in the third vertebra; beyond this process the anterior border is sharply cut off, so that the extremity appears to point backwards. The hinder border is nearly straight, with a notch close to its origin from the body, continuous with the groove before spoken of on the inferior surface of the bone.

The vertebra here reckoned as the first caudal closely resembles the last lumbar. Its body is of the same length, but its transverse process is even broader. The succeeding tail-vertebræ keep up the same general character, having large heavy bodies and broad processes. The projecting surfaces on the hinder edges for the attachment of the chevron bones are very strongly marked as far as the ninth, after which they become obscure; they are not seen on the anterior edge until the fifth. It is difficult to determine exactly how many chevron bones there were, but probably not more than eleven. The spinous processes, broad and rounded at their summits, become gradually lower, until in the tenth the greatly reduced vertebral canal is scarcely closed in by the laminæ of the neural arch, and there is no longer a true spine. In the eleventh, the canal is altogether open above. The metapophyses continue in much the same relative development and situation as far backward as the spinous processes extend. The transverse processes gradually diminish in length, and lose their characteristic form. Already in the second that cutting away of the anterior edge noticed in the lumbar region is lost; and in the third and succeeding vertebræ the anterior edge is straight, and the hinder one sloping, so that they appear to point forwards. In the eighth they form but a slight prominence on the anterior part of the body, and in the ninth they have altogether disappeared. The vertical perforations for the lateral ascending branches of the caudal artery, so characteristic of a certain region of the tail-vertebræ of the Cetacea, occur first in the fifth vertebra, but only on the left side; in the sixth they are seen on both sides, perforating the body of the bone, not the root of the transverse process.

As in all Cetacea, the caudal vertebræ suddenly change their characters at the point where they enter the laterally expanded part of the tail and where the chevron bones cease to be developed. They now lose their cylindrical form, and become broad, depressed, and angular. There are seven such vertebræ in the present specimen; and the eighth from the end of the series, or the eleventh caudal, reckoning from the beginning, is what may be called the transitional vertebra, being intermediate in form and size between its two exceedingly different neighbours. The last two show a rapid diminution in width. The terminal one is triangular in outline when seen from above.

Nothing can well be more dissimilar than the lumbo-caudal region of the spinal column in *Inia* and *Platanista.* In the latter the short bodies, the long narrow transverse processes, and high spines curving forwards and bearing immense laterally developed oblique processes with (throughout the lumbar region) well-marked anterior and posterior articular surfaces, form most striking distinguishing characters.

The chevron bones sent with the skeleton are ten in number. It is probable that the first is wanting, as there is none corresponding with the form this usually has in the Cetacea. I have therefore indicated its situation with a dotted outline in the figure of the vertebral column (Pl. XXV. fig. 2). These bones agree in general characters with the processes of the vertebræ with which they are connected, being of moderate length, very broad and rounded at their free extremity. The lateral halves of the last three are not united in the middle line.

There are thirteen pairs of ribs (Pl. XXVII. fig. 2), the last being well developed and articulating with the transverse processes of the corresponding vertebræ. They are stout and heavy for their length, more so than in the ordinary Dolphins. In their comparatively cylindrical form they present a marked contrast to the broad flat ribs of *Platanista.* The last two or three are, however, much more compressed than the others. The curve, very strong and angular in the first, gradually diminishes and becomes more regular. The last has a slight turn outwards at the lower end, giving a gentle sigmoid curve to the whole bone.

The anterior ribs have long and broad, somewhat compressed capitular processes, with distinct articular surfaces at the extremity and at the tubercle. In the fifth the length of this process is sensibly diminished. In the sixth, seventh, and eighth it shortens rapidly, the two articular surfaces being already confluent in the seventh. In the ninth a rounded projection of the lower border of the vertebral end indicates the rudimentary process; in the tenth it has disappeared altogether, and henceforward the upper end of the rib ends in a somewhat dilated, oval, convex, articular surface, gradually diminishing in size. The mode of attachment of the ribs to the vertebral column has been noticed in the description of the thoracic vertebræ.

The extreme length of the ribs of the right side in a straight line is as follows:—

First	″ 3·7	Eighth	″ 6·9
Second	5·7	Ninth	6·7
Third	6·9	Tenth	6·5
Fourth	7·3	Eleventh	6·4
Fifth	7·3	Twelfth	5·9
Sixth	7·2	Thirteenth	5·3
Seventh	7·1		

The costal cartilages, as in *Platanista* and all the Physeteridæ, are not ossified. How many may have reached the sternum it is, in the present state of the skeleton, impossible to determine; but indications of the attachment of only two pairs are to be seen on this bone, which, if confirmed, would be most exceptional among Cetacea, and be another feature of resemblance with the Sirenia.

The sternum (Pl. XXVII. figs. 3, 4 & 5) is very peculiar in shape, quite unlike that of any other Cetacean with which I am acquainted, and in its shortness, breadth, and the deep notch on the anterior border somewhat recalling that of the Manatee. It differs from this, however, in its greater solidity, especially towards the anterior part, and in possessing two strong triangular processes (*b*) projecting downwards and outwards from the fore part of the external surface.

It consists of a single bone, which is at present but incompletely developed, all the prominences and the whole hinder margin terminating in cartilage.

The extreme length of the ossified portion of this singular bone is 4″·2; its greatest breadth, near the middle, is 3″. Its general form is irregularly oval. In the anterior border is a notch 1″ in depth, with smooth, rounded edges. On each side of this are two thick conical processes (*a*), projecting directly forwards, ·7″ apart at their ends. As these have dried cartilage both on their tips and inner surfaces, it is possible that in the adult animal their ossification might extend so far as to convert the notch into a foramen. On each side of the hinder half of the notch the bone becomes very thick, running out on the external or inferior surface into the triangular process before noticed (*b*), and backwards and upwards into a thick irregular edge (*c*), apparently for the attachment of the cartilage of the first rib. The hinder half of the bone is flat, and gradually becomes thinner towards its rounded and incomplete posterior edge, which is divided into two lobes by a narrow cleft, situated slightly to the right of the median line. About the middle of the left lateral margin is a small transverse notch, represented on the right side by an oblique perforation, apparently for the passage of a blood-vessel. Immediately behind this the margin is thickened and excavated for the attachment of the cartilage of the second pair of ribs (*d*). There are no other indications of such attachments, though it is possible that the cartilaginous hinder margin may have been connected with another pair.

In *Platanista*, according to Eschricht, four pairs of ribs are attached directly by their cartilages to the sternum, and the form of this bone has nothing in common with that of *Inia*. The manubrium is flat and triangular, very broad in front, with a straight anterior edge, and without either of the processes so prominent in *Inia*. This is succeeded by a distinct body, ossified from two lateral centres, and a xiphoid process wholly cartilaginous in the young specimen described. Many of the true Dolphins have two conspicuous pairs of processes on the manubrium sterni, evidently for the attachment of muscles—one projecting forwards and outwards, in front of and within the surface for the attachment of the first pair of sternal ribs, the other rising from the lateral border between the surfaces for the articulation of the first and second sternal ribs, and directed somewhat backwards. These are especially developed in *Monodon*. It is to these that the processes of the sternum of *Inia* appear to correspond, though much modified in direction. The sternum of *Phocæna* entirely wants these processes; otherwise it presents some resemblance to that of *Inia* in its breadth, flatness, and in consisting of a single piece.

The pectoral limbs of *Inia* are described by d'Orbigny as "larges, longues, et obtuses;" and the present skeleton fully corroborates this account.

The scapula (Plate XXV. fig. 3) does not present that singularly aberrant character which is one of the most peculiar features of the skeleton of *Platanista*, but conforms more to the ordinary type of the Dolphin-family. Its superior costa is long, and with a tolerably regular arch; the anterior and posterior costæ (of which the former is slightly the longer) are much hollowed out, so that the lower half of the bone is narrower from side to side than in most Dolphins. Both the acromion process and coracoid are very long, flat, and expanding and truncated at their extremities. The glenoid fossa is large.

The principal dimensions are:—

	"
Extreme height, from glenoid fossa to middle of superior costa	3·7
Extreme breadth	4·8
Breadth of body at root of acromion process	1·2
Length of acromion	1·7
Length of coracoid process	1·3
Length of glenoid fossa	1·2
Breadth of glenoid fossa	0·9

The humerus is unusually long in proportion to the other segments of the limb, and very simple in its character. The tuberosity is very small; but it is probably not completely ossified. The neck is but slightly marked. The distal end of the bone is flattened, and not much expanded in width. The inner surface is quite smooth and slightly concave longitudinally. The outer surface is rougher, and has a rather deep pit a little way below the neck.

The radius and ulna are considerably shorter than the humerus, contrary to what obtains in most Cetacea. They are very simple, broad and flat bones, but have a considerable space between them, owing to the concavity of the contiguous borders of the ulna and radius. The ulna presents the great peculiarity of possessing no rudiment of an olecranon process.

	"
Length of humerus	3·2
Width at middle	1·1
Width at lower end	1·6
Length of radius	2·5
Width at middle	1·2
Width at lower end	1·4
Length of ulna	1·9
Width at middle	1·0
Width at lower end	1·6

The carpal region is large, and composed in the present specimen in great measure of cartilage. There are five principal ossifications. Intending to discuss fully the homologies of the carpal bones of the Cetacea with those of the terrestrial mammals in my Osteography of the genus *Physeter*, I will only say here that these appear to represent:—1 the scapho-trapezium, 2 the lunar, 3 the cuneiform, 4 the unciform, and 5 the magno-trapezoid. They have probably been somewhat disturbed from their natural position by unequal shrinking of the surrounding cartilage in drying. In addition to these five, an oval bone (6) projects from the ulnar border of the carpus, which must represent the pisiform bone, although considerably displaced from its normal situation. The bone which appears to belong to the second row of the carpus near the radial border, and which might well be taken for a trapezium, is probably the first metacarpal, as already determined in other Cetaceans by Cuvier, Gegenbaur, and Van Bambeke.

The digital portion of the hand consists of five fingers of moderate length, and spreading somewhat from each other. The second digit is the longest, the third nearly approaches it, the fourth and fifth are much shorter. It is possible that the terminal phalanges of the digits are not present in every case, especially as they do not always ossify before the animal has attained a considerable age; but the following are the numbers of the phalanges present, exclusive of the metacarpals:—I. 1, II. 5, III. 4, IV. 2, V. 2. The individual phalanges are thus not numerous; but they are long in proportion to their breadth.

From the humerus downwards the pectoral limb of *Inia* presents considerable resemblance to that of *Platanista*, both agreeing in the great length of the humerus as compared with the forearm, and in the absence of the olecranon process. In the carpus, to judge by Eschricht's figure, some differences of detail may be found. They agree in the comparative length and slenderness of the phalanges and spread of the fingers; but *Platanista* differs from *Inia* and all the other Dolphins in the nearly equal development of the four outer digits, giving the remarkable truncated form to the termination of the extremity.

The pelvic bones have unfortunately not been preserved with the skeleton. They are also unknown in *Platanista*.

II. *On the Skull of* Pontoporia blainvillii.

In the Museum at the Jardin des Plantes, Paris, is the skull of a small Dolphin brought by M. de Fréminville, an officer in the French navy, from the neighbourhood of Monte Video, at the mouth of the Rio de la Plata. This was first described by Professor P. Gervais, in the 'Bullet. de la Soc. Philomathique de Paris,' 1844, (27 Avril) p. 38, as *Delphinus Blainvillei*; also in 'l'Institut,' of the same year.

In the part of the 'Zoology of the Voyage of the Erebus and Terror' devoted to the Cetacea, published in 1846, Dr. Gray gave a figure and brief description of this skull, and constituted the genus *Pontoporia* for the reception of the animal to which it belonged.

Professor Gervais, in the description of the "Mammifères" of d'Orbigny's 'Voyage en Amérique Méridionale,' published in 1847, but the introduction to which bears the date of December 1846, redescribed and figured the skull (plate 23), pointing out that its peculiarities were sufficient to entitle it to rank as a subgenus, for which the name of *Stenodelphis* was proposed. In the same plate a figure is given of a long-beaked Dolphin, observed by d'Orbigny off the coast of Patagonia, but of which no portion was brought home; and a conjecture is thrown out that this Dolphin belonged to the same species as the skull presented to the Museum by M. de Fréminville. Although this is a mere assumption, and not a very well founded one, as even the colour does not correspond with the brief description given by M. de Fréminville*, it has unfortunately been treated as a certainty in most systematic works†, and thus *Pontoporia*, the skull of which shows such near affinities with those of the river-Dolphins *Inia* and *Platanista*, and which from its only known habitat may be wholly or partially fluviatile, and of which the external form is entirely unknown, is now regularly installed in zoological literature as an oceanic Dolphin with a high falcate dorsal fin!

A few weeks ago, and after the whole of the foregoing description of the skeleton of

* "D'après un renseignement favori par M. de Fréminville, le Dauphin dont provient ce crâne, est long de quatre pieds, et il est blanc, avec une bande dorsale noire."

† See Gervais, Hist. Nat. des Mammifères (1855), vol. ii. p. 322; Gray, Cat. Seals and Whales, Brit. Mus. (1866) p. 231.

Inia was written, a second skull of *Pontoporia*, also from the mouth of the Rio de la Plata, was received at the British Museum, as a present from Dr. Hermann Burmeister, of Buenos Ayres. With his wonted liberality, Dr. Gray immediately informed me of its arrival, and has permitted me to add to the description of the skull of *Inia* a comparison with this nearly allied form.

The skull (Pl. XXVIII.) is that of a perfectly adult animal. The sutures are partially obliterated, and the bones are compact and heavy. Many of the teeth are broken, some having been lost during life and the alveoli filled up; the remainder are considerably worn at the points. The rostrum is curved downwards towards the extremity, much more so than in the Paris specimen; this is probably the effect of age, as a similar change takes place in *Inia* and some other Dolphins. The mandible partakes also of this curve. The small, rounded and depressed cranium, and very long, narrow and compressed beak, give a remarkable appearance to this skull, reminding one, as Gervais remarks, of the head of a scolopacine bird.

The principal dimensions are:—

Extreme length	15″·8
Length of rostrum (from anterior end of premaxillary to bottom of antorbital notch of maxillary)	11·2
From anterior end of premaxillary to lower edge of nasal bones	13·5
Greatest breadth (across zygomatic process of squamosals)	4·8
Breadth of foramen magnum	1·1
Breadth of occipital condyles	2·4
Breadth across antorbital processes of frontals	2·6
Breadth of rostrum at base	1·8
Breadth of rostrum at middle	0·6
Mandible, length	13·7
Mandible, length of symphysis	8·0
Greatest breadth posteriorly	4·5
Height at the coronoid process	2·3

The supraoccipital is broader and shorter than in *Inia*, terminating in front by a much more open angle, and on each side in a low ridge, coming in close contact with the broad posterior extremities of the suprafrontal plates of the maxillaries. In the ankylosed condition of the bones it is impossible to say whether any of the frontal intervenes between them. The temporal fossa resembles that of *Inia* in its extent and form. The zygomatic process of the squamosal is proportionally longer, and meets the postorbital process of the frontal. The relative forms of the parietal, squamosal, and frontal bones, as they appear in the temporal fossa, more resemble those of *Platanista* than of *Inia*; but a narrow piece of the parietal prevents the union of the frontal and squamosal below. The alisphenoid is concealed by a plate of the pterygoid, which articulates with all three bones just mentioned.

The orbit is slightly larger in proportion to the length of the cranium than in *Inia*, and therefore considerably more so than in *Platanista*. The upper margin forms a wider arch than in the former; the postorbital process is broader and shorter; the antorbital tuberosity much smaller, but still chiefly formed by the malar bone. The styliform processes are unfortunately broken off.

The upper surface of the skull is remarkably flat, showing scarcely a trace of the postnarial elevation. On this surface the frontal bones appear in a narrow, slightly raised median piece behind the nasal bones, ·7″ long, and ·5″ wide, bounded laterally by the posterior extensions of the maxillaries—and on each side in the supraorbital plates, of which a much broader piece is left uncovered by the maxillaries than in *Inia*. The nasals are flattened, irregularly quadrate plates, as in *Inia*, but, in consequence of the direction of the frontals, lying nearly horizontally instead of vertically.

The narial aperture is broader, but shorter, than in *Inia*, being encroached upon by the largely developed antenarial tuberosities of the premaxillaries, which are broader and flatter on the surface than in *Inia*. The upper obtusely pointed ends of the premaxillaries extend to a level with the inferior border of the nasals, but do not articulate with them, as a strip of the maxillary comes between. The hinder ends of the maxillaries are broader and flatter than in *Inia*; but in front of the nostrils they are much more contracted, and above the orbits have a small but distinct longitudinal crest, ·3″ high at the middle and gradually subsiding at the ends. This is not a mere elevation of the edge of the bone, as in *Inia*, but a distinct ridge placed some way within the suture between the maxillary and the orbital plate of the frontal, and of which there is no trace in *Inia*. Between this crest and the elevated portion of the premaxillary there is a very deep and narrow fossa, continuous in front with an extremely narrow but deep groove, which lies between the maxillary and premaxillary along the entire length of the rostrum, and which is only faintly indicated in *Inia*. The rostrum is considerably longer and narrower in proportion to the size of the cranium than in *Inia*.

The palate-bones resemble those of *Inia* in not covering the vomer in the middle line. They have a small free external plate. Unfortunately the greater part of the pterygoids is broken away; but enough remains to show that these bones do not conform to the type of the ordinary Dolphins, but are arranged in a peculiar manner, apparently intermediate between those of *Inia* and *Platanista*. A broad outer lamella, resembling that so characteristic of *Platanista*, remains on each side, and, though not covering the palatine anteriorly as in that genus, passes upwards and outwards to the temporal fossa, overlying the alisphenoid and articulating with the squamosal, parietal, and frontal

The petrotympanic bones are wanting on both sides, showing that their mode of attachment resembles that of *Inia* rather than that of *Platanista*.

The mandible resembles that of both *Inia* and *Platanista*, and is intermediate between the two in narrowness and comparative length of the symphysis. Its osseous substance is very dense, and the two rami are completely ankylosed at the symphysis. Running along each side of the symphysial portion is a deep and narrow groove, corresponding to that on the rostrum between the maxillary and premaxillary.

The teeth are implanted in distinct alveoli. As many have been lost from the anterior part of the lower jaw during life, and the sockets completely filled up, their number cannot be estimated with perfect accuracy, but it may be estimated as follows: $\frac{57-56}{54?-54?}=221?$. All have broad fangs, much compressed laterally, surmounted by a crown, the base of which, when seen from above, is of a quadrilateral form, with the angles rounded off, longer from before backwards than from side to side; this suddenly contracts into a slender subconical apical portion, much compressed in the opposite direction, and slightly incurved at the apex, which is worn off in nearly all the teeth of this old specimen. The enlarged base of the crown, which forms a sort of cingulum, is slightly granulated on the surface, and in the natural state is entirely concealed within the gum. The projecting contracted portion has a smooth glossy surface. The teeth vary but little in size or form throughout the whole series of both jaws. The dimensions of one taken from the middle of the lower jaw are:—

Length of fang	·15″
Length of crown	·24
Antero-posterior breadth of cingulum	·17
Transverse breadth of cingulum	·11
Antero-posterior breadth of apical part at middle	·05
Transverse breadth	·10

This peculiar form of the teeth, which distinguishes *Pontoporia* from all the ordinary Dolphins, and affords another evidence of its affinity with *Inia*, has not been observed in the Paris specimen. Gervais's description is as follows:—"Les dents * * * * sont petites, longues de 5 ou 6 millimètres au plus, toutes plus ou moins aiguës, et au nombre de 53 ou 54 supérieurement, ainsi qu'inférieurement. Les postérieures sont un peu moins aiguës que les autres, et leur partie terminale est un peu recourbée."

The Paris skull, moreover, according to the figures, has a less elongated and slender rostrum than the present specimen—a difference which may certainly depend on age, presuming that the two animals belong to the same species.

III. *On the Systematic Position of* Inia *and* Pontoporia *in the order* Cetacea.

The foregoing sketch of the principal osteological features of *Inia* shows that this Cetacean presents peculiarities sufficient to constitute it a well-marked genus among the Dolphins. Its natural position in the order, and its affinities, however, can only be determined when a complete and satisfactory classification of the entire group can be arrived at. The requisite materials for accomplishing this are at present wanting. The anatomy of many distinct forms is still but imperfectly known; and moreover it is probable that there are many others existing as yet undiscovered. We know enough, however, to arrive at certain general conclusions. The larger natural divisions may be indicated with tolerable certainty; and when the extent and limits of these become generally recognized, much will have been done towards clearing the ground for future observation. We shall at least be spared from the irrelevant comparisons, between objects essentially dissimilar, with which anatomical treatises on the Cetacea are too often encumbered.

Before proceeding further with this part of the subject, I would remark, in passing, that several resemblances pointed out above between the skeleton of this Cetacean and that of the Sirenia, according singularly with d'Orbigny's observations upon its external form and habits, can scarcely be regarded as evidences of affinity; they only add somewhat to the numerous morphological analogies between the members of these essentially distinct orders.

The interval which separates the Whalebone-Whales from all the Whales with teeth, in almost every point of their structure, is far greater than can be found between the most widely divergent forms of the latter. Hence the division of the Cetacea into several primary groups or families, of which the Whalebone-Whales constitute one, and are therefore treated as equivalent to some of the minor groups of the Toothed Whales, is quite inadmissible. The recognition of two great and distinct groups (suborders) is the first requisite to a right appreciation of the classification of the Cetacea.

The principal distinctive characters of these two groups were defined in a former paper *. Increased knowledge of their structure, especially of the *Odontoceti*, has rendered some slight modifications of these characters necessary. They may at present stand thus:—

1. MYSTACOCETI or BALÆNOIDEA. Teeth never functionally developed, but always disappearing before the close of intra-uterine life. Upper jaw provided with plates of baleen. Olfactory organ distinctly developed. External respiratory aperture double. Skull symmetrical. Maxilla produced in front of, but not over, the orbital process of the frontal. Lachrymal bones small and distinct from the jugal. Rami of mandible arched outwards, their anterior ends meeting at an angle, and connected by fibrous tissue, without any true symphysis. Sternum composed of a single piece, generally broader than long, and connected only with the first pair of ribs. No costo-sternal bones. All the ribs at their upper extremity articulating only with the transverse processes of the vertebræ; their capitular processes, when present, not articulating immediately with the bodies of the vertebræ.

* Proc. Zool. Soc. 1864, p. 388.

2. ODONTOCETI or DELPHINOIDEA. Teeth always developed after birth, and generally numerous, sometimes few and early deciduous. No baleen. Olfactory organ rudimentary or absent. External respiratory aperture single. Upper surface of the skull generally, if not always, unsymmetrical. Hinder end of the maxilla expanded, and covering the greater part of the orbital plate of the frontal bone. Lachrymal bone either inseparable from the jugal or, when distinct, very large and forming part of the roof of the orbit. Rami of mandible nearly straight, much expanded in height posteriorly, and coming into contact in front by a surface of variable length, but always constituting a true symphysis. Sternum almost always composed of several pieces placed one behind the other, and always connected with several pairs of ribs, either by cartilage or by distinct costo-sternal bones. Many of the ribs with capitular processes developed, and articulating with the bodies of the vertebræ.

It is not necessary to pursue further the arrangement of the *Mystacoceti*, as it has no direct bearing upon the subject of this memoir, and as moreover I have no reason to make any alteration in the divisions into families and genera sketched out in the paper above referred to.

The subdivision of the *Odontoceti*, according to their structural affinities, presents at first sight considerable difficulty. To relate all the various attempts, more or less successful, that have been made to unravel this problem would be out of place here. I will only add one more to the number, founded chiefly on an examination of the osteological characters of the principal members of the group*.

In seeking for some starting-point from which to commence the formation of a natural division of the Toothed Whales, one has occurred to me which I have not found hitherto noticed. The strong and well-defined bones which connect the ribs with the sternum, ossified even at birth, common to the Porpoise, true Dolphins, and their nearest allies, are represented even in the adult *Hyperoodon* by an entirely unossified cartilage. In the four skeletons of *Physeter macrocephalus* that I have had the opportunity of examining, I have looked in vain for sterno-costal bones, some of which would certainly have been preserved if they approached in relative magnitude and density those of the true Dolphins. In answer to my inquiries on the subject, Dr. George Bennett has kindly informed me that, in both the skeletons of the genus *Kogia*, now mounted in the Sydney Museum, the cartilages are unossified; and I am indebted to Professor Van Beneden for similar information respecting the skeleton of the ziphioid *Micropteron* preserved in the Zoological Museum at Brussels. From these facts, I think that we may safely infer that the absence of ossified sternal ribs is a character common to the large natural group which includes *Physeter*, *Hyperoodon*, and the Ziphioids. To

* The arrangement here proposed nearly coincides with that arrived at by Professor Huxley and myself, when discussing this subject together before the delivery of the course of Hunterian Lectures at the Royal College of Surgeons for the present year (see 'Lancet,' 1866, vol. i. p. 381).

these may also be added *Platanista* and *Inia*. Here, then, is a character derived from a part of the organization apparently less liable to adaptive modification than the teeth or fins, which may be taken as the basis of a primary division. It must now be seen whether the remaining essential structural modifications are in accordance with it. Still confining our attention to the axial skeleton, there are certain tolerably obvious peculiarities about the vertebral column, more especially in the thoracic region, that will afford considerable assistance. As before indicated (p. 98), a peculiar mode of attachment of the ribs to the vertebræ is constantly found associated with the sterno-costal bones. The genera thus characterized may therefore be separated at once as a distinct natural group. They have also several minor characters in common, which will be pointed out presently.

Should the whole of the genera with cartilaginous sternal ribs be united into a single group, equivalent to that just marked off? I am inclined to think that they should not. To revert to the same point of structure just mentioned, it was shown before that *Physeter* and *Hyperoodon* agree in a very peculiar condition of thoracic vertebræ and rib-attachments. Whether *Kogia* and the Ziphioids conform with their nearest allies in this respect I am not at present able to say; but we may assume with tolerable certainty that they do. But here, as well as in many more trivial characters, including the teeth and pectoral limbs, *Inia* and *Platanista* differ—and differ, as it appears to me, more than any of the true Dolphins do, *inter se*. I would therefore raise the Cachalots and Ziphioids on the one hand, and *Platanista* and *Inia* on the other, to the rank of primary divisions of the Toothed Whales. With the latter it is in the highest degree probable that the genus *Pontoporia* should be associated. This group is not so compact and easily defined by positive characters as the other two, between which it naturally stands. The two genera whose structure is most completely known vary widely from each other, one diverging towards the Physeteridæ, the other towards the Delphinidæ, yet distinctly marked off from either. The validity of the group as a natural one will be greatly strengthened if the skeleton of *Pontoporia* should be found to possess the characters common to *Platanista* and *Inia**. It would be interesting, moreover, if it should be discovered that this Dolphin is, like the members of the other two genera, habitually fluviatile†.

* Dr. Gray in the "Zoology of the Voyage of the Erebus and Terror" placed *Inia* and *Pontoporia* in one section at the end of the family Delphinidæ, following immediately upon *Platanista*. In his recently published Catalogue, *Platanista* constitutes the fourth family (Platanistidæ) of the Cetacea, following the Catodontidæ; *Inia* forms a separate (the fifth) family, Iniidæ; and *Pontoporia* commences the sixth family (Delphinidæ), comprising all the remaining Dolphins except the Globiocephalidæ and the Ziphiidæ.

Gervais (Hist. Nat. des Mammifères, 1855) unites *Platanista, Inia,* and *Stenodelphis* (*Pontoporia*) to form one of the five tribes (*Platanistins, Delphinins, Orcins, Monodontins,* and *Phocénins*) into which the family *Delphinidés* is divided. The primary divisions of the order or families are:—*Physéteridés, Ziphiidés, Delphinidés,* and *Balénidés*.

† It is to be hoped that Dr. Burmeister may be able to obtain information on this point. I should mention

I will now endeavour to formularize the distinctive characters of these three primary groups of the ODONTOCETI, giving them the rank of families.

1. PHYSETERIDÆ. Costal cartilages not ossified. The hinder ribs losing their tubercular and retaining their capitular articulation with the vertebræ. The greater number of the cervical vertebræ ankylosed together. Pterygoid bones thick, produced backwards, meeting in the middle line, and not involuted to form the outer wall of the postpalatine air-sinus. Symphysis of mandible of moderate or excessive length. No functional teeth in upper jaw. Mandibular teeth various, often much reduced in number. Lachrymal bones usually large and distinct. Bones of the skull raised so as to form an elevated prominence or crest behind the anterior nares. Orbit of small or moderate size. Pectoral limbs small. Dorsal fin usually present.

II. PLATANISTIDÆ. Costal cartilages not ossified. The tubercular and capitular articulations of the ribs blending together posteriorly. Cervical vertebræ all free. Pterygoid bones thin, not conforming in their mode of arrangement with either of the other sections. Jaws very long and narrow; both with numerous teeth having compressed fangs. Symphysis of mandible very long, exceeding half the length of the entire ramus. Orbit very small. Lachrymal bones not distinct from the jugal. Pectoral limbs large. Dorsal fin rudimentary*.

III. DELPHINIDÆ. Costal cartilages firmly ossified. Posterior ribs losing their capitular articulation, and only uniting with the transverse processes of the vertebræ by the tubercle. Anterior (2–6) cervical, in most, ankylosed together. Pterygoid bones short, thin, involuted to form, with a process of the palatine bone, the outer wall of the postpalatine air-sinus. Numerous teeth in both jaws (*Monodon* excepted), sometimes deciduous. Symphysis of mandible short or moderate, never exceeding one-third the length of the ramus. Bones of the skull not raised into a distinct crest behind the anterior nares. Orbit of moderate size. Lachrymal bone not distinct from the jugal. Pectoral limbs varying much in form and size. Dorsal fin usually present.

I. The *Physeteridæ* appear to constitute a very natural group†. This may, however, be divided into two well-marked subfamilies:—

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that Mr. Darwin has informed me that he met with no evidence of the existence of a freshwater Dolphin in the La Plata system of rivers, and that no mention is made by Azara of any such animal.

* These characters are subject to modification when more is known of the structure of *Pontoporia*.

† Van Beneden insists strongly upon the close affinity of *Physeter* with the Ziphioids: he says, "Comme on le voit, les Cachalots sont pour nous des Ziphioïdes véritables, portant une rangée de dents fortes et espacées sur chaque branche de maxillaire" (Mém. sur une Nouv. Espèce de *Ziphius*, Mém. de l'Acad. Royale de Belgique, t. xvi. 1863).

1. *Physeterinæ*, characterized by the numerous teeth in the lower jaw, and having no distinct lachrymal bone, including the genera *Physeter* and *Kogia* (Gray)*.

2. *Ziphiinæ*, with only one or two pairs of teeth in the lower jaw (besides the rudimentary concealed teeth), and a distinct lachrymal bone. This includes *Hyperoodon*, *Berardius*, *Ziphius*, *Micropteron*, *Dioplodon*, and several extinct forms.

II. The two best-known genera of the *Platanistidæ* must each be placed in a distinct subfamily, characterized thus:—

1. *Platanistinæ.* Maxillary bones supporting large bony incurved crests. No cingulum or tubercle at the base of the crown of the teeth. Pectoral fins truncated. Visual organs rudimentary. External respiratory aperture longitudinal, linear.

2. *Iniinæ.* Maxillary crests absent, or very slightly developed. Many of the teeth with a complete cingulum or a distinct tubercle at the base of the crown. Pectoral fin ovate, obtusely pointed.

The position of *Pontoporia* cannot be definitely determined until more is known of its general structure; but as its cranial and dental characters accord most nearly with those of *Inia*, it may be placed provisionally in the same subfamily.

III. Although the *Delphinidæ* present considerable diversity in the characters of their dentition, in the relative length of the rostral part of the skull, in the form and structure of the pectoral limb, and in the form and size of the dorsal fin, it is by no means easy to subdivide them into natural groups. It is even difficult to define neatly the distinguishing characters of the genera, so much do they blend one into the other.

The Narwhal and the *Beluga* appear to separate themselves from all the rest, by certain well-marked structural conditions, especially the characters of the cervical vertebræ. As these two animals are in almost every part of their skeleton nearly identical, even to the number of the vertebræ and phalanges, I am disposed to look upon the exceptional dentition of the former as an aberration of secondary importance, and to unite the two genera into a distinct subfamily, placing it next to the *Platanistidæ*. Among the remaining genera, none stand out in equal prominence. We must either group them together in one subfamily or make almost as many subfamilies as there are genera. For the present I prefer adopting the former course. *Phocæna* and *Neomeris* stand by themselves in the form of their teeth and certain cranial characters. *Orca* is distinguished from all the others by its excessively broad manus, and *Globiocephalus* by the extreme length and narrowness of the same member. *Delphinus* and its allies are characterized by the long narrow rostrum and numerous teeth. Each of these genera might

* A genus quite distinct from *Physeter*. It has also been called *Euphysetes* (Wall. Descr. New Sperm Whale, &c., 1851); but Gray's name (Zool. Erebus and Terror, 1846) clearly has the priority.

easily be made the type of a distinct subfamily, were it not for the difficulty of placing the numerous osculant forms, *Pseudorca*, *Grampus*, *Lagenorhynchus*, &c.

In the following tabular view of the arrangement of the Cetacea, many of the genera lately formed, chiefly by subdivision of the old genus *Delphinus*, are not introduced. It must not be be inferred from this that I question their validity, though such as are founded on skulls alone may require revision when the entire skeleton is known. But as the present object is to determine the position of *Inia* and *Pontoporia* in the order, it is only necessary to mention the well-established and generally recognized generic divisions.

Order CETACEA.

Suborders.	*Families.*	*Subfamilies.*	*Genera.*
I. Mystacoceti* or Balænoidea.	Balænidæ	Balæninæ	Balæna. Eubalæna.
	Balænopteridæ	Megapterinæ	Megaptera.
		Balænopterinæ	Physalus. Sibbaldius. Balænoptera.
II. Odontoceti† or Delphinoidea.	Physeteridæ	Physeterinæ	Physeter. Kogia.
		Ziphiinæ	Hyperoodon. Berardius. Ziphius. Dioplodon. Micropteron.
	Platanistidæ	Platanistinæ	Platanista.
		Iniinæ	Pontoporia ? Inia.
	Delphinidæ	Beluginæ	Monodon. Beluga.
		Delphininæ ?	Phocæna. Neomeris. Grampus. Orca. Pseudorca. Lagenorhynchus. Delphinus. Delphinapterus. Globiocephalus.

* μύσταξ, κῆτος; equivalent to the German "Barten-Walle."

† ὀδοὺς, κῆτος.

DESCRIPTION OF THE PLATES.

The figures in Plates XXV., XXVI., and XXVII. are drawn from the skeleton of the young *Inia geoffrensis* described above.

PLATE XXV.

Fig. 1. Upper surface of the cranium and vertebral column of *Inia geoffrensis*. One-fourth the natural size.

Fig. 2. Side view of the skull and vertebral column. One-fourth the natural size.

Fig. 3. Bones of the right pectoral limb. Half the natural size.

PLATE XXVI.

Fig. 1. Inferior surface of the cranium of *Inia geoffrensis*. Half the natural size.

Fig. 2. Superior surface of the mandible. Half the natural size.

Fig. 3. A maxillary tooth from the left side, the fourth from the posterior end of the series. Natural size.

Fig. 4. The basi- and thyro-hyals. Half the natural size.

Fig. 5. One of the stylo-hyals. Half the natural size.

PLATE XXVII.

Details of the osteology of *Inia geoffrensis*. All the figures half the natural size.

Fig. 1. Anterior surfaces of the seven cervical vertebræ.

Fig. 2. The thirteen ribs of the right side.

Fig. 3. Side view of the sternum.

a. Anterior process.
b. Lateral process.
c. Surface for attachment of cartilage of first rib.
d. Surface for attachment of cartilage of second rib.

Fig. 4. Internal surface of sternum.

Fig. 5. External surface of sternum.

PLATE XXVIII.

Skull of adult *Pontoporia blainvillii*. All the figures (except fig. 5) half the natural size.

Fig. 1. Side view of cranium.

Fig. 2. Side view of mandible.

Fig. 3. Upper surface of cranium.

Fig. 4. Inferior surface of mandible.

Fig. 5. A maxillary tooth from the left side, the fourth from the posterior end of the series. Twice the natural size.

Fig 1.

1/4

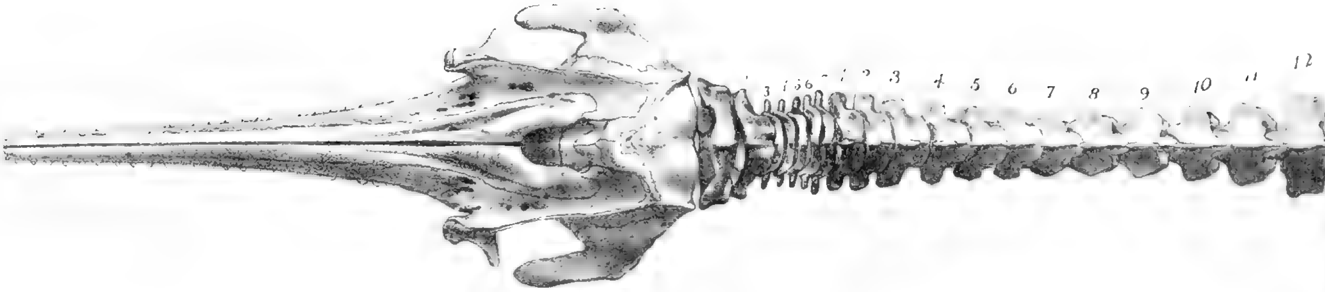


Fig. 3

1/2

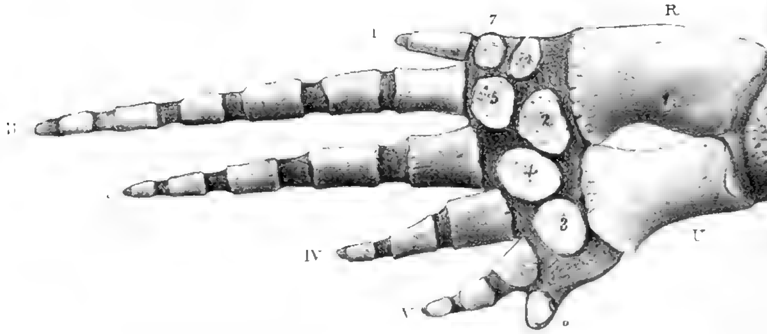
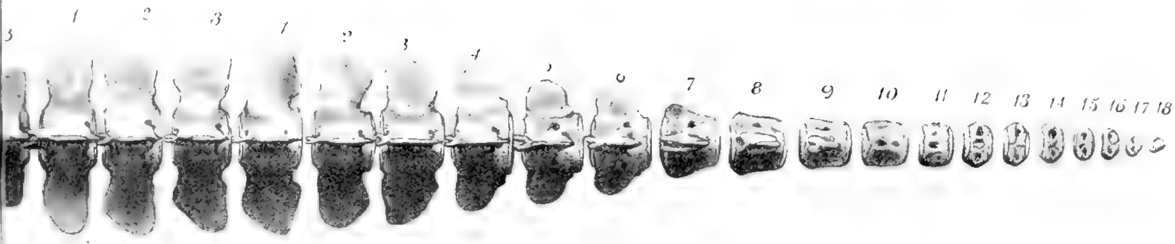


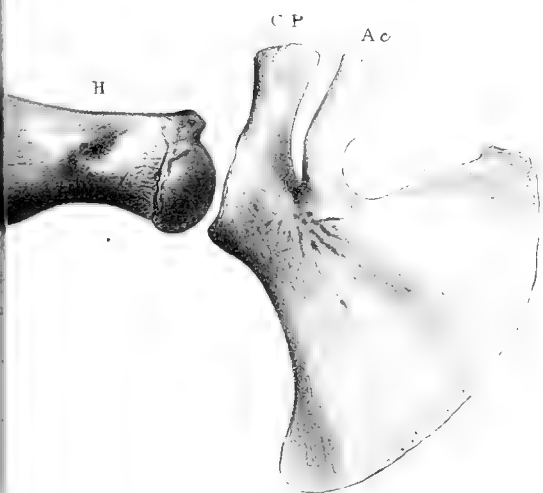
Fig 2.

1/4

J. Smit lith.

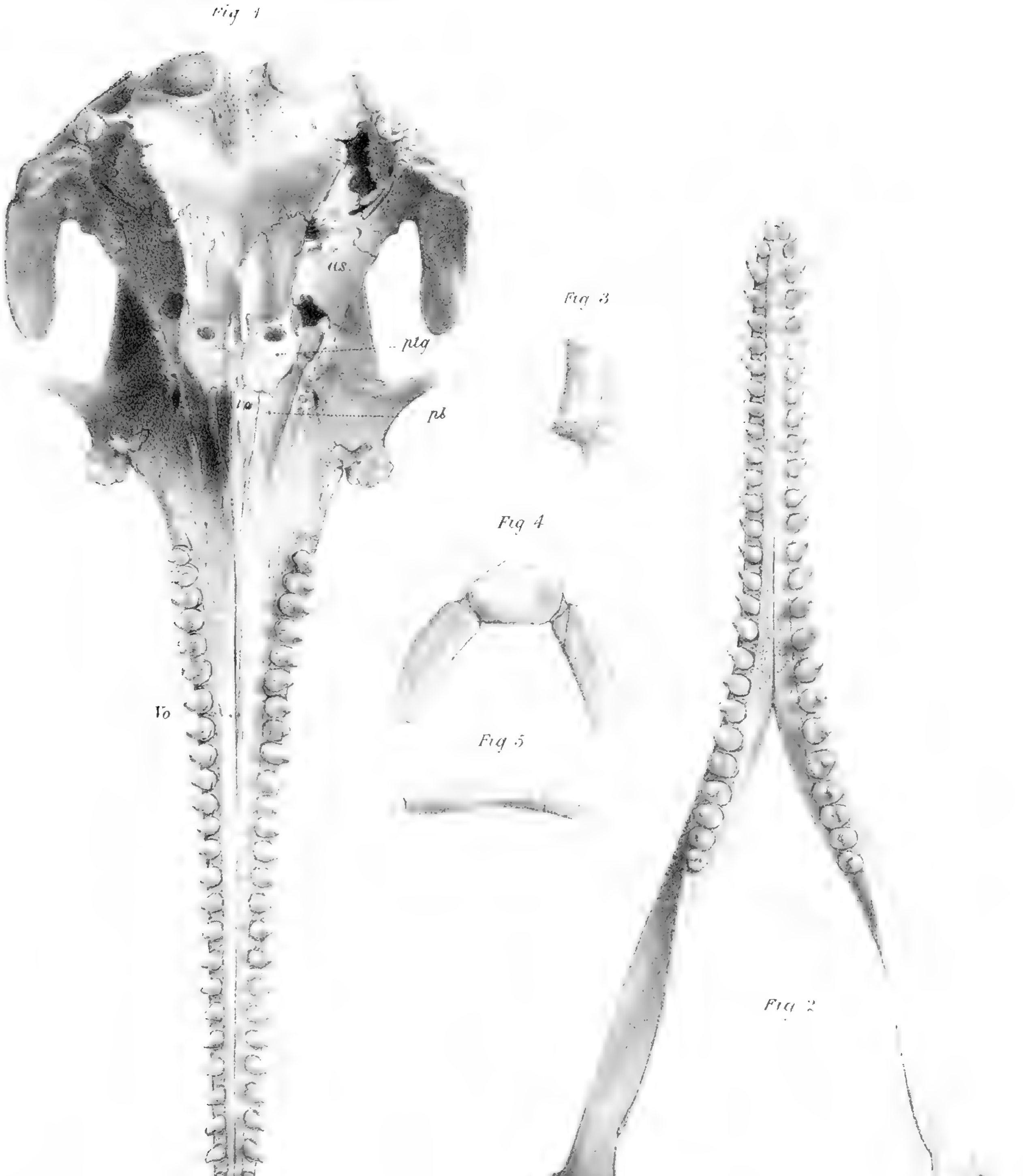
INIA GEOFFR





M & N Hanhart imp

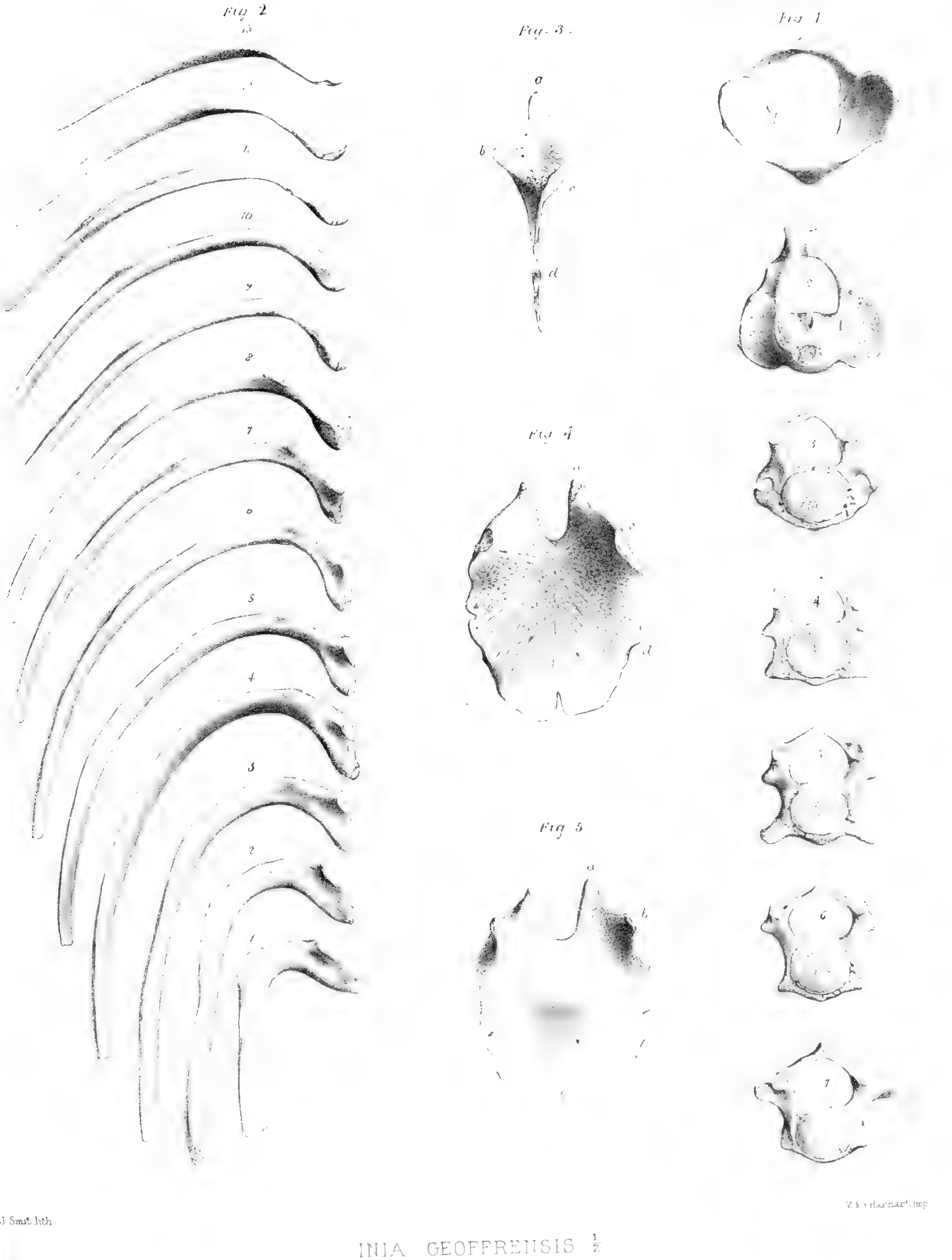
1/4



J. Smit lith.

M & N Hanhart imp

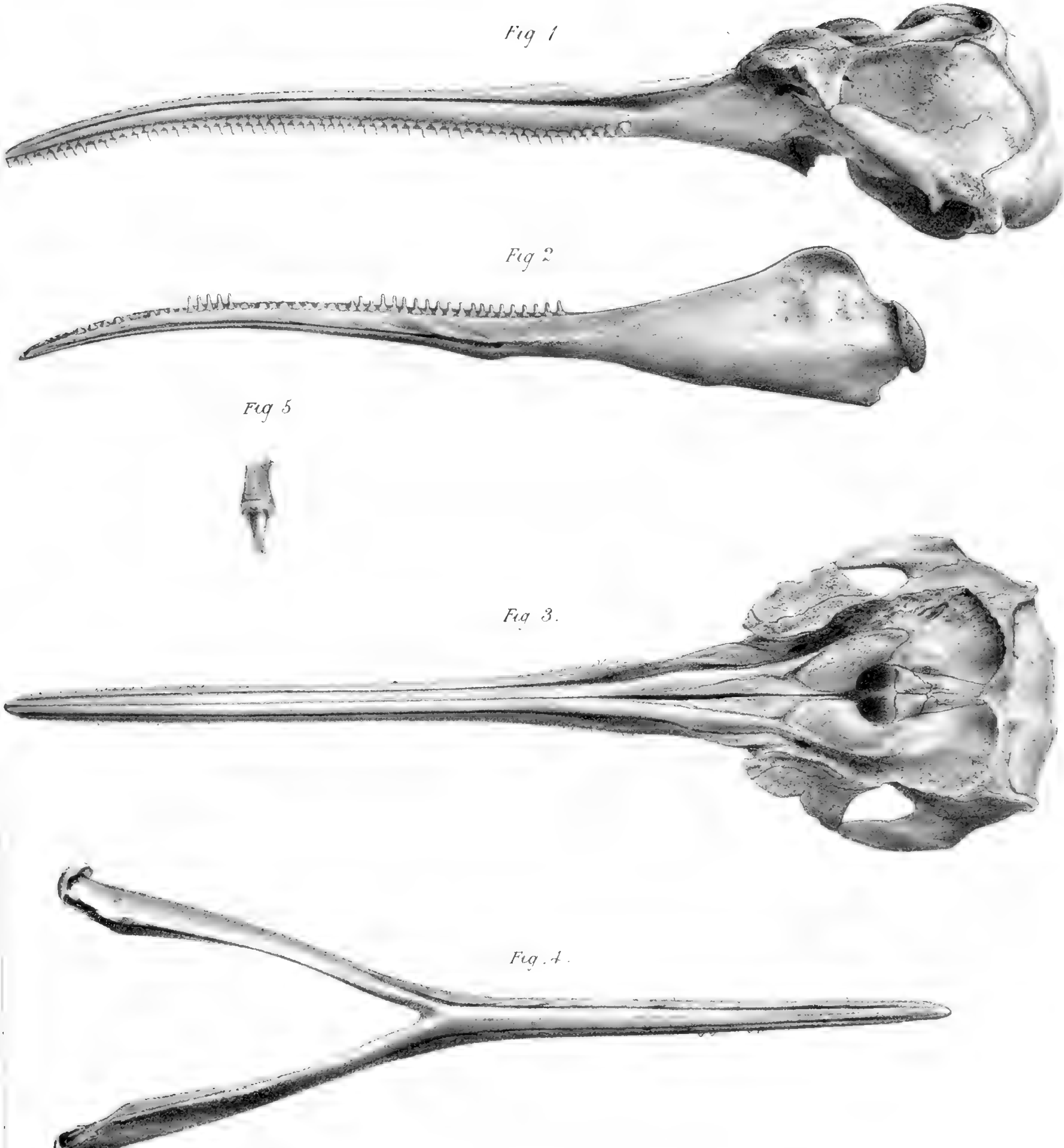
INIA GEOFFRENSIS. $\frac{1}{2}$



J. Smit lith.

Hanhart imp.

INIA GEOFFRENSIS ½



J. Smit lith.

M & N Hanhart imp

PONTOPORIA · BLAINVILLII. ½

V. *On a Raptorial Bird transmitted by* Mr. Andersson *from Damara Land.* *By* J. H. Gurney, *F.Z.S.*

Read November 14th, 1865.

[Plate XXIX.]

THE raptorial bird now exhibited has been recently sent to me, with some other birds collected in Damara Land, by my friend Mr. Charles J. Andersson, to whose exertions we have already been frequently indebted for valuable contributions to our knowledge of the ornithology of that part of South-western Africa.

Mr. Andersson remarks, with reference to the present specimen, which was procured at Objimbinque, Damara Land, on the 10th of March last, "I have only obtained this individual, a female, shot by my servant, who observed another, which was probably the male. I imagine I have once or twice observed this species near my place (Objim binque) just before dusk. I strongly suspect that it is a nocturnal or seminocturnal bird. I found only a Bat in the stomach of the specimen sent, of which the description and measurements are as follows:—

"Irides bright lemon-yellow; extremities of mandibles black; basal parts and gape bluish lead-colour; tarsi and toes bluish white; claws bluish black.

"Entire length 1 ft. $6\frac{2}{12}$ in.; length of wings when folded 1 ft. $1\frac{11}{12}$ in.; length of tarsus $2\frac{5}{12}$ in.; length of middle toe $2\frac{1}{12}$ in.; length of tail $7\frac{6}{12}$ in.; length of bill from corner of gape to the tip of the mandible, straight, $1\frac{9}{12}$ in."

To the above remarks of Mr. Andersson I have to add the following:—The colours of the plumage are dark brown mingled with pure white, the tint of the brown being very similar to that of a dark specimen of *Buteo vulgaris*; a very few feathers of a still darker tinge, however, are apparent on the occiput and back. With the exception of a line of white above and below the eye, the feathers on the upper part of the head are brown: this colouring extends slightly below the gape, and also over the whole of the upper surface of the bird, including the wings and tail; but the basal parts of the feathers on the upper part of the head, the nape, and back are white, though this is not apparent except when a feather is displaced; but this white becomes somewhat more visible where it is mingled with the brown, in the form of bars and spots, on all the feathers of the wings, both above and below, and including the upper and under wing-coverts, as also on the upper and under tail-coverts; the upper surface of the tail bears five transverse bars of a pale brown, which on the lower surface of the tail-feathers are white, and the tail is also very slightly tipped with dirty white. The throat is white, but is bisected for the upper three-fourths of its length by a brown medial line, starting from the angle of the lower mandible, and extending for about 3 inches in a straight line towards the sternum. The feathers of the breast and sides are of a mingled brown and white, the latter predominating in the vicinity of the throat.

The abdomen and inner sides of the thighs are white, the outer sides of the thighs are brown, the plumage of the thighs also extending over about one-fifth of the upper portion of the tarsus.

The occipital feathers are lanceolate and slightly darker (some of them being also a little longer) than the feathers of the adjacent plumage, thus presenting an appearance similar to that which is frequently to be observed in adult specimens of *Pernis cristatus.*

Of the primary feathers the third is the longest, the second next, then the fourth, the fifth, and the first successively; the points of the primaries, when closed, reach to within three-quarters of an inch of the tip of the tail.

The tail, which consists of twelve feathers, is very slightly forked, the centre feathers being the shortest, and the pair next to the outside pair the longest.

The bill is singularly small for the size of the bird; but the gape is very large, extending backwards till it reaches a point directly below the centre of the eye. Between the eye and the upper mandible a row of small bristles takes its rise, pointing towards and extending over the upper edge of the mandible as far as the nostrils, which are uncovered and of a narrow oval form. As in the case of the American Vultures, there appears to be no septum between the nostrils. The ridge of the upper mandible is remarkably keel-shaped, and there is a very noticeable depression intervening between it and the cutting-edge of the mandible, which latter is entirely destitute of anything in the nature of a tooth, a notch, or a festoon.

The tarsi and toes are slender in their character, and the scales with which they are covered are (with the exception of those covering the last joint of each toe) remarkably small. The middle toe, which is considerably elongated, has a prominent roughened pad below each end of the last joint; the inner toe is similarly provided, but with the hinder pad thrown further back; the outer toe has two of these appendages situated as those on the middle toe, and two others placed further back; the hinder toe has one large pad only, seated immediately behind the root of the claw.

The inner edge of the middle claw projects laterally, and appears to me to present a rudimentary pectination resembling that which is found in the Owls, a tribe to which the present species seems also to offer some resemblance in the form of its bill and the extent of its gape.

P.S. I had intended proposing the name of *Stringonyx anderssoni* for this singular form, supposing it to be undescribed; but, as has been pointed out by Mr. Bartlett since my paper was read*, it is no doubt identical with the *Machærhamphus alcinus* of Westerman†, the type of which is in the Museum at Leyden. The present specimen has been added to the collection in the Norwich Museum.

* Proc. Zool. Soc. 1866, p. 324.

† Westerm. Bijd. t. d. Dierk. i. p. 29.

J. Wolf del. et lith. MACHFIRHAMPHUS ALCINUS M & N Hanhart imp.

VI. *On some Fossil Birds from the Zebbug Cave, Malta.*
By W. K. Parker, *F.R.S., F.Z.S., &c.*

Read and received for publication Dec. 12th, 1865.

[Plate XXX.]

FIVE years have elapsed since I first examined numerous bony remains from the Zebbug Cave, the "lamellirostral" nature of which was apparent to Dr. Falconer and myself from the first. I transmitted a list of them to that lamented palæontologist for his and Captain Spratt's inspection, the latter gentleman having taken an active part in exhuming these treasures. A fresh examination of them has not changed my views as to their nature; and I can now refer to figures of the most important, drawn side by side with their counterparts in the common Swan (*Cygnus olor*). The specimen of this species, the bones of which I have used for comparison, was a fine old female, 5 feet long from the tip of the beak to the end of the tail, not so large as the male, but a large bird notwithstanding. As half or more of the fossil bones evidently belonged to a Swan about one-third larger than my specimen of the tame kind, it must have been a noble creature, and its extinction is to be deplored as much as that of the Dinornis and the Dodo.

Many of the bones belonged to a smaller kind than even the common mute species: it was about the size of a male Bewick's Swan, or the female of the Common Hooper (*C. musicus*); some, however, belonged to a bird as large as the male Hooper. There were also some bones of much smaller dimensions; these appear to have belonged to a small Bernicle, such as the *Bernicla brenta*.

On June the 10th, 1861 (the next summer), I received, through Professor Rupert Jones, another parcel of these bones; and last autumn Mr. Busk put into my hands the hinder part of the skull of the largest kind, which, with a few thigh-bones of the same species, he had received from Dr. Leith Adams, of Malta.

Altogether there are in my hands about three pounds' weight of fragments, amounting to several dozen in number. About one-fifth of these are indeterminable, on account of their worn and comminuted condition. The only bones quite perfect are phalanges; and, with the exception of the lower part of a *tibia* of the largest kind, which is $6\frac{1}{2}$ inches long, the pieces are from 1 to 4 inches in length. Mr. Erxleben suggests that they are the remains of feasts held by foxes—a very good suggestion, as far as I can see.

The specimens of bones belonging to the largest kind of Swan, which I propose to call *Cygnus falconeri*, in honour of the great palæontologist whose loss we have so lately suffered, are as follows:—

Skull (posterior fragment)	2	specimens.
Ribs (upper part)	3	,,
Ulna (middle)	1	specimen.
Femur (various parts)	12	specimens.
Tibia (various parts)	20	,,
Tarso-metatarse (various parts)	20	,,
Phalanges (perfect)	3	,,

Of the smaller kind of Swan (*Cygnus musicus*?) there are—

Cervical vertebra (2nd or 3rd)	2	,,
Sternum (anterior part)	1	specimen.
Scapula (proximal part)	7	specimens.
Humeri (various parts)	18	,,
Ulna (various parts)	7	,,
Radius (various parts)	7 or 8	,,
Metacarpus (various parts)	5	,,
Phalanx (proximal, perfect)	1	specimen.
Phalanx (distal, perfect)	2	specimens.
Sacrum (various)	3	,,
Femur (shaft-part)	2	,,
Tibia (various)	3	,,
Tarso-metatarse (various parts)	4	,,
Phalanges (perfect)	5	,,

Of the small Goose-bones (*Bernicla* ——?) there are—

Coracoid (head)	1	specimen.
Radius (distal and middle portions)	2	specimens.
Ulna (middle)	1	specimen.
Metacarpus (almost perfect)	1	,,
Femur (nearly perfect)	1	,,
Tibia (lower end)	1	,,

Some of these bones are of a beautiful ferruginous dark brown; others are of a light colour, like the clay in which they were imbedded.

Cygnus falconeri, Parker. Skull.

Dr. Leith Adams's specimen of this part of the great Swan came to hand too late to bə figured; I was able to make out that it belonged to a Swan nearly one-third larger tahn *Cygnus olor*, and to see the occipital plane, foramen, and condyle, as well as part of the parietal and temporal regions. With this specimen of the skull there were two or three fine " ossa femoris," which corroborated the conclusion I came to as to the skull belonging to *C. falconeri*; for the thigh-bones were the exact counterpart of those which had come earlier under my notice.

I annex a Table of measurements of the bones of *C. falconeri*, as compared with those of the large female *C. olor*:—

	C. olor.		*C. falconeri.*	
	inches.	lines.	inches.	lines.
Middle thoracic rib—				
a. Across the neck	0	5	0	6
b. Width of outer edge	0	3	0	4
Ulna—				
Diameter of shaft	0	5	0	7
Radius—				
Diameter of shaft	0	3	0	4
Femur—				
Across head and trochanter	1	1	1	5
Width of middle of shaft	0	5½	0	8
Width across lower condyles	1	0	1	5½
Tibia—				
Fore-and-aft width of head	1	5	1	9
Thickness of head	0	9½	1	2
Width of shaft	0	5½	0	8
Width across lower condyles	0	11	1	4½
Tarso-metatarse—				
Extreme length	4	3	5	3
Width across head	1	0	1	2½
Width across shaft	0	5	0	6
Width across condyles	1	0	1	4
Phalanx (proximal, middle)—				
Length	2	2½	1	7½
Thickness of proximal end	0	5⅔	0	7½
Thickness of shaft	0	3	0	4½

Mr. Erxleben's figures show very faithfully the perfect agreement, in everything but size, between the great extinct Swan and *Cynus olor*. The largest bones of *C. falconeri* are not, however, displayed in the Plate, for this reason, that the most perfect bones for figuring were apparently those of *females*; but there are bones still larger in the collection, most likely those of male birds.

The coarseness of these bones is well shown when the diploë is displayed (see Pl. XXX. figs. 10, 11 & 12), and the walls of the tibial diaphyses are a line and a half (one-eighth of an inch) thick in the stoutest specimens.

The Ribs.—The coarseness of the bones, and their great size as compared with those of the tame species, are well seen in the three fragments of ribs; they are, altogether, one-fourth larger than their counterparts in the living Swans.

The Ulna (Pl. XXX. figs. 4 & 5).—The diameter of the ulna, as seen in fig 5, is as 7 to 5 compared with fig. 5 *a*; and the strength of the shaft is well shown in fig. 4. The oblong quill-knobs, confluent by means of an elevated ridge, are well shown to be precisely alike in the extinct and the tame species.

The Femur (Pl. XXX. figs. 6, 7, 8, 9, 10 & 11).—These figures of the left femur, although not of the most massive specimens, give a good idea of the stoutness of this lost bird: its head, trochanter, shaft, and lower condyles are seen to be most exactly like those of the tame kind, save and except such intensification of the ridges and general surface-marking as is due to the origin and insertion of the muscles of a much mightier bird.

Tibia (Pl. XXX. figs. 12, 13, 14 & 15).—This, again, is evidently the bone of a female, as there are considerably larger specimens, although not so perfect, in the collection. Fig. 12 shows the strength of the shaft; fig. 13 is an anterior view of the distal end of the right tibia, showing the broad tendon-bridge and groove, the space for attachment of the fibula, and two depressions in the space for the precalcaneal knob, which are but faint in the tame kind. Fig. 14 shows the extent of the lower condyle as seen laterally on the inside, and fig. 15 its division into an inner and outer lobe.

Tarso-metatarse (Pl. XXX. figs. 16, 17, 18 & 19).—The length of this right shank is seen to be greater in proportion to its thickness than in the tame Swan; but their general agreement is most accurate.

The low precalcaneal knob, the postcalcaneal ridges, grooves, and bridge, and the form and relative proportions of the lower bifid condyles are well seen. There is, however, a passage, shown in the head of the shank of the tame Swan (fig. 19*a*), which does not appear in fig. 19: this mistaken *foramen* escaped me when examining the proof-plates; it was made by me in the tame Swan's bone for the purpose of syringing out the marrow.

The bony bridge uniting the outer and middle condyles (figs. 16, 17, 18) is seen to correspond beautifully in the two birds; the perfection of the figures exonerates me from detailed description.

Phalanges (Pl. XXX. figs. 20, 21 & 22).—There are only three phalanges which I can safely refer to the largest Swan; but they are very remarkable, being quite unlike what we see in the species of Swans still living; for fig. 20, as compared with fig. 20*a*, is seen to be full one-third thicker, and but little more than two-thirds the length. This is the case with the proximal phalanx of the great or middle toe; and the other two are quite similar in shortness and robustness.

If this shortness of the toes be remembered, along with the fact that the shank is longer in proportion than in the recent kinds, we shall see that the great extinct Swan was rather generalized in character, being somewhat of a Goose, possessing, as he did, longer legs and shorter toes than the typical Swans.

It would appear, however, that, like the gigantic Adjutant among the Storks, this bird had its wings of the full relative size: the immense ulna shows this (see Pl. XXX. figs. 1, 4 & 5).

As the feet were shorter, it is probable that the extinct bird was not so expert at *rowing* as the smaller but more elegant kinds; on land he may have shown better; and perhaps he was altogether more terrestrial.

It is worthy of remark, that the most generalized type of all the "Lamellirostres," viz. the *Palamedea*—that in which the lamellæ of the beak are arrested in their growth, and which has no webs to connect the toes—has the digits longer even than the Swans. This bird, however, is not unrelated to the Grallatorial "Macrodactyli."

Cygnus musicus (?).

The most important bone of those belonging to the smaller Swan, which, as the foregoing list shows, are very numerous, is the front part of the sternum. This fine fragment is well shown in Pl. XXX. figs. 1, 2, 3; and, besides exhibiting the separated coracoid grooves, anterior part of keel, costal process, condyles for sternal ribs, ridge for middle pectoral, &c., is especially interesting because of the well-displayed anterior part of the cavity for the wind-pipe. Fig. 3 shows the smooth, rounded cavity; fig. 2 part of its left wall; and fig. 1 the eminence caused by it on the midline of the sternum: the two rows of wind-passages are also well seen.

This, then, is the sternum of one of the Wild Swans, perhaps the greater species (*C. musicus*), perhaps *C. bewickii*, or, it may be, some species nearly allied to these. At any rate it is interesting to find that *C. musicus* is still to be found in lands bordering the Mediterranean, the Rev. H. B. Tristram having, in his last travels, received it from Solomon's Pool, near Jerusalem (see Proc. Zool. Soc., 1864, p. 453).

The similarity of the bones in the species of Swans is so great that I feel it to be unnecessary to describe the rest of the bones of the smaller kind; they are nearly all fragmentary, like those of *C. falconeri*, and the fragments are in the same good condition. The birds which owned these bones varied in size from that of a small female tame Swan to that of a medium-sized Black Swan; yet the difference is scarcely more than *varietal* and *sexual*. There may have been more than two species buried in the Zebbug Cave; but we lack positive evidence.

The smallest "lamellirostral" bones are intermediate in size between those of the Wild Goose (*Anser cinereus*) and those of the Mallard (*Anas boschas*); so that they may have belonged to a small female Bernicle, such as the black-faced kind (*Bernicla brenta*).

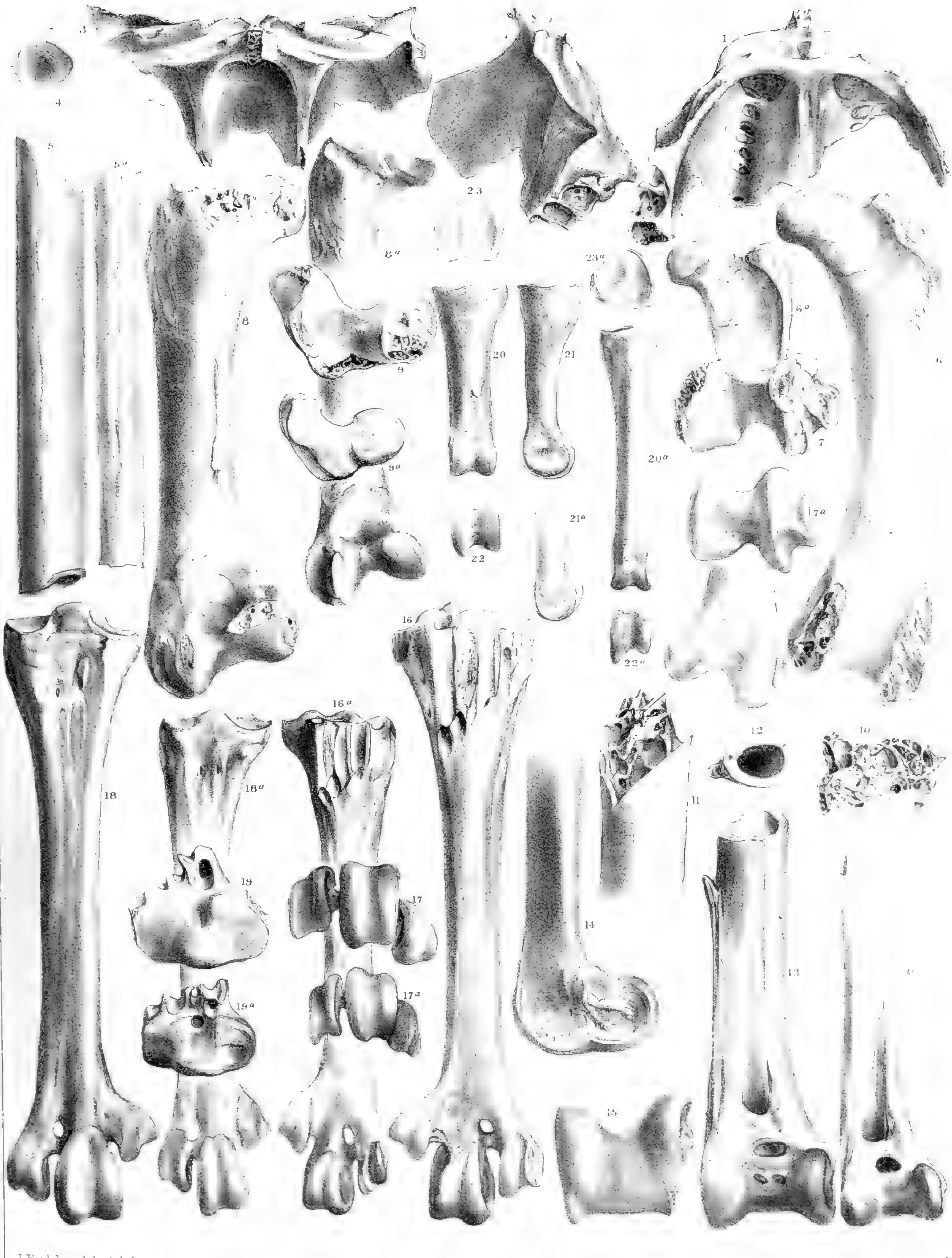
But, few as these are, they probably belonged to two kinds; for the femur and tibia are relatively larger than the coracoid and metacarpus: these latter bones are not larger than those of a good-sized tame Duck (*A. boschas*).

DESCRIPTION OF PLATE XXX.

(N.B.—The figures are all of the natural size.)

Fig. 1. Anterior fragment of sternum of *Cygnus musicus* (?); upper view.
Fig. 2. Anterior fragment of sternum of *C. musicus* (?); side view.
Fig. 3. Anterior fragment of sternum of *C. musicus* (?); front view.
Fig. 4. Ulna of *C. falconeri*; end view of fragment.
Fig. 5. Ulna of *C. falconeri*; side view of fragment.
Fig. 5*a*. Ulna of *C. olor*; side view of fragment.
Fig. 6. Femur (left) of *C. falconeri*; front view.
Fig. 7. Femur (left) of *C. falconeri*; lower view.
Fig. 8. Femur (left) of *C. falconeri*; hinder view.
Fig. 9. Femur (left) of *C. falconeri*; upper view.
Figs. 6*a*–9*a*. Femur (left) of *C. olor*.
Figs. 10, 11. Femur of *C. falconeri*; fragments.
Fig. 12. Tibia (right) of *C. falconeri*; end view of fragment.
Fig. 13. Tibia (right) of *C. falconeri*; front view of distal end.
Fig. 14. Tibia (right) of *C. falconeri*; side view of distal end.
Fig. 15. Tibia (right) of *C. falconeri*; end view of distal end.
Fig. 13*a*. Tibia (right) of *C. olor*; front view of distal end.
Fig. 16. Tarso-metatarse (right) of *C. falconeri*; hinder view.
Fig. 16*a*. Tarso-metatarse (right) of *C. olor*; hinder view.
Fig. 17. Tarso-metatarse (right) of *C. falconeri*; lower view.
Fig. 17*a*. Tarso-metatarse (right) of *C. olor*; lower view.
Fig. 18. Tarso-metatarse (right) of *C. falconeri*; front view.
Fig. 18*a*. Tarso-metatarse (right) of *C. olor*; front view.
Fig. 19. Tarso-metatarse (right) of *C. falconeri*; upper view.
Fig. 19*a*. Tarso-metatarse (right) of *C. olor*; upper view*.
Fig. 20. Phalanx (proximal, of middle toe) of *C. falconeri*; upper view.
Fig. 20*a*. Phalanx (proximal, of middle toe) of *C. olor*; upper view.
Fig. 21. Phalanx of *C. falconeri*; side view.
Fig. 21*a*. Phalanx of *C. olor*; side view.
Figs. 22, 23. Phalanx of *C. falconeri*; end views.
Figs. 22*a*, 23*a*. Phalanx of *C. olor*; end views.

* The circular hole in this view is of artificial origin.



J. Erxleben, del et lith.

M & N Hanhart, Imp.

1–3 CYGNUS MUSICUS ? 4–23. C. FALCONERI, P.

VII. *Synopsis of the species of recent* Crocodilians *or* Emydosaurians, *chiefly founded on the specimens in the British Museum and the Royal College of Surgeons. By* Dr. JOHN EDWARD GRAY, *F.R.S., V.P.Z.S., F.L.S., &c.*

Read December 9th, 1862.

[PLATES XXXI. to XXXIV.]

THE distinction of the species of Crocodiles has hitherto been one of the difficult problems in systematic zoology; and therefore I believe that it may be of some slight use to lay before the Society the result of my examination of the very large collection of Crocodiles, of all ages and from various localities, which are contained in the British Museum. Knowing the difficulty that surrounds the subject, I have made great exertions to obtain specimens from different countries; and the examination of these specimens has shown that the characters of the species, when allowance is made for the changes that take place in the growth of the animal, are quite as permanent as in any other group of Reptiles, and not more difficult to define.

An outline of the synopsis of the Crocodilidæ or Alligatoridæ was published in the 'Annals and Magazine of Natural History' for 1861 (3rd series, vol. viii.). Since that period I have examined the additional specimens which have been received in the British Museum, and also those in other collections, especially the skulls in the Museum of the Royal College of Surgeons, the specimens in the two museums at Liverpool, and in other local collections within my reach. Among the specimens recently received by the British Museum are some typical skulls from the Dutch possessions in the East, obtained from Leyden, which enable me to determine with certainty the species described by the Dutch zoologists.

The determination of the species of the Crocodilians has always been attended with considerable uncertainty; and if we may judge by the manner in which the specimens and the skulls of them are named in Museums, or sent about by the more scientific dealers, it would appear that as yet they are not properly understood.

I do not mean as to the precise limit of a species—that is to say, whether the specimens from different districts of the same zoological or geographical province are mere local varieties of the same species, or are distinct; for that is a question which I admit must, with the materials at our command, for the present remain unsolved and open to discussion. But it is not unusual to find most distinct species confused under the same name, and specimens of the same species, only different in age, separated under two or more names.

In this paper I have endeavoured to condense into a short synopsis the principal leading characters, especially those furnished by the examination of the skull and the nuchal and dorsal plates, by which the different species of Crocodiles and Alligators may be most easily determined.

My object in this paper is to furnish the zoologist with the best character to distinguish the different species of Crocodile and Alligator, without any pretence of giving an account of the comparative anatomy or osteology of the species. I make this statement, as confusion arises in the student's mind between the object of the studies of the two branches of the science, both equally important; but the one ought to be based on the examination and comparison of the largest possible number of specimens and species, while the most important papers on comparative anatomy are often those that arise from the examination of a single example of the animal.

I am well aware that there is a prejudice against such short papers, and that they incur the reproach of certain continental and native naturalists; but after considering their objection and their practice, I am still of the opinion that papers of the kind are far more useful to the working naturalist than the long descriptions of species which it is the custom of these naturalists to prepare, when their descriptions, instead of merely presenting the peculiar character of the species under consideration, give in full detail under each species (so as to hide in a bushel of words the characters which you are looking for) the character of the genus, or even often of the family or order to which the species belongs. Macleay well observes, "The modern art of describing is too long, often insufferably long, while human life remains as short as ever" (Illust. Zool. S. Africa, p. 54).

I know by experience that synoptical papers take far more mental and bodily labour to prepare than the description of a single specimen, often taken at haphazard and regarded as the type of a species because it presents some striking peculiarities of appearance.

This paper, short as it is, is the result of the examination and repeated reexamination, at different periods, of more than two hundred specimens of Crocodiles,—a series of the most characteristic specimens of each species having been laid out so that they could be viewed and studied together and at leisure, and their peculiarities and likenesses noted down.

If all the notes made during these comparisons were printed, as is the custom with many naturalists, they would fill many pages, and thus make a long paper. Many papers and books are estimated by their size, rather than by the extent of labour that has been bestowed upon them; while the results of much labour and careful study, condensed into a few pages, are often spoken of by critics, who never undertook such researches, or who dislike the labour of condensing their observations into systematic order, as merely the short notes of a hasty examination: at least that is the way in which some papers, which were the results of equally extensive examinations, have been regarded by naturalists who should have known better.

I may further observe that, even after so much study, when new specimens have been accumulated and with additional experience, one frequently finds peculiarities overlooked and facts requiring verification, when the old and the newly acquired specimens are submitted to a reexamination and study. It is this experience that makes me inclined to place less reliance than other naturalists upon essays prepared by persons who come and look at a series of specimens for the first time, and describe them offhand. Yet such works are often regarded as of authority, very often on account of their length, or the beautiful manner in which they are printed or illustrated.

The references to the catalogue of the osteological specimens in the College of Surgeons are based on the examination of the specimens in that collection; and I have to thank the Council of the College for their permission to examine them, and Mr. Flower, the energetic Curator of the collection, for his kindness and assistance in determining them.

If any evidence were required of the difficulties of determining the species of this family, I need only refer to the nomenclature of the skull in the catalogue above referred to, which was prepared by the late Curator of the collection, Professor Owen.

In this collection, for example, I found what I consider to be three distinct species in one case, and two distinct species in another, confounded under the same name; and on the other hand, I found what I regard as skulls of the same species inserted under three different names.

The skull of a Crocodile which is found in the internal rivers of India, is named *Crocodilus rhombifer*, Cuvier (which is an American species), though the specimen in the College Museum was received from Bengal.

I do not by any means regard my determination of these skulls as infallible; but I have taken every care to make it correct by repeated examination. I first arranged the skulls as they appeared to be alike, according to the characters here assigned to them, without paying any attention to the names given, placing them in order according as the size showed the change in the growth; and Mr. Flower, Mr. Gerrard, and some other zoologists who are used to the examination of bones, agree with me in my determination, and were much interested in observing how gradually the skulls of different ages glided into each other[1].

I must observe, if there is this difference of opinion in the determination of skulls of recent Crocodiles, where the series of skulls for different-aged animals can be compared, and where the skulls are in a perfect state, how much more difficult it must be to have confidence in the determination of the skull of the fossil, or some fossil species where the skulls are generally more or less imperfect, and perhaps only single specimens (often very imperfect specimens) have been examined!

[1] The following is the result of my examinations of the specimens of Crocodiles in the Museum of the College of Surgeons (the numbers refer to the numbers in the catalogue):—

682–707. *Gavialis gangeticus*=*Gavialis*.

710. *Crocodilus cataphractus*=*Mecistops cataphractus*, the type specimen.

711, 712, 714, 716. *Crocodilus acutus*=*Molinia americana*, from America.

The chief difficulty in distinguishing the species has originated from the very great change of forms that takes place in the shape and proportions of the head of the animal in its different stages of growth; but the changes seem nearly similar in all the species, and therefore when once observed they can be easily allowed for. The difference may be divided into three stages, exemplified in the young, the nearly full-grown, and the adult or aged specimens. The head and beak of the young are generally depressed, with more or less distinctly marked symmetrical ridge and depressions; and these characters are gradually modified until the animal assumes its nearly full size,—the skull becoming thicker and more solid, but yet retaining most of the characters that distinguish its young state. After this period, as the animal increases in age, the skull becomes more and more convex and swollen and heavy, and assumes a very different external form.

It is to be observed that in all these changes in the external form of the skull, the bones themselves of which it is composed preserve their general form and relation to each other; and the sutures between these bones appear to me to offer some of the best characters to separate the species into groups. In many instances, when I have been in doubt, the sight of the intermaxillary suture has at once solved the difficulty, which has been verified by the examination of the locality of the specimen.

These changes in the form of the head have been among the causes that have made the study of the species of Crocodiles so difficult. If this is the case with the recent species, how much more caution is requisite to determine the fossil remains of the animal! Cuvier set a very good example in that respect: he commenced the study of each group of animals with an examination of the osteology and external characters of the living species, and then applied the knowledge he thus acquired, to the distinction of the fossil remains; but now we often find palæontologists, as they call themselves, neglecting, or, at most, only taking the outline of the osteological and zoological characters of the living species at second hand, and describing the fossil, and often forming genera and species on a small fragment, thus encumbering the science with a multitude of names.

At one time I proposed to give accurate measurements of the different parts of the

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713. *Crocodilus acutus*=*Oopholis porosus* of India.
715. *Crocodilus acutus*=*Crocodilus vulgaris* of Africa.
717. *Crocodilus vulgaris*, much distorted.
718. *Crocodilus vulgaris*=*Bombifrons*, perhaps *B. siamensis.*
719–724, 727, 728. *Crocodilus biporcatus*=*Oopholis porosus.*
725. *Crocodilus biporcatus*=*Crocodilus vulgaris.*
726. *Crocodilus biporcatus*=*Bombifrons indicus.*
750, 751. *Crocodilus rhombifer*, from Bengal=*Bombifrons indicus.*
752. *Crocodilus palustris?*=*Bombifrons indicus.*
760–762. *Alligator lucius*=*Alligator mississippiensis.*
764. *Alligator niger*=*Jacare nigra.*

[1] Dr. J. E. Gray "On the Change of Form of the Heads of Crocodiles," Transactions of the Sections in 'Report of the British Association of Science,' Cambridge, 1862, p. 109.

skull of each of the specimens of the different species in the British Museum Collection; but I am satisfied that the importance of such tables of measurement is over-estimated: no doubt it has a very imposing appearance; but a good figure is more useful than any amount of measurement. Every species has its normal measurements; but these are liable to vary in the different individuals; and any difference sufficient to show a distinction of species is easily appreciated by the eye, as it must alter the general proportions of the different parts of the head.

It has been suggested that I ought to give the description of each separate bone of which the skull is composed. This may be of use to the student of comparative anatomy, but is not of so much importance to the zoologist; for though each bone has a normal form in each species of Crocodile, yet they are each liable to considerable variation within certain limits in the different individuals of the species.

The bones of the different genera have been described in several works on osteology, and they are well figured by De Blainville and others.

De Blainville, in his 'Ostéographie,' devotes five folio plates to the osteology and dentition of recent Crocodiles, giving details of *Crocodilus biporcatus*, *C. lucius*, *C. vulgaris*, *C. schlegelii*, *C. longirostris*, *C. rhombifer*, and *C. sclerops*. These plates were prepared to accompany an essay that M. de Blainville was preparing for the 'Mémoires de l'Académie des Sciences de France' when he died.

Professor Carl Bernhard Brühl, of the Universities of Cracow and Pesth, has published twenty quarto etchings of the skeletons of Crocodiles and Alligators, giving details of three or four species. The plates are exceedingly accurate, and full of details, being drawn and etched by the Professor and his wife direct from the specimens. They were published at Vienna in 1862. There is a continuation of the work, containing three additional plates, published in 1865, principally devoted to the canals of the ear-bone.

I must here refer to a paper by Professor Huxley, entitled "On the Dermal Armour of of *Jacare* and *Caiman*, with notes on the Specific and Generic Characters of recent Crocodilia," Journ. Proc. Linn. Soc. Zool. iv. p. 1. As this paper contains an excellent account of the osteological differences between the different genera of Crocodilia, I have not considered it desirable to repeat them here, more especially as they were chiefly drawn up from specimens in the British Museum.

Order EMYDOSAURI (Emydosaurians).

***Emydosauri*,** Blainville, Gray, Ann. Phil. x. 195, 1825; Cat. Tortoises & Crocodiles Brit. Mus. 38, 1844.
***Crocodilia*,** Huxley, Journ. Proc. Linn. Soc. Zool. iv. p. 1.

The Emydosaurians or Crocodilians may be divided into three families:—

A. *The cervical and dorsal plates forming one dorsal shield.*

I. GAVIALIDÆ. The large front teeth and the canines in the lower jaw fit into notches in the margin of the upper jaw.

B. *The cervical shield forms a small group, which is separate from the dorsal shield.*

II. Crocodilidæ. The canines fit into notches in the upper jaw, and the large front teeth fit into pits or perforations in the front of the upper jaw.

III. Alligatoridæ. The large front teeth and the canines fit into pits or perforations in the edge of the upper jaw.

The large front teeth of the Garials fit into a notch in the front of the upper jaw, and the canines into a notch also. In the Crocodiles the canines fit into a notch, as in the Garials, but the large front teeth fit into a pit or perforation in the front of the upper jaw; and in the Alligators both the canines and the large front teeth fit into pits or perforations in the edge of the upper jaw.

The geographical distribution of the genera may be thus exhibited:—

Africa.	Asia and Australasia.	America.
	Fam. *Gavialidæ.*	
	Gavialis.	
	Tomistoma.	
	Fam. *Crocodilidæ.*	
Crocodilus.	Oopholis.	
	Bombifrons.	Palinia.
Halcrosia.		Molinia.
Mecistops.		
		Fam. *Alligatoridæ.*
		Alligator.
		Caiman.
		Jacare.

In Africa there are three species of Crocodiles. They seem all to have been known to Adanson. They are, 1. The common Crocodile (called the Olive Crocodile by Adanson), *Crocodilus vulgaris*, which is spread over the whole of Africa, from north to south and from east to west; 2. The Black Crocodile of Adanson (*Halcrosia nigra*); and, 3. The False Gavial of Adanson, the *Mecistops cataphractus.* The two latter are confined to the rivers on the west coast of Africa.

In India[1] there are also three species of Crocodiles:—1. The *Oopholis porosus* (or *Crocodilus biporcatus* of Cuvier), which is found only in the estuaries at the mouths of the large rivers; 2. The Muggar[2] (*Bombifrons indicus*); and 3. The Garial (or Ghurrial),

[1] See Dr. J. E. Gray "On the Crocodiles of India and Africa," Transactions of the Sections in 'Report of the British Association of Science,' Cambridge, 1862, p. 107.

[2] Dr. Falconer says, the proper name of the Crocodile is *Coombeer*. The Rapacious Shark is called the *Muggar*; and by reflection this name is also sometimes given to the Crocodile, because it is a rapacious animal.

which is confined to the rivers in the interior of the country. The Coombeer or Muggar ascends the rivers to the mountains, where the water is often frozen. The Ghurrial, on the contrary, is confined to the lower level, where the climate is warm.

In stating that there are three species of Crocodiles in India, I only intend to state there are three distinct forms; for I will not undertake to say for certain that the Muggar of Ceylon, of Siam, and of India are not distinct species.

Mr. Blyth observes, "Both the Gangetic species of Crocodiles have been received by the Asiatic Society, Calcutta, from Java. The Crocodiles are known to abound in Timor, from which island they may well have passed to Australia. Governor Grey met with them in the north-west."—Blyth, Rep. Austral. Vert. in Mus. A. S. C.

If by "both the Gangetic species of Crocodile" Mr. Blyth means the estuarine Crocodile (*Oopholis porosus*) and the Coombeer or Muggar (*Bombifrons indicus*), no example of the latter animals from either Java, Timor, or Australia has occurred to me, and the animal figured as *Crocodilus raninus* by Dr. Salomon Muller is certainly *Oopholis porosus*; and there is in the British Museum a fine adult skull of that species sent by the Leyden Museum from Java.

The observations of MM. Duméril and Bibron (Erp. Gén. 25, 47), that Crocodiles are not found in Australia, and that the American Crocodiles are confined to the islands of that continent, are no longer consistent with facts; indeed, long before the publication of their work, various travellers had recorded the occurrence of Crocodiles on the north coast of Australia.

The estuarine *Oopholis porosus* was observed by Governor Grey on the north-west coast of Australia. There is in the British Museum a skull of the species sent thence, and also a full-grown specimen which was killed and preserved in that country.

The Island of Borneo is inhabited by a false Garial, named *Tomistoma schlegelii.* I am not aware that it has been found in any of the other islands of the archipelago. It is intermediate in character between the true Garial and the Crocodiles.

The Crocodiles and Alligators are widely distributed in America. There are four American Crocodiles, and nine Alligators. One of the Crocodiles, *Palinia rhombifer*, is peculiar to the island of Cuba. The other species of Crocodiles and the Alligators are found on the mainland. The *Alligator mississippensis* is found far north, where the waters are often frozen; all the other Alligators and American Crocodiles are confined to the tropical and subtropical parts of the continent. *Molinia americana* is found in Cuba and St. Domingo, as well as in the rivers of the east and west side of the continent, showing the incorrectness of the assertion of MM. Duméril and Bibron that the Crocodiles of America are confined to the islands of that continent (Erp. Gén. 25, 47)[1].

[1] In the 'Gentleman's Magazine' for August 1866 appears an article, entitled "Notes on a Young Crocodile found in a Farmyard at Over Norton, Oxfordshire," by George R. Wright, F.S.A. Mr. Wright observed the specimen in a case of birds and animals, preserved by Mr. William Phillips, who said that it was found lying dead in a gutter in his farmyard, evidently but lately killed; its bowels protruded from a wound in the belly.

Family I. GAVIALIDÆ.

The cervical and dorsal plates formed into a single continuous shield. Teeth nearly of uniform size, all fitting into notches on the edge of the upper jaw. The front large teeth fitting into a notch in the front, the canines into a notch on the sides of the front of the upper jaw. The jaws elongate, slender.

Crocodilidæ (part.), Gray, Ann. Philos. x. 195, 1825.
Crocodilidæ § *, Gray, Cat. Tortoises & Crocod. B.M. 36.
Gavialidæ, Huxley, Journ. Proc. Linn. Soc. Zool. iv. p. 16, 1859.

Synopsis of Genera.

GAVIALIS. Beak elongate, linear, end swollen. The lateral teeth oblique, not received into pits.

TOMISTOMA. Beak conical, thick at the back, the lateral teeth erect, received into pits between the teeth.

1. GAVIALIS.

Beak of skull linear, end dilated from the enlarged nostrils. Teeth $\frac{27-27}{25-25}$, or $\frac{28-28}{26-26}$. The mandibular symphysis extends to the twenty-third or twenty-fourth tooth. Most of the lateral teeth of both jaws are directed obliquely, and not received into interdental pits. The front margin of the orbit is much raised.

Gavial, Oppel. *Le gavial*, Cuvier.
Gavialis, Merrem, Gray, Ann. Phil. x. 195, 1825; Cat. Tortoises, &c., B. M. 36, 57, 1844. Geoff. Mém. Mus. xii. Huxley, Proc. Linn. Soc. Zool. iv. p. 20, 1859.
Gavialia, Fleming, Phil. Zool.
Ramphostoma, Wagler, Syst. Amph. 441. *Rhamphognathus*, Vogt, Zool. Brief. ii. 289.

1. GAVIALIS GANGETICUS. (The Garial or Nakoo.)

Narrow-beaked Crocodile, Edw. Phil. Trans. xlix. 639, t. 19.
Le gavial, Lacép. Q. O. 1235, t. 15. Faugas, Mont. S. P. 235, t. 8. f. 46, 47.
Lacerta gangetica, Gmelin, S. N. i. 1057. Shaw, Zool. iii. 197, t. 60.

The men said it ran out of the stack of wood, they killed it, but they could easily get him another; he offered a guinea for another specimen, dead or alive; but the reward was never claimed.

An account of the discovery appeared in the 'Field Newspaper' for 1861 or 1862; and another, with a figure of the specimen, was published in Hardwicke's 'Science Gossip,' Jan. 1, 1867, p. 7, figs. 1 & 2. Dr. Vesalius Pettigrew and Mr. Frank Buckland thought it was a very young Crocodile that had escaped from some travelling show. I should suspect that it was much more likely to be a just-hatched specimen that had been preserved in spirit and thrown away. The wound in the belly was probably the *umbilicus*. The figure shows too long and slender a beak for a young specimen of any Crocodile I have seen.

Crocodilus longirostris, Schneid. Amph. 160. Daudin, Rept. 4293. Blainv. Ostéog. Crocod. t. 2. f. 4, t. 3. f. 6, t. 4. f. C, t. 5. f. 5.
Crocodilus arctirostris, Daud. Rept. ii. 393.
Crocodilus tenuirostris, Cuvier, Ann. Mus. x. t. 1. Tiedem. Amph. t. 15. Wagler, Syst. t. 7. f. 111. Merrem, Tent. 38.
Gavialis gangeticus, Geoff. Mém. Mus. xii. Gray, Syn. Rept. 36; Cat. Tortoises &c. B. M. 57. Dum. & Bib. Erp. Gén. iii. 135, t. 26. f. 2. Huxley, Journ. Proc. Linn. Soc. Zool. iv. p. 20, 1859. Brühl, Skelet. Krokod. t. 8, 9, 10, 11, & 17.
Crocodilus gangeticus, Tied. Oppel, & Libosch., Naturg. Amph. 81, t. 14. Geoff. Mém. Mus. H. N. xii. 118.
Gavialis longirostris, Merrem, Amph. 37.
Gavialis tenuirostris, Merrem, Amph. 38. Guérin, Icon. R. Anim. t. 2. f. 3.
Ramphostoma tenuirostre, Wagler, Nat. Syst. Amph. 141, t. 8. f. 3.
Le gavial, Lacép. H. N. Q. Ovip. i. 235, t. 15.
Gavial, Owen, Monogr. Fossil Reptilia of the London Clay, t. 11. 1849 (skeleton).

Hab. Indian rivers. Bengal, Nepal, Malabar.

2. Tomistoma.

Beak of the head conical, thick at the base. Teeth $\frac{20-20}{18-18}$. The mandibular symphysis extends to the fifteenth tooth; the hinder tooth of the upper jaw, and most of those of the lower jaw received into interdental pits. Premaxillary hardly expanded, orbital margins not raised.

Gavialis, sp., Müller; Owen.
Tomistoma, S. Müller, Wiegm. Arch. 1846, i. 122.
Rhynchosuchus, Huxley, Journ. Proc. Linn. Soc. Zool. iv. p. 16, 1859.

The upper edge of the intermaxillary bone extends back as far as the second canine tooth; and in this character it differs from the skull of the slender-nose Crocodiles, as *Croc. gravesii* and *Mecistops cataphractus*.

Dr. Falconer, when describing the skull of *Crocodilus cataphractus*, in Ann. and Mag. Nat. Hist. 1866, xviii. 362, observes, "*Crocodilus schlegelii* constitutes the passage from the true Crocodiles into the Gavials," and he shows how the skull agrees with the Crocodiles' in the position of the nasal bones.

Professor Owen, in the first 'Essay on the fossil reptiles of the London Clay,' Crocodiles, p. 15, observes, "The Bornean species, *Crocodilus schlegelii*, was in fact originally described as a new species of Gavial; but the nasal bones, as in the fossil from Sheppey (figured in t. 2. f. 5), extend to the hinder border of the external nostrils." This does not agree with our skull, nor with the figures of the skull in Blainville's 'Ostéographie.' See also Huxley, Journ. Proc. Linn. Soc. Zool. iv. p. 18.

1. Tomistoma schlegelii. (Bornean Gavial.)

Crocodilus gavialis schlegelii, Müller, Naturgesch. Ost. Ind. t. 123. f. 1–5.
Crocodilus schlegelii, Blainv. Ostéog. Crocod. t. 2. f. 3; t. 5. f. 4. Brühl, Skelet. Krok. t. 8. f. 6. Owen, Fossils of the London Clay, p. 15.
Rhynchosuchus schlegelii, Huxley, Proc. Linn. Soc. iv. (1859) p. 17; Ann. & Mag. Nat. Hist. 1859.
Mecistops journei, Gray, Cat. Tortoises &c. B. M. 38, not synonyma.

Hab. Australasia, Borneo (*Müller, Brit. Mus.*).

The two figures of the skull in *Müller* and *Schlegel*, t. 3. f. 1 and 2, show the difference that occurs in the form of the skull of the same species.

In the British Museum there is a young specimen in spirits, and an adult skull received from the Leyden Collection, and a very fine adult skull from Borneo, obtained from Mr. Mitten.

Family II. CROCODILIDÆ.

The cervical plates forming a distinct shield, separate from the dorsal shield. Teeth strong, very unequal in size, hinder larger. The 9th upper and the 11th lower teeth larger, like canines, the large teeth of the lower fitting into pits or perforations, and the canines fitting into notches on the edge of the upper jaws. Nose of both sexes simple.

The upperside of the intermaxillary is slightly expanded behind, and its hinder end is divided, and separated into two parts by the front end of the nasal bone.

Crocodilidæ §**, Gray, Cat. Tortoises &c. B. M. 36, 1844.
Crocodilidæ, Huxley, Proc. Linn. Soc. Zool. iv. 5.
Crocodilus, Cuvier; Gray, Ann. Phil. 1825, x. 195.
Champse, Merrem, Tent.

Professor Huxley divides this family into two genera, *Crocodilus* and *Mecistops*. See Journ. Proc. Linn. Soc. Zool. iv. 6.

The Crocodiles when they are first hatched have a very short beak to the head. This is even the case with the long-beaked *Mecistops cataphractus*, which in its very young state is hardly to be distinguished in the form of its beak from the young of the common Crocodile, *Crocodilus vulgaris*.

As the young obtain strength the beak developes itself more or less rapidly according to the species, until its normal character is attained.

The head seems to continue of nearly the same form, merely increasing in size, for some time, perhaps years; for we know little of the duration of the life of the Crocodiles; and they are probably long-lived animals. As they reach maturity, and as old age creeps on, the skull thickens considerably, and the jaws dilate and thicken on the sides. The growth of the teeth, which are produced in succession, and greatly enlarge in diameter, and the enlargement of the jaws proceed *pari passu*: the latter is also influenced by the development of these teeth and the larger alveoli required to support them.

The head of the Crocodile first increases in length compared with its width, and then, having arrived at a certain form, increases in width, thickness, and solidity.

The same change takes place in the head and skull of the Bornean Garial, *Tomistoma schlegelii*, as is found in Müller and Schlegel's figures of the half-grown and adult skulls in their work.

It is to be observed that each of the Crocodiles of India and Africa (and it may also be the case with those of America) seems to present two varieties—one with a broad and the other with a narrower face; this variation occurring in each species appears to me to show that it is more probably a local, or perhaps even sexual variation than a specific distinction.

If it were a sexual distinction, it might be soon settled by observers in the country where they abound; but the sex of the skin and the skull sent to Europe is rarely, if ever, marked on the specimens.

The broad-nosed variety is much more abundant in the Museum than the narrow-nosed one; and this is against the form of the face being a sexual distinction, as one would suppose that they would be nearly equal in number, unless the narrow-nosed specimens are the males and they are more wary and not so frequently caught.

Some naturalists might be inclined to regard them as distinct species; but in the Museum series, large as it is, we have not sufficient materials to decide the question with any confidence. Perhaps, if the skulls of specimens from each locality could be compared, other characters might be found; but this must be left for my successors in this field of research.

In the short-nosed species the upperside of the intermaxillary bones is short, and the nasal bones are produced between their edges to the edge of the nostril; and in the genus *Halcrosia* they are produced beyond it, and form a bony septum between the nostrils. In the long and slender-nosed species the intermaxillary bones are rather produced behind and the nasal bone does not reach the edge as does the long nostril in the genus *Mecistops*; they are considerably short of them; but still the nasal bones come between the hinder ends of the intermaxillaries, and this character at once separates the skull of that genus from the two genera of Garials which have short nasal bones.

The skulls of Crocodiles may be separated thus:—

1. Nasal bone produced, and separating the nostril into two parts. *Halcrosia.*
2. Nasal bone produced, and dividing the edges of the nostril. *Oopholis, Crocodilus, Molinia (americana), Bombifrons, Palinia.*
3. Nasal bone not reaching the nostril. *Molinia (intermedia), Mecistops.*

The intermaxillary bone in *Bombifrons* and *Palinia* is short and truncated behind. In *Halcrosia* it is rather produced behind, the straight sides converging to a point. In all the other genera it is produced behind, with the hinder edges converging on the sides and truncated at the end.

The palatal bone in all the genera is truncated or rounded in front, except in *Mecistops*, where it is narrow, short, and acute in front.

The skulls of the genera *Bombifrons*, *Oopholis*, and *Molinia* are easily distinguished in the young state,—the face of *Oopholis* being much longer and narrower than that of *Bombifrons*, and that of *Molinia* is longer and narrower than that of *Oopholis*. The measurements following are for three skulls which appear to be from animals nearly of the state of growth, same in inches and lines:—

	Bombifrons.		*Oopholis.*		*Molinia.*	
	in.	lines.	in.	lines.	in.	lines.
Length of the skull, entire	4	8	5	8	6	9
Length of face to front of orbit	2	8	3	6	4	4
Length of forehead to front of orbit	2	0	2	1	2	4
Length of palate from condyle to front end of palatine	2	11	3	4	3	10
Length of middle suture of maxilla	1	2	1	1½	1	7
Length of middle suture of intermaxilla	0	9	1	3	1	6
Width at occiput	2	6	2	5	2	10½
Width at hinder contraction of beak	1	6	1	4	1	4½
Width at notch	0	9	0	9	0	9

The dorsal scales present considerable variations in different specimens from the same locality; but, allowing for such variations, the genera may be arranged thus:—

1. The dorsal scales nearly uniformly keeled, in four or six longitudinal series; the outer series ovate-elongate. *Oopholis.*

2. The dorsal scales nearly uniformly keeled, quadrilateral, as broad as long. *Crocodilus*, *Palinia*, *Molinia*, and *Mecistops*.

3. The dorsal scales quadrilateral, as broad as long; the vertebral series scarcely keeled, the lateral series irregular and keeled. *Halcrosia* and *Molinia.*

The eyelid of the genus *Halcrosia* is thickened with hard bony plates, as in some of the Alligators, with which it also agrees in the external form of the head and the disposition of the nuchal shield. In all the other genera it is thin and membranaceous.

Synopsis of Genera.

I. *Cervical disk rhombic, separated from the dorsal shield.* Normal Crocodiles.

A. *Nuchal scutella none. Dorsal plates ovate-elongate, in four or six longitudinal series.* Estuarine Crocodiles.

1. Oopholis. Asia and North Australia.

B. *Nuchal plates four, in a transverse series. Dorsal plates as broad as long, square.* Fluviatile Crocodiles.

a. *Intermaxillary bone truncated behind, with a nearly straight hinder edge. Face broad, oblong.*

2. Bombifrons. Toes webbed. Legs distinctly fringed. Asia.
3. Palinia. Toes short, free. Legs with only an indistinct fringe· America.

b. *Intermaxillary bone elongate, produced, and truncated behind; sutures sloping backwards and converging, then transverse or sinuous. Toes webbed. Legs fringed.*

4. Crocodilus. Face oblong, without any ridge from front of orbit, forehead flat. Africa.
5. Molinia. Face elongate, forehead convex, smooth, without any ridge from orbits. America.

II. *Cervical disk strongly keeled on each side, and nearly continuous with the dorsal shield.* Aberrant Crocodiles.

* *Face broad, nasal bone produced into the nostrils.* Alligatoroid Crocodiles.

6. Halcrosia. Africa.

** *Face very long, slender, nasal bones not reaching the nostrils.* Gavialoid Crocodiles.

7. Mecistops. Africa.

1. *The nape with a rhombic disk formed of six plates, which is well separated from the dorsal shield.* Normal Crocodiles.

A. *Nuchal scutella none. Dorsal scales in four or six longitudinal series; the outer series ovate-elongate. Toes webbed. Legs fringed. The intermaxillary bone produced, truncated, and converging on the sides.* Estuarine or brackish-water Crocodiles.

1. Oopholis.

Face oblong; orbits with an elongated, longitudinal, more or less sinuous ridge in front. Nuchal scutella none, or rudimentary. Cervical disk rhombic, of six plates. Dorsal plates uniformly keeled, in four or six longitudinal series; the vertebral series with straight internal edges, the outer ovate-elongate. Legs acutely fringed. Toes broadly webbed. Intermaxillary bone produced, and truncated behind, the sutures sloping backwards and converging, and then transverse or sinuous.

Oopholis, Gray, Cat. Tortoises & Crocodiles in B. M. 1844; Ann. & Mag. Nat. Hist. 3rd series, x. 267.

a. *The dorsal scales in six longitudinal series; the vertebral ones elongated like the others.*

1. Oopholis porosus. (The Saltwater Crocodile.)

Crocodilus porosus, Schn. Amph. 159. Gray, Cat. Tort. & Croc. &c. Brit. Mus. 58; P. Z. S. 1861, 140.
Crocodilus oopholis, Schn. Amph. ii. 165.
Crocodilus biporcatus, Cuvier, Oss. Foss. v. 65, t. 1. f. 4, 18, 19 (young skulls); t. 2. f. 8. Müller and Schlegel, Verh. t. 3. f. 6 (middle-aged skull). Owen, Cat. Osteol. Mus. Col. Surg. 159, nos. 719, 723, 724, 727, 728. Huxley, Journ. Proc. Linn. Soc. Zool. iv. 11. Blainv. Ostéogr. Crocod. t. 1, t. 3. f. 1, t. 4. f. , t. 52.
Crocodilus acutus, Owen, Cat. Osteol. Mus. Col. Surg. 157, no. 713.
Champse fissipes, Wagler, Amph. t. 17.
Crocodilus biporcatus raninus, Müller and Schlegel, Verh. t. 3. f. 7 (aged skull)!
Oopholis porosus, Gray, Ann. & Mag. Nat. Hist. 3rd series, x. 267, 1862.

Hab. Asia and Australia; India, Bengal, and Penang (*Hardwicke*); China (*Lindsay*); Trincomalee; Borneo (*Belcher*); Tenasserim coast (*Packman*); Siam, Cambogia (*Mouhot*).

Var. *australis,* Günther.
Crocodile, Landsborough, Explor. of Australia, i. 70.

Hab. North Australia (*Elsey & Kraig*).

Dr. Günther has pointed out to me that all the Australian specimens which we have examined have one cross band of the shield less than the Indian specimens; that is to say, they have sixteen, and the Indian specimens seventeen bands of shields from the neck to the base of the tail. That is the case both in the small specimen in spirits and the large specimen, 17½ feet long, which was procured by Mr. Kraig.

In the British Museum there is the skin of an adult from N.E. Australia, another, 13 feet long, received from the Zoological Society, and several (two-thirds half-grown) young specimens, stuffed, and several young specimens in spirits.

The largest skull in the British Museum is 29 inches long; the adult skulls vary from 29 to 31 inches in length; a half-grown species is 19 inches long. The skull 26 inches long, is said to be from an animal caught in Bengal that was 33 feet long.

Cuvier figures the skulls of young and half-grown specimens. S. Müller and Schlegel figure two skulls, one under the name of *C. biporcatus* (f. 6), and the other *C. biporcatus raninus* (f. 7): the latter seems to be from an adult or aged animal; the former (f. 6) from a full-grown one before the skull is thickened and spread out. Another specimen, figured as *C. biporcatus raninus* (f. 8), appears to be from a specimen of *Crocodilus* or *Bombifrons siamensis.* It certainly is not an *Oopholis*, from the form of the dorsal scales and the presence of the nuchal ones.

There is a good series of skulls of this species in the Museum of the College of Surgeons; but No. 725, named *C. biporcatus* in the Catalogue, is the skull of an adult *Crocodilus vulgaris*; and No. 713, called *Crocodilus acutus* in the Catalogue, is *Oopholis porosus.*

The British Museum received from the Leyden Museum an adult skull of the *Crocodilus (biporcatus) raninus* from Borneo; it is 22 inches long, and agrees in every respect with the *Oopholis porosus* from India.

Mr. Landsborough observes, "harmless as this animal is in Australia, we were not anxious for his company in his native element."—Exploration of Australia, p. 70.

b. *The dorsal scales in four series; the vertebral series broader than long, the outer series elongate-ovate.*

2. Oopholis pondicherianus. (Pondicherry Crocodile.)

Oopholis pondicherianus, Gray, Ann. & Mag. N. H. 3rd series, x. 268.
Crocodilus pondicerianus, Günther, Rept. B. I. t. 7.

The specimen of this species in the British Museum is small, and only just hatched, but it is quite distinct from all the others. The vertebral series of plates are nearly twice as broad as those in *O. porosus*; the others are also rather wider in comparison; all the dorsal scales are more keeled, and the keels on the scales on the side of the base of the tail are higher, and more prominent. The black spots are larger and further apart.

The specimen was purchased of M. Parzudaki of Paris, it having formed part of a collection which he received from the French Museum.

B. *Nuchal plates four, or rarely two or five, in a cross series. The dorsal plates as broad as long, in four or six series.* Fluviatile or River Crocodiles.

a. *The intermaxillary bones truncated behind, with a nearly straight premaxillary suture. Face broad, oblong.*

To observe the form of the premaxillary suture in the preserved specimens, it is only necessary to elevate the skin of the front of the palate, and lay the bones bare.

* *Toes webbed. Legs distinctly fringed.* Asiatic Crocodiles.

2. Bombifrons.

The premaxillary suture straight, or rather convex forwards. The face oblong; forehead with nodules in front of the orbits, but no distinct preorbital ridges. Nuchal plates four, in a curved line. Cervical plates six, in the form of a rhombic shield, distinct from the dorsal one. Dorsal plates oblong, rather elongate, all keeled, in six longitudinal series, and with two short lateral series of keeled scales. The legs fringed with a series of triangular elongated scales. Toes webbed.

Bombifrons, Gray, Ann. & Mag. N. H. 3 series, x. 269.

Skull with the nostril separate, the internal nostril as broad as wide, with a deep pit on each side in front of it, and rather bent down, so as to open nearly horizontally.

1. Bombifrons indicus. (The Muggar.) (Plate XXXI., figs. 1, 2, 3.)

The intermaxillary short, nearly semicircular.

Crocodilus vulgaris, var. *indicus,* Gray, Syn. Rept. 58, 1831!
Crocodilus dubius, Geoff. Ann. du Mus. xii. 122?
Crocodilus suchus, var. D., Dum. Enc. Méth. Rept. 27.
Crocodilus palustris, Lesson, Bélanger, Voy. 305. Gray, Cat. Tort. & Croc. B. M. 62 (young). Owen, Cat. Osteol. Mus. Coll. Surg. 164 & 752! Günther, Rept. B. Ind. t. 8. f. *a.*
Crocodilus bombifrons, Gray, Cat. Tortoises & Crocodiles &c. B. M. 59, 1844 (adult)!
Crocodilus bombifrons (*palustris*?), Huxley, Proc. Linn. Soc. Zool. iv. 13! 1859.
Crocodilus biporcatus, Cautley, Asiat. Research. xix. t. 3. f. 1. p. 3! (not Cuvier).
Crocodilus trigonops, Gray, Cat. Tort. & Croc. B. M. 62, 1844 (young)!
Bombifrons trigonops, Gray, Ann. & Mag. N. H. 3rd series, x. 269!
Crocodilus vulgaris, var. B. Dumér. & Bibron, Erp. Gén. iv. 108.
Crocodilus rhombifer, Owen, Cat. Osteol. Mus. Coll. Surg. 164, n. 752! (not Cuvier).
Crocodilus ——? Owen, Cat. Osteol. Mus. Col. Surg. 159, n. 726!

Hab. India: Ganges (*Dr. Sayer*); Madras (*Jerdon*); Ceylon (*Kelaart*).

The dorsal shields in four series, all equally keeled, with two irregular series of plates on the sides. The shields are often nearly of the same form and size; but sometimes there are larger and broader shields intermixed in and deranging the series, and at other times the whole vertebral series is formed of wider shields.

This species has generally been confounded with *Oopholis biporcatus* and *Crocodilus vulgaris.*

The face of the younger specimen is rugulose and depressed, with a deep pit on the sides over the eighth and ninth teeth; there are two arched ridges on each side behind the nostril, and some rugosities in front of the orbits. In the older skull the face is very convex and rounded, rugose, with some more or less distinct rugosities in front of the orbits, but not the distinct longitudinal ridge so characteristic of *Oopholis porosus.*

Professor Owen described the peculiar form of the premaxillary in a skull in the College of Surgeons Museum, sent from Bengal by Dr. Wallich; but he refers the skull to *Crododilus rhombifer* of Cuvier, which is an American species.

The smallest specimen in the British Museum is 19 inches, and the largest nearly 10 feet long; there are skulls showing that it grows to a much larger size. The specimen I described as *C. trigonalis* is 24½ inches long.

In my Catalogue of the Tortoises and Crocodiles in the British Museum, published in 1844, I described it, from two adult skulls from India of 18 and 20 inches long, as a new species, which I called *Crocodilus bombifrons,* pointing out the straightness of the suture between the intermaxillary and the maxillary bones. I observed that I had seen in the Paris Museum a large specimen which had been described by Duméril and Bibron as an adult of *Crocodilus biporcatus,* which appeared to belong to this species, stating that it was immediately known from *C. porosus* by the breadth and convexity of the face.

In the same work I separated the Indian specimen from the common African *Crocodilus*, under the name of *Crocodilus palustris* of Lesson, and pointed out that it seemed to be the same as the *Crocodilus biporcatus raninus* of Müller and Schegel; and I described two other very young specimens under the name of *Crocodilus trigonops*, on account of the shortness and width of the head.

The examination of the specimens on which these species were founded, and the comparison of them one with another when ranged in a series, with the other specimens since obtained interlocated in their places according to their size, have convinced me that they are referable to mere variations of growth of a single species, which is generally spread over the Indian peninsula.

Var. Nose narrow, the intermaxillary bones rather longer and narrower.

Hab. Ceylon (skull, *Kelaart*).

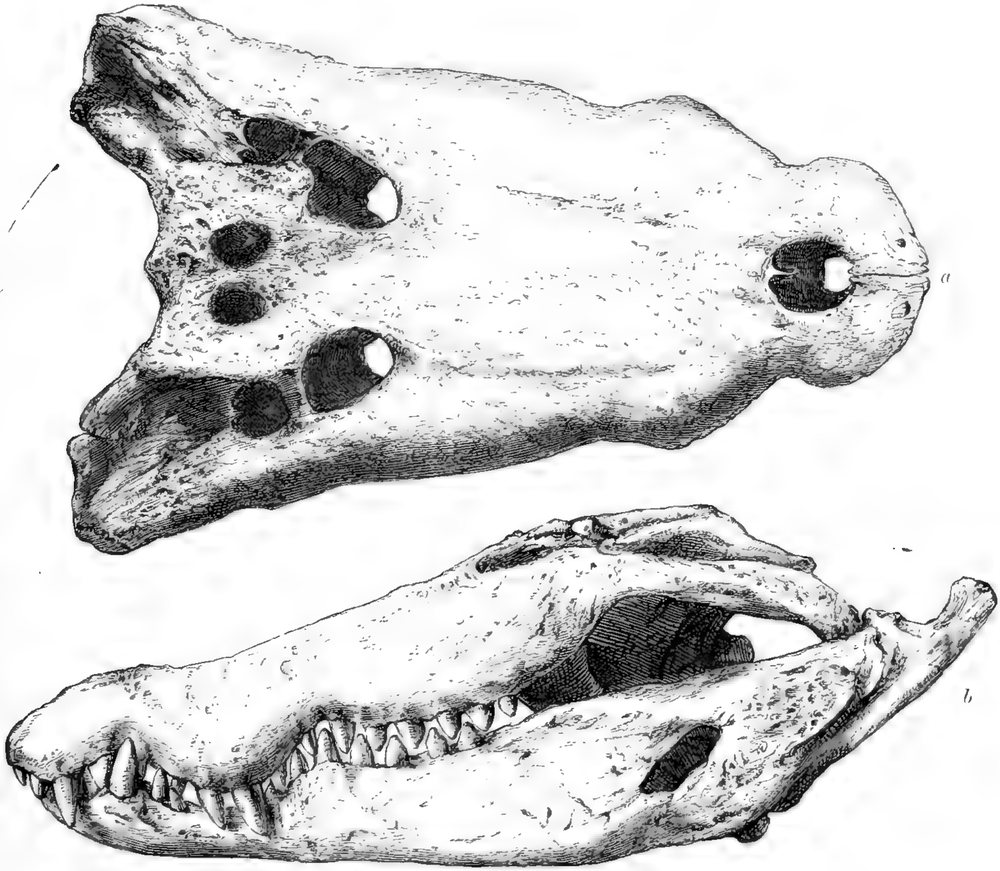


Fig. 1. and *b*. Skull of adult *C. bombifrons*, Gray, 1847. Presented by Capt. Oriel.

There may be two species of Ceylon Muggars, as in one of the heads the intermaxillaries appear to be longer and narrower than in the others from the same country. I have not sufficient materials to satisfy myself as to the distinctness of this species and the permanence of the forms.

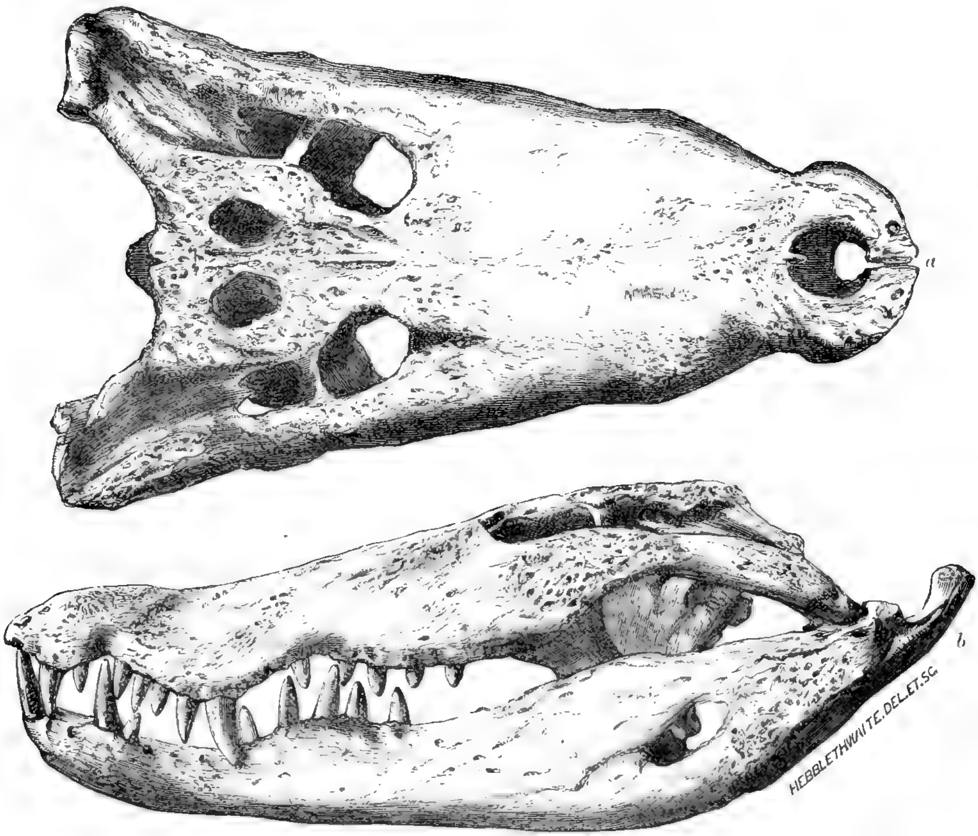


Fig. 2. Skull of *B. indicus*, nearly adult.

	Fig. 1.		Fig. 2.		Fig. 3.		Fig. 4.	
	in.	lines.	in.	lines.	in.	lines.	in.	lines.
Length of skull	20	0	17	3	9	10	4	8
Length from occiput to front of orbit ..	6	9	5	9	3	7	2	8
Length of face	13	3	11	6	6	3	2	0
Length of lower jaw	27	0	23	0	none.		5	5
Width at occiput	13	5	10	6	5	11	2	6
Width at hinder notch	9	2	6	9	3	9	1	6
Width at notch	5	4	5	11	2	4	0	9

The face becomes shorter, compared with the width of the middle of the face, as the animal becomes older.

In the young, fig. 4, the length of the head is rather more than three times the width of the swollen part behind the notch. In fig. 3 it is just three times, and in fig. 2 it is twice and a half the length of the width at the same part; and in the old skull, fig. 1, it is only a little more than twice the width of the face in length.

Fig. 3. Skull of *B. indicus*, half-grown. India, Sir John Boileau.

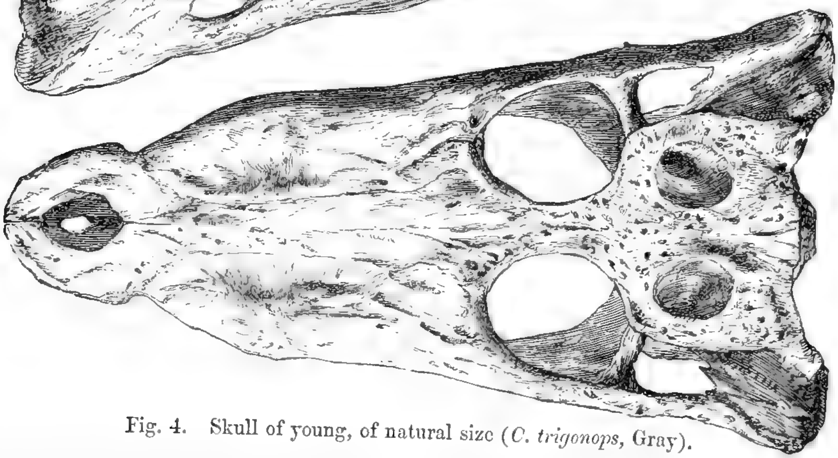


Fig. 4. Skull of young, of natural size (*C. trigonops*, Gray).

As a good illustration of the difference in the appearance of the skulls of the individuals of the species, I may give the measurement of two skulls of "Muggars" from India, of the same size, in the British Museum Collection:—

	Broad variety.	Narrow variety.
	inches.	inches.
Length of the skull along the forehead	$9\frac{7}{8}$	$9\frac{7}{8}$
Length of side of the skull	$10\frac{7}{8}$	$10\frac{7}{8}$
Width of back of skull	$5\frac{7}{8}$	$5\frac{1}{2}$
Width in front of orbits	$4\frac{1}{4}$	4
Width over largest tooth	$3\frac{3}{4}$	$3\frac{1}{4}$
Width at notch	$2\frac{1}{2}$	2 or $1\frac{15}{16}$

The broad-nose variety (fig. 3) was presented by Sir John Boileau, and the narrow one by Capt. Boys.

When the two skulls are placed side by side, the large teeth are just the same distance apart, and the different teeth in the two skulls exactly agree in size, position and distance from each other.

2. Bombifrons siamensis. (Siamese Muggar.)

The face depressed, elongate, nearly smooth, with a slight nodule in front of the orbits. Intermaxillaries rather elongate, half oblong.

Crocodilus niloticus, Latr. Rept. i. 206, t. —. From Faujas St. Fond, Mont. St. Pierre, t. 43.
Crocodilus siamensis, Schn. Amph. 157. Gray, Syn. 60; Cat. Tort. & Croc. B. M. 63 (monstrosity)? From Perrault, Hist. Acad. Sci. iii. 255, t. 54. Günther, Rept. B. I. t. 18. f. 3.
Crocodilus galeatus, Cuvier, Oss. Foss. v. 52, t. 1. f. 9 (from Perrault). Dum. & Bibr. Erp. Gén. iii. 113.
Crocodilus palustris (part.), Dum. & Bibr. Erp. Gén. iii. 113.
Crocodilus vulgaris (part.), Gray, Syn. 58. Dum. & Bibr. Erp. Gén. ii. 108? Müller & Schlegel, Verh. t. 3. f. 9 (head?).
Crocodilus vulgaris, Owen, Cat. Osteol. Mus. Col. Surg. 107. n. 718?
Bombifrons siamensis, Gray, Ann. & Mag. N. H. 3rd series, x. 269.

Hab. Siam, Cambogia (*M. Mouhot*).

There is a well-preserved half-grown specimen of this species in the British Museum. It differs from all the specimens of *Bombifrons indicus* in the collection in the face being much longer, and not so tubercular and pitted.

It has four series of nearly equal-sized, uniformly shaped, and keeled shields, with three interrupted series of unequal-sized smaller shields on each of the sides; those of the outer series are the longest.

As the head agrees with the figure of the head from which Schneider named his species, I have retained it; and I have little doubt that the two keels which are present in that specimen are either an individual peculiarity, or perhaps a character that developed itself as the animal approached old age.

The skull of the young animal in the Museum of the College of Surgeons, no. 718, appears to belong to this species; but it requires more comparison. It is clearly a *Bombifrons*, and it is much smoother and longer than the skull of *B. indicus* of the same size and age. Professor Owen observes, "The palatine suture between the premaxillary and maxillary bones passes obliquely backwards a little way at its commencement, and then extends truncated across; but the premaxillary bones are larger than in the second Gangetic Crocodile." There is a small palpebrary ossicle above the anterior angle of the eyes.—Owen, *l. c.* p. 157. n. 718.

There is a young specimen of a Crocodile, received from Singapore, which somewhat resembles the one from Siam in the form of the head, and has six series of strongly keeled shields on the back; but the four middle ones, of nearly equal size and form, and those of the outer series, are narrower, and there is a series of much smaller ones below on each of the sides. I am by no means convinced that this will form a distinct species, it is probably only an accidental or a local variety.

** *The legs with an indented fringe of short, narrow scales. Toes short, nearly free.* American Crocodiles.

3. Palinia.

The face oblong; forehead very convex, with a ridge in front of each orbit, converging in front and forming a lozenge-shaped space. Nuchal plates two or four, unequal. Cervical disk rhombic, of six large plates. Dorsal plates large, broad, in six series; the vertebral series nearly smooth, the lateral one strongly keeled. The intermaxillary short, truncated behind the premaxillary; suture straight, transverse.—See Cuvier, Oss. Foss. iii. 72, t. 3. f. 1–5.

Palinia, Gray, Cat. Tortoises & Crocodiles, B. M. 1844; Ann. & Mag. Nat. Hist. 3rd series, x. 270.

1. Palinia rhombifera. (Cuban Palinia.)

The upper surface of the forearms and thighs covered with convex keeled scales; the outer edge of the legs and feet with a series of very elongate scarcely raised scales, forming only a slight fringe. The toes short, scarcely webbed.

Aquez palin, Hernand. Nov. Mexic. ii. 2.

Crocodilus rhombifer, Cuvier, Ann. Mus. H. N. x. 51; Oss. Foss. v. 51, t. 3. f. 1–4. Tiedem., Oppel, & Lebosch, Nat. Amph. 75, t. 10. Gray, Syn. Rept. 59. Dum. & Bibr. Erp. Gén. iii. 97. Sagra, Cuba, t. 4! Huxley, Proc. Linn. Soc. iv. 10. Blainv. Ostéog. Croc. t. 5. f. 3 (head?) (not *Owen*).

Crocodilus (*Palinia*) *rhombifer*, Gray, Cat. Tort. Croc. B. M. 63; Ann. & Mag. Nat. Hist. x. 270.

Crocodilus planirostris, Graves, Ann. Gén. des Sci. Phys. de Bordeaux, ii. 348. Gray, Syn. Rept. 59.

Crocodilus gravesii, Bory de St. Vincent, Dict. Class. H. N. iii. 109, t. Dum. & Bibr. Erp. Gén. iii. 101.

Hab. South America, Cuba (*W. S. Macleay*, *Ramon de la Sagra*).

In the British Museum there is a well-grown specimen, 5 feet 4 inches long, of this species, collected in Cuba by M. Ramon de la Sagra, and sent from the French Museum. Two young specimens in spirits, sent from Cuba by Mr. W. S. Macleay, are almost 2 feet long, are pale brown, with small dots on the head, and a dark spot on the middle of many of the dorsal scutella; the face is irregularly tessellated with square brown spots.

Cuvier described the *Crocodilus rhombifer* from two specimens:—one in the Cabinet of the Academy of Sciences, in a nearly entire state; and the other, a very mutilated skin, in the Museum, which also furnished him with the skull figured in t. 3. f. 1, 2, 3, 4, 5 of his work on Fossil Bones, pp. 51–70. The original habitats of these specimens were not marked. But M. Ramon de la Sagra sent a young living specimen to the Jardin des Plantes, proving that this is an American species; and it is probable that the Crocodile which Hernandez describes and figures as coming from New Spain, under the name of *Aquez palin*, belongs to this species.

M. Graves, in the 'Annales Générales des Sciences Physiques de Bordeaux,' describes a Crocodile under the name of *C. planirostris*, from a specimen which was formerly in the Collection of the Academy of Bordeaux, but is now in the Museum of that town. It was procured from M. Journée, a surgeon of a ship that for some time traded with the negroes of the coast of Congo. M. Bory de St. Vincent for these reasons thought it might have come from Africa; and he figured and described it under the name of *Crocodilus gravesii* in the Dictionnaire Classique d'Hist. Nat. vol. iii. p. 109, t.

MM. Duméril and Bibron observe that, when they asked for a new account of the specimen, it was in such a bad condition that they could only reproduce the description given by M. Graves. The study of the description and figure, which are the only material now left for the purpose, lead to the idea that it was not distinct from *Crocodilus rhombifer*, and was most probably brought from the island of Cuba; and the ships which are engaged in trade with the negroes on the coast of Congo frequently visit Cuba, as that island is furnished with slaves from the Congo coast; so that it is not at all unlikely that the specimen was brought from that island.

2. PALINIA? MORELETII. (Yucatan Palinia.)

Crocodilus moreletii, Dum. Arch. du Mus. vi. 255, t. 20; Cat. Rept. 28, n. 5*.
Palinia? moreletii, Gray, Ann. & Mag. N. H. 3rd series, x. 271.

Dorsal scales keeled, nearly square; scales of the sides and limbs smooth, without tubercles.

Hab. Yucatan, Lac Flores (*M. Morelet*).

This species is described from a specimen in the Museum of Paris, which is very badly figured and indistinctly described in the memoir above cited.

There are two young specimens of Crocodiles, in spirit, without habitats, in the British Museum, which are peculiar in the large size of the nuchal shield, the strength of the keels of the dorsal shields, and the large keeled scales of the forearms and thighs, in which they agree with *Palinia rhombifera*; but there is so much difference between the two, and between each of them and the specimens of that species from Cuba, that I think they must be left in doubt for further elucidation. There are also two small stuffed specimens in the collection (purchased of dealers, without any locality attached), which are peculiar in having six series of uniform, squarish, very strongly keeled dorsal scales; they are very unlike any other specimen in the collection, and may be new; but I do not like to describe them in the present imperfect state of our knowledge.

b. *The intermaxillary bone elongate, produced and truncated behind; the sutures sloping backwards and converging, and then transverse or sinuous. Toes webbed. Legs with a fringe of elongated triangular scales.*

4. CROCODILUS.

Face oblong, depressed, without any ridge in front of the orbits. Nuchal shields four, in an arched series. Cervical disk rhombic, of six shields. Dorsal plates quadrilateral, as broad as long; the vertebral series rather the widest and most keeled. Intermaxillary produced behind.

Crocodilus, Gray, Ann. & Mag. N. H. 3rd series, x. 271.

"The crocodiles live on the mud-banks or swimming about the rivers" of Africa.

Dr. Balfour Baikie observes:—"The ninth upper tooth of crocodiles is said to be enlarged like a canine; but this is not correct. I have examined the dentition of eighteen skulls of various species; in the lower jaw there are always nineteen teeth, but in the upper jaw the number in the adult is seventeen on either side, while in the young it is eighteen. This is owing to the second incisor being deciduous; and in old skulls the socket is completely obliterated by the enlargement of foramen for the two anterior teeth. Thus in old animals there are only four teeth in each intermaxillary bone, while in the younger individuals there are always five. So, more strictly, it is the tenth, and not the ninth, upper tooth which is enlarged."—*P. Z. S.* 1857, p. 50.

CROCODILUS VULGARIS. (Olive African Crocodile.)

Crocodilus niloticus (part.), Daud. Rept. ii. 267. Wagler, Syst. Amph. t. 7. f. 11. 1, 2.
Crocodilus vulgaris, Cuvier, Oss. Foss. v. 42, t. 1. f. 5 & 12, t. 2. f. 7. Blainv. Ostéogr. Crocod. 126. Gray, Ann. & Mag. N. H. 3rd series, x. 271. Huxley, Proc. Linn. Soc. iv. 6.
C. suchus, Geoff. Ann. Mus. x. 84, t. 3. f. 2–4.
C. chamses, Bory, Dict. Class. H. N. v. 105.
C. lacunosus, Geoff. Croc. d'Egypte, 167.
C. marginatus, Geoff. Desc. d'Egypte, 365. Gray, Cat. Tortois. 61.
Crocodilus cataphractus, Rüppell, MS. Gray, Syn. Rept. 78. Mus. Frankfort.
Crocodilus verd de Sénégal, Adanson, Sénég. Cuvier Oss. Foss. v. 4.
Crocodilus acutus, Owen, Cat. Osteol. Mus. Coll. Surg. p. 157. n. 715, not Cuvier.
Crocodilus binuensis, Balfour Baikie, Proc. Zool. Soc. 1857, xxv. 484. Skull described.
Green crocodile, Gray, Rep. of Brit. Assoc. 1862, Sections, p. 107.

Hab. African rivers. Living on the mud-banks: North Africa, Egypt; West Africa, Senegal (*Adanson*); Gaboon (*Murray*, *Cope*); South Africa, Cape of Good Hope; Central Africa, Kwora and Binui (*Baikie*); Madagascar (*Havet*, fide *Cuvier*, Oss. Foss. 44).

Fig. 5.

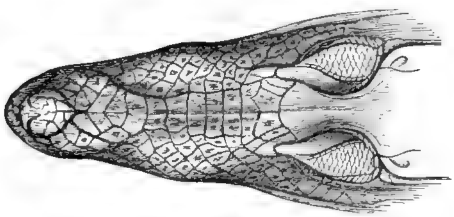


Fig. 7.

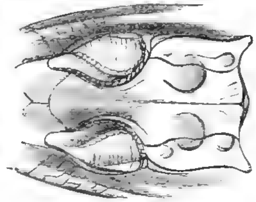


Fig. 6.

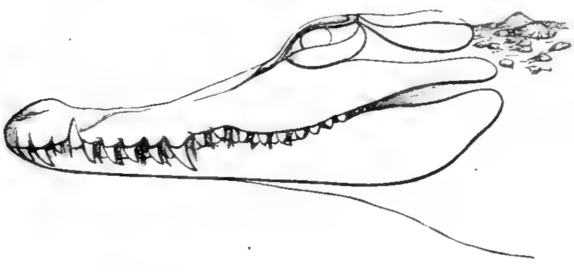
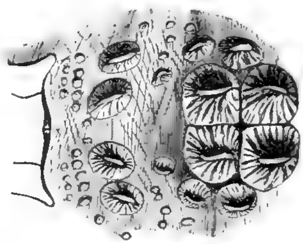


Fig. 8.



Figs. 5, 6, 7, 8. Head and nuchal and cervical shields of *Crocodilus vulgaris.*

The largest specimen in the British Museum is nearly 15 feet long. There is a very fine skull received from old Calabar, whose greatest width behind is 13 inches, length above upper surface from end of nose to back of occiput 22 inches, width at the larger lateral tooth $7\frac{3}{4}$ inches, at the notch $4\frac{3}{4}$ inches. The intermaxillary bones are produced backwards between the ends of the maxilla. The hinder nasal opening is transverse, inferior, and ascending nearly perpendicularly. The nose has two large oblong diverging prominences on the sides—one over the hinder edge of the notch, and the other over the hinder part of the root of the largest tooth, behind the notch.

There is a second skull from Western Africa in the Museum, of nearly the same length, which is considerably narrower in all its parts. Length along the upper surface from end of nose to back edge of occiput $20\frac{1}{2}$ inches; greatest width behind, 12 inches, at largest lateral tooth $6\frac{1}{2}$ inches, at the notch $3\frac{3}{4}$ inches.

These two skulls rather differ in the direction of the suture behind the maxillary bones; in the wider specimen it is much more produced behind than in the other.

I have examined and compared with care specimens of different ages from North Africa near the Nile, from West Africa at Senegal and Gaboon, South Africa at the Cape of Good Hope and Natal, and a specimen brought from Central Africa by Dr. Baikie; and though they each exhibited certain peculiarities, yet I believe, as far as the specimens at my command enable me to form a judgment, that they all belong to a single species which is generally distributed over the African continent.

At the same time, from the slight differences which the specimens from the different localities do exhibit, I should not be surprised, if we had a complete series of perfect specimens and of skulls of different ages from each locality, to find that there were sufficient differences between them to show that each locality has a special local variety or, perhaps, species; but unfortunately there is not in the British Museum, or in the other museums and collections to which I have access, such a series; all the specimens from the cape of Good Hope and West Africa seem to be either in the adult or very young state, while those from the other localities are either very young, or of an intermediate age.

On the other hand the series of specimens from the same locality, as from South Africa for example, whence we have most specimens, exhibit variations among themselves, quite as great as between the specimens from various parts of Africa.

It is therefore more safe to regard them all as one species.

These species grow to a large size; we have a specimen from the Nile and some from the Cape of Good Hope in the British Museum which are nearly 15 feet long.

The skulls which seem to belong to larger specimens often reach the length of 24 or 25 inches.

The history of the Nile Crocodile is given in great detail in the fifth volume of Cuvier's 'Recherches sur les Ossemens Fossiles,' v. 43.

Geoffroy St. Hilaire, in his 'Essay on the Crocodiles of Egypt,' separated the Egyptian specimens into two species under the name of *Crocodilus lacunosus* and *C. marginatus*. In the "Annales du Muséum," vol. x. p. 83, he described a third, under the name of *C. suchus*.

Professor Owen has figured the skull of a crocodile, from an Egyptian mummy, under the name of *Crocodilus suchus*, Geoff., in the 'Monograph on the Fossil Reptilia of the London Clay,' published by the Palæontographical Society, 1850, t. 1. f. 2. I do not see how it differs from the crocodiles at present found in the Nile. See also Huxley, Journ. Proc. Linn. Soc. iv. 15.

In the 'Catalogue of Tortoises and Crocodiles,' p. 61, I separated the adult Cape crocodiles from the North-African specimens, under the name of *C. marginatus*, because the head is not so narrow; but it is to be observed that most of the North-African specimens with which I had compared them were of small size, and consequently had the head less developed.

Dr. Baikie described the crocodile of Central Africa, found in the river Kwora and Binue (or Niger and Twedda), under the name of *Crocodilus binuensis*; it is of a dark green colour, and lives on the mud-banks or swimming in the rivers.

Mr. Cope, 'Proceedings of the Academy of Natural Sciences of Philadelphia' for 1859, p. 296, regards the crocodile of Equatorial Western Africa (Ogobai) as the *Crocodilus marginatus* of Geoffroy.

Dr. A. Smith, referring the Cape specimens to *Crocodilus marginatus*, observes, "they are occasionally found in the rivers west of Port Natal, but more abundantly in those to the eastward and northward, and occur in such numbers in the rivers in a district north of Kurrichane, between 24° and 22° south latitude, that the natives who used to reside there were known by the appellation *Baquana*=the people of the crocodile."—*Zool. South Africa*, Appendix 2, 1845.

MM. Duméril and Bibron in their 'Erpétologie Générale,' iv. 104, divided their *Crocodilus vulgaris* into four varieties, thus:—

Var. *a*. The *Crocodilus vulgaris* of Geoffroy, from North Africa, Egypt, and the Nile.

Var. *b*. *Crocodilus palustris*, Lesson, described from a specimen sent from the Ganges by M. Duvaucel, and from the coast of Malabar by M. Dussumier.

Var. *c*. the *Crocodilus marginatus*, I. Geoffroy, from North Egypt and the Cape of Good Hope.

Var. *d*. the *Crocodile verd* of Adanson, from the Nile, the Niger, and Senegal.

There is no doubt that vars. *a*, *c*, and *d* are true Crocodiles, and are what is considered in this essay to be the *Crocodilus vulgaris* of Africa.

Var. *b* on the other hand does not belong to the same genus. I have not the slightest doubt this variety is founded on young and half-grown specimens of *Bombifrons indicus*, most distinct from *Crocodilus vulgaris* by the form of the head and the structure of the skull, as MM. Duméril and Bibron would have found, if they had examined any of the twelve specimens which they say they procured. They have named the adult specimen in the Paris Museum *Crocodilus biporcatus.*

In the 'Annals and Magazine of Natural History,' vol. xviii. t. 7, Dr. Falconer figures the skull of a Crocodile under the name of *C. marginatus*, which is in the Belfast Museum. It is said to have been brought from Sierra Leone; but I think that this must be a mistake: it is not like the skull of any Crocodile I have seen from West Africa, and it is not a bad representation of the skull of a half-grown *Bombifrons indicus* from India. Can the habitat be a mistake? perhaps the habitat was only intended for the first-described species, *Cataphractus mecistops*, for which it is the true locality.

A skull of *Crocodilus vulgaris* is described in Professor Owen's 'Catalogue of Osteological Specimens in the Museum of the College of Surgeons' under the name of *Crocodilus acutus*, p. 157. n. 715.

5. Molinia.

Face elongate; forehead swollen, convex, especially in the adult; orbits without any anterior ridge. Nuchal plates two or four, small. Cervical disk rhombic, of six plates, the side plates generally small. The legs fringed with a series of triangular elongate scales. Toes webbed. Scales of the forearm and thigh thin, smooth.

Muzzle oblong, elongate, slender, with a swollen convexity on the middle of the face before the eyes. Nostril not separated by a long ridge: the internal nostril posterior, with an oblong sloping opening; the intermaxillary suture produced behind between the ends of the maxillæ.

Molinia, Gray. Ann. & Mag. N. H. 3rd series, x. 272.

* *Face slender. Dorsal plates irregular; the central series small, keeled; lateral scattered, strongly keeled. Nasal bones produced to the nostrils.* Molinia.

1. Molinia americana (American Crocodile).

Crocodilus americanus (*Plumieri*), Schn. Amph. ii. 23. Gray, Cat. Tort. & Croc. &c. B. M. 60.

Crocodilus acutus, Geoff. Ann. Mus. ii. 53, t. 57. f. 1. Cuvier, Oss. Foss. v. t. 1. f. 3 & 14, t. 2. f. 5. Gray, Syn. 60. Dum. & Bib. Erp. Gén. iii. 120. Owen, Cat. Osteol. Spec. Mus. Col. Surg. 157. n. 711, 712, 714, 716; Reptiles of the London Clay, t. 25. f. 10. Brühl, Skelet. Krokod. t. 8 & 9, t. 10, t. 17.

Crocodilus americanus (*acutus*, Cuv.), Huxley, Journ. Proc. Linn. Soc. iv. 11, 1859.

Molinia americana, Gray, Ann. & Mag. N. H. 3 ser. x. 272.

?? *Crocodilus biscutatus* (part.), Cuvier, Oss. Foss. x. t. 2. f. 6. Tiedem. Amph. t. 12.

Crocodilus de St. Domingue, Geoff. Ann. du Mus. ii. 53, t. 27. f. 1.

Hab. Tropical America. Cuba (*W. S. Macleay*); Jamaica (*B.M.*); West Ecuador Nicaragua (*Fraser; Richardson*); West coast of America (*Belcher*); St Domingo (*Cuvier*); Guatemala (*Salvin*).

The specimens in the British Museum vary in length from 19 to 103 inches; and the skulls show that they grow to a larger size.

Var. with two additional small cervical scutella behind the others. B.M.

Crocodilus americanus, var.? Gray, Cat. Tort. & Croc. B. M. 60.
Crocodilus acutus, var., A. Dum. Cat. Rept. 28; Arch. du Mus. vi. 256.
Molinia americana, var., Gray, Ann. & Mag. N. H. x. 272.

Hab. West coast of America (*Belcher*); Mexico (*Warwick*).

Cuvier in his essay gives the history of this species under the name of Le Crocodile à museau effilé, ou de Saint Domingue (*Crocodilus acutus*, nob.), Oss. Foss. v. 458, and figures the skull at t. 1. f. 3 & 14, and the nuchal shield at t. 2. f. 5.

Professor Brühl described and figured the skeleton of this species in his work. There is the skeleton of a well-grown specimen in the British Museum, and several skulls. The central prominence of the hinder part of the muzzle is sometimes much less developed than in the typical skulls.

** *Face very slender. Dorsal plates nearly uniform. Nasal bones not produced quite to the nostrils.* Temsacus.

2. Molinia intermedia (Orinoco Crocodile). (Plate XXXII. figs. 4–6.)

Dorsal plates in six rows, all slightly and nearly equally elevated; the keels of the two vertebral series rather larger than the others, quadrilateral, rather broader than long; the lateral ones oval, with five or six large plates forming an interrupted line on the sides.

Crocodilus intermedius, Graves, Ann. Sci. Phys. ii. 344. Gray, Syn. 59.
Crocodilus journei, Bory, Dict. d'H. N. v. iii. Dum. & Bib. Erp. Gén. iii. 129. A. Dum. Arch. du Mus. x. 172, t. 14. f. 3 (head). Huxley, Proc. Linn. Soc. iv. 11.
Crocodile de l'Orénoque, Parzudaki, MS.
Mecistops journei (part.), Gray, Cat. Tort. & Croc. B. M. 58, from Bory.
Molinia intermedia, Gray, Ann. & Mag. N. H. 3rd series, x. 272.
?? *Mecistops bathyrhynchus*, Cope, Proc. Acad. N. S. Philad. 1860, xii. 550 (skull).

Hab. America: Orinoco.

There is a young specimen in spirits in the British Museum, sent by M. Brandt, of Hamburg, as *Crocodilus acutus*, and an adult skull, 20 inches long, received from Paris as *Crocodile de l'Orénoque*, and a second very large skull purchased in London.

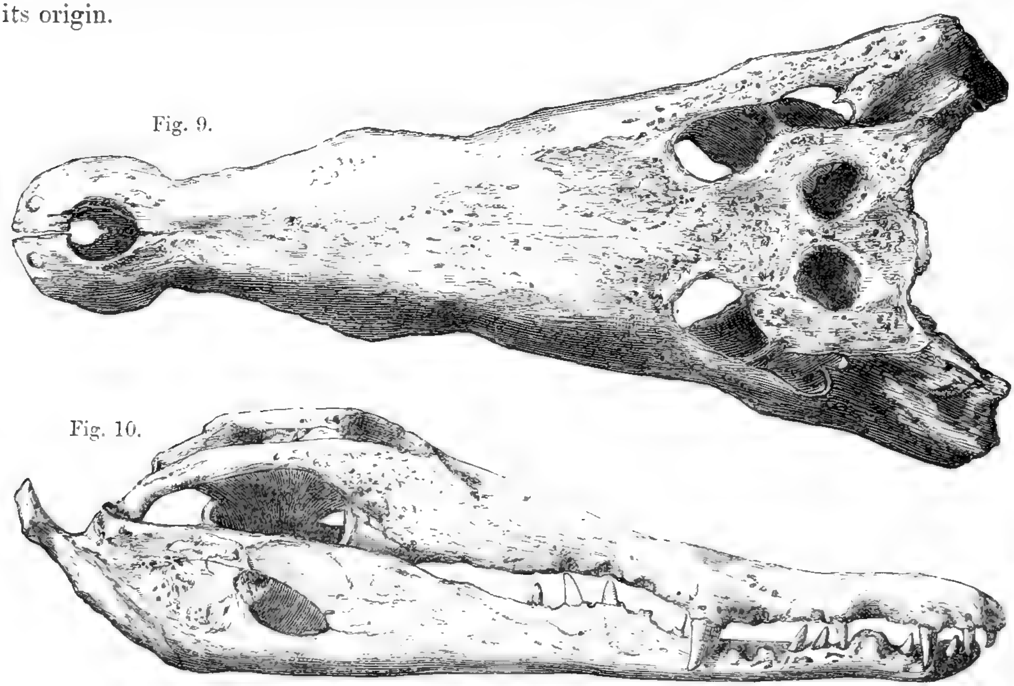
In my Catalogue of Tortoises and Crocodiles in the British Museum Collection, from all I could then learn, I was induced to believe that the *Crocodilus intermedius* of Graves was the same as the *Crocodilus schlegelii* of Borneo, and therefore called the Bornean animal *Mecistops journei*. M. Duméril, in his paper in the Archives du Muséum, not seeing the mistake, says that I refer the true *Crocodilus intermedius* to the genus *Mecistops*, and suggests that *Crocodilus acutus* ought also to belong to it.

M. Auguste Duméril, for the purpose of comparing the head of this Crocodile with that of *Crocodilus leptorhynchus* of West Africa, gave a figure of the head and front part of the back of the *Crocodile de Journée*, Archiv. du Mus. x. 173, t. 14. f. 3; but it does not appear whether it is from a specimen, or only an enlarged copy of the figure of

M. Bory de St. Vincent. If the latter, it is so embellished that one is unable to recognize its origin.

Fig. 9.

Fig. 10.



Figs. 9 & 10. Skull of *Molinia intermedia*: adult.

II. *Nape with a broad flat-topped shield formed of two or three pairs of keeled plates, strongly keeled on each side, and nearly continuous with the dorsal shield. Legs fringed. Toes webbed.* Abnormal Crocodiles.

* *Face broad; nasal bone produced into the nostril.* Alligatorian Crocodiles.

6. Halcrosia.

The premaxillary suture transverse, rather convex backwards. Nasal bones produced beyond the intermaxillary, and forming a bony septum between the nostrils. The palatine bone produced to the same level as the lateral opening—that is, to the lateral inflection of the skull. The face oblong, broad, without any ridge in front of the orbit. Eyelids with two bony plates. Nuchal plates four, in a cross row, strongly keeled. Cervical plates three or four pairs, forming a ridge on each side, the hinder one smaller. Dorsal plates in four series; the central broad, slightly keeled, the outer narrow, distinctly keeled; sides with large convex scales.

Halcrosia, Gray, Ann. & Mag. N. H. 3rd series, x. 273.
Osteolæmus, Cope, Proc. Acad. N. S. Philad. xii. 550.

It has the square head and the elongated cervical shield formed of single pairs of scutella, and the bony eyelids, of the Alligators with bony eyelids; but it is a Crocodile, and there are two bones in the eyelid instead of one as in *Caiman palpebrosus*.

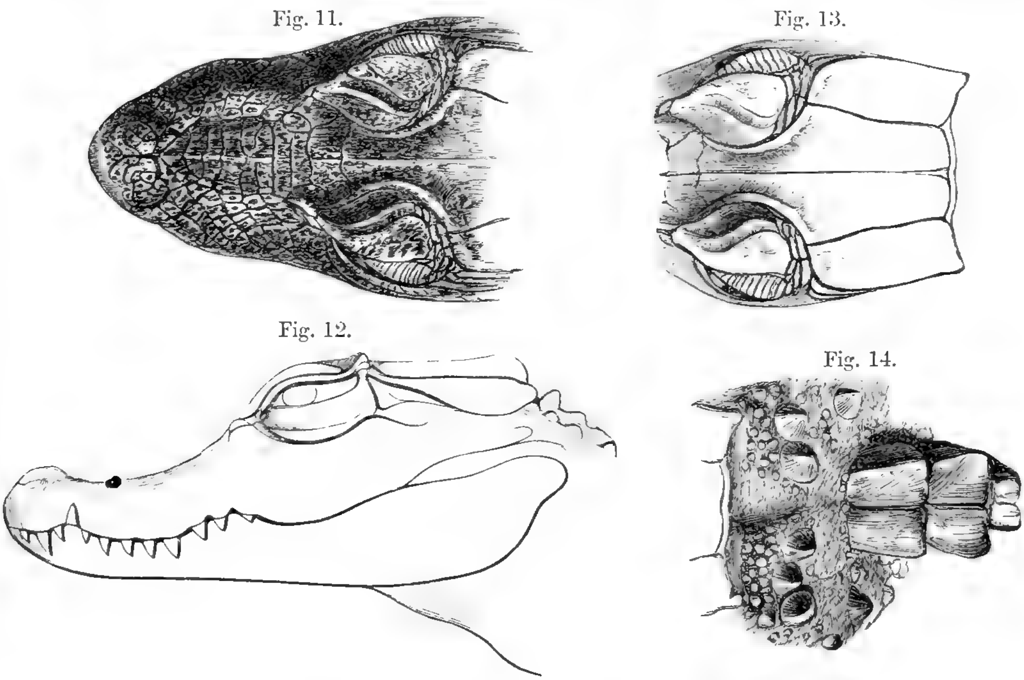
The skull of the *Alligator palpebrosus* is easily known from that of this species even in the young by the cheeks of the former being flattened and nearly erect, and of the latter spread out, and in the supratemporal fossæ being open, while in the Alligator they are closed even in the young specimens.

Most probably it was from the examination of a skull of this Crocodile that the statement has arisen that in some Alligators the canine teeth sometimes fit into a notch in the upper jaw, and not into a pit as they normally do in that genus. I will not undertake to say that such an abnormal state does not exist in the genus *Alligator*; but I have not observed it.

HALCROSIA NIGRA (Black African Crocodile). (Plate XXXI. figs. 4, 5, 6.)

Krokodile noir du Niger, Adanson, MS., Mus. Paris. See Cuvier, Oss. Foss. iii. 41.
Crocodilus niger, Latr. H. N. Rept. i. 510, from Adanson.
Crocodilus palpebrosus, var. 2, Cuvier, Oss. Foss. iii. 41, t. 2. f. 6 (part.).
Crocodilus trigonatus (part.), Cuvier, Oss. Foss. iii. 65.
African Black Crocodile, Gray, Rep. Brit. Assoc. 1862, Sections, 107.
Osteolæmus tetraspes, Cope, Proc. Acad. N. S. Philad. xii. 550.
Crocodilus frontatus, A. Murray, Proc. Zool. Soc. 1862, pp. 139, 213, fig. head, t. 29. by Ford. Strauch, Syn. Croc. t. 1 (head, young).
Halcrosia frontata, Gray, Ann. & Mag. Nat. Hist. 3rd series, x. 277.

Hab. West Africa: Senegal (*Adanson*); Gaboon; Old Calabar; Ogobai River (*Cope*).



Figs. 11–14. Head and cervical and nuchal plates of young *Halcrosia nigra*

Black, slightly mottled with pale whitish. Head pale olive, black dotted; sides of lower jaw black-banded; muzzle broad, oblong, trigonal, rather dilated on the sides; forehead high, broad, and flat, with a small tubercle at the front angle of the orbit. Nuchal shields strongly keeled, two in a cross line in two groups. Cervical shields six, in three pairs, all close together, the two anterior pairs of equal size, large, strongly keeled, and bent in on the outer sides, the hinder pairs much smaller. The vertebral series of dorsal shield broad, square, scarcely keeled, with one, and in the front of the back two rows of oval, elongated, keeled shields on the side of them, and a few isolated, scattered, compressed, high, tubercular-like, small, ovate shields on the sides of the body. Shields of the upper arm oblong, trigonal, keeled, in six oblique cross series. The lines of the upper jaw sinuous, three-parted, the front with five, the second with seven, and the hinder with five teeth.

The largest specimen I have seen is in the Free Museum at Liverpool, which is nearly 5 feet long, but I have no doubt it grows larger. The muzzle of this specimen from the tip of the nose to the orbit is 3½ inches, its width in front of the orbit 2½ inches, and at the notch of the canine teeth 1½ inch. The eyelid is obliquely divided from the front of the orbit to the back of the eye.

The Black African Crocodiles appear to be a common species on the west coast of Africa; for they are often brought to the Port of Liverpool by the palm-oil ships, and frequently in a living state; indeed I am informed there were some lately alive in the Society's Gardens in the Regent's Park.

Mr. Andrew Murray, at my recommendation, has described it in the 'Proceedings' of the Society as a new species of Crocodile under the name of *C. frontatus*; for at that instant it did not occur to me that it might be the Black Crocodile of Adanson, noticed as an *Alligator*. It is to be observed that, though they have specimens of this Crocodile in the Paris Museum in such abundance as to part with the skeleton of it as a duplicate, it is not included as *Alligator palpebrosus*, or under any name, in M. Auguste Duméril's List of the Reptiles of West Africa, printed in the last volume of the Archives du Muséum of Paris.

This Crocodile has very much the external appearance of the Caiman with bony eyelids, *Crocodilus palpebrosus*, Cuvier; and I think it very likely that Cuvier mistook a specimen of it in the Paris Museum, which Adanson had marked with his own hand "*Krokodile noir du Niger*," for a specimen of that species. (See Cuvier, Oss. Foss. iii. p. 41.) And it is still confounded with that species by the French naturalists; for there is a skeleton in the British Museum, lately sent from M. Braconier, of the French Museum, under the name of *Caiman à paupières osseuses*.

Adanson, in his 'Voyage to Senegal,' at p. 10, mentions the occurrence of Crocodiles, and at p. 73 a second kind of Crocodile, which is as large as the other, and distinguished by the black colour and by the jaws being much more elongated. It is more carnivorous, and said to be fond of human flesh.

Cuvier, in his Essay on the species of existing Crocodiles, first published in the 10th volume of the 'Annales du Muséum,' and reprinted in his 'Ossemens Fossiles' under the head of *Le Caiman à paupières osseuses* (*Crocodilus palpebrosus*, nob.), after dividing this species into two varieties, expressed a doubt if they were not inhabitants of different continents. He observes, "One of my individuals, which has been for many years in the Museum, has on it the half-effaced name of *Krokodile noir du Niger* in the hand-writing of Adanson,"—and proceeds thus:—

"This naturalist, in his 'Voyage,' speaks of two Crocodiles in the Senegal. M. de Beauvois adds that he saw at Guinea a *Crocodile* and a *Caiman*. It is therefore clear that there is a species with the form of a *Caiman* that inhabits Africa.

"There remains still an embarrassment. Adanson says his *Black Crocodile* has the muzzle longer than the *Green*, which is certainly the same as the *Crocodile of the Nile*; but we have a specimen ticketed by his own hand which has a much shorter muzzle than that from Egypt.

"Has Adanson made a mistake in writing this phrase? or has he erroneously ticketed the specimen? How are we to disentangle these errors?" &c., vol. v. p. 41.

Duméril and Bibron, in their 'Erpétologie Générale' (vol. iii. p. 75) adopt and repeat all that Cuvier has said, and still doubt if these two varieties may not be found. the one in America, and the other in Africa.

If Cuvier and his successors had examined the two specimens on which they founded the account of his second variety of *C. palpebrosus*, they would have found that they were not only distinct species, but also species belonging to two genera or subgenera. The one which had served as the model for Seba, and which Seba, with the usual inattention to true habitats at that period, said came from Ceylon, was a true *Alligator*, and a native of America; and the other, ticketed by Adanson as from the Niger, was really a Crocodile from Africa: so that the sarcastic observation which he made on travellers, and which may in some cases be true, in this instance was uncalled for, the traveller being in fact more accurate than the cabinet naturalist; and Adanson only made a slip of the pen in saying the beak was *longer* instead of *shorter* than the common Green Crocodile; and any one who compares the Black Crocodile of Africa with an American Caiman will not think that M. Beauvois was very much out when he called it a "Caiman."

Cuvier, in his Essay, when describing *Crocodilus biscutatus*, established on the *Gavial du Sénégal* of Adanson, again refers to the *Crocodile noir* of that author. He states that among the drawings of Adanson there is the figure of a *Crocodilus vulgaris*, named *Crocodile noir*, and a *Caiman à paupières osseuses*, inscribed the *Crocodile vert*. This must evidently have been an inadvertence, like the statement of the length of the nose; but, as Cuvier observed, this is pardonable, as Adanson most probably named these drawings after he had forgotten them, and had been studying other things, long after his voyage, which occupied some of the first years of his youth. (See Cuvier, Oss. Foss. iii. 53.)

A *Caiman*, in some of its characters, but which is nevertheless a true Crocodile, with the canines fitting into a notch, and not into a pit, in the upper jaw, is, there cannot be any doubt, the Crocodile that Adanson referred to; for it agrees with his description in colour and in its ferocious habits. And further that it is the Crocodile that the French naturalists refer to, is proved by the fact, already recorded, that we have received from one of the persons employed by M. Duméril at the Paris Museum a skeleton of a young specimen of the Black Crocodile of West Africa as the skeleton of the American *Alligator palpebrosus* of Cuvier.

** *Face very long, slender; nasal not reaching to the nostril.* Gavialian Crocodiles.

7. Mecistops.

Face subcylindrical, scarcely dilated in the middle; orbits simple. Nuchal shields numerous, small, in two cross series. Cervical disk narrow, containing two or three pairs of plates. Dorsal plates small, all keeled, in six longitudinal series, lateral one narrowest. Intermaxillary produced behind, and embracing the front end of the nasal.

Mecistops, Gray, Ann. & Mag. Nat. Hist. 3rd series, x. 273; Cat. Tortoises & Crocodiles B. M. 58. Huxley, Proc. Linn. Soc. iv. 15, 1859.

This genus has some resemblance to the Gavials; but the structure of the skull and the position of the teeth are those of a true Crocodile.

Professor Owen observes, "There is, however, a very close resemblance in the elongate, slender proportion of the skull and the elongated festooned border of the jaws between this species and the *Crocodilus schlegelii* from Borneo."—*Loc. cit.* p. 158. The *Crocodilus schlegelii* is a Gavial.

Dr. Falconer observes, "The nasal bones (in *Mecistops*) are extremely narrow and attenuated, but, as in the true Crocodiles, they descend between the maxillaries so as to project into a notch between the intermaxillaries. The same holds good in *C. schlegelii*, where, as with Gavials, the nasal terminates a short way in front of the orbits, and does not enter into the formation of the anterior portion of the beak" (p. 363). "This character is a good diagnostic mark between the Crocodile proper and the Gavials, separating *C. schlegelii* from the latter genus, under which Müller ranged it" (p. 363).

Dr. Balfour Baikie states, "In all essentials the skull of the *Mecistops* shows it is to be properly classed as a member of the family Crocodilidæ rather than the Gavialidæ. The teeth are irregular, the sides of the jaw are not parallel; there is a distinct swelling opposite the ninth remaining upper molar; and the lower canines are received into notches in the upper jaw."—*P. Z. S.* 1857, p. 58.

Mecistops cataphractus. (African False Garial.) (Plate XXXII. figs. 1, 2, 3.)

Crocodilus biscutatus, Cuvier, Oss. Foss. iii. 52, 65, t. 5 (very young).

Crocodilus bisulcatus, Bory, Dict. Class. N. H. v. 108, misprint.

Crocodilus cataphractus, Cuvier, Oss. Foss. v. t. 5. f. 1, 2 (crocodile à nuque cuirassée); [copied A. Dum. Arch. du Mus. x. t. 14. f. 2]. Dum. & Bib. E. G. iii. 126 (young). Bennett, Proc. Zool. Soc. 1834, p. 110. Owen, Cat. Osteol. Spec. Mus. Coll. Surg. p. 155. n. 710 (Cuvier's type).

The Crocodile, Bowdich, Madeira, 232.

Crocodilus leptorhynchus, Bennett, Proc. Zool. Soc. 1835, p. 129. A. Dum. Arch. du Mus. x. 252 & i. 171, t. 14. f. 1.

Mecistops cataphractus, Gray, Cat. B. M. 58.

Mecistops bennettii, Gray, Cat. B. M. 57.

Gavial of Senegal, Gray, Rep. Brit. Assoc. 1862, Sect. 107.

Mecistops, Balfour Baikie, Proc. Zool. Soc. 1857, p. 58.

Hab. West and Central Africa; ? Fernando Po (*Bennett*), Gaboon, Lagos. Central Africa, River Binuë (*Baikie*).

The species has been described from small young specimens. It grows to a large size. There is an imperfect specimen which is scarcely adult, in the British Museum, that was sent from Fernando Po by Capt. R. F. Burton, which must have been 13 or 14 feet long. Unfortunately it wants the head; the body is 5 feet and the tail $8\frac{1}{2}$ feet long.

Fig. 15.

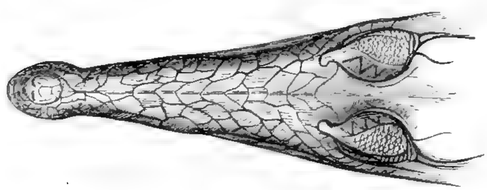


Fig. 17.

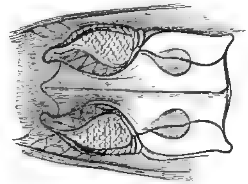
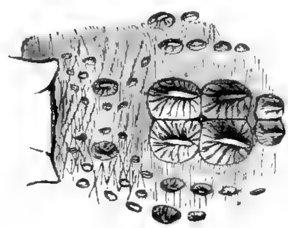


Fig. 16.

Fig. 18.



Figs. 15–18. Head and cervical shield of *Mecistops cataphractus.*

The specimen, originally sent by Mr. Bennett, was said to have come from Fernando Po; but Dr. Balfour Baikie observes that Fernando Po is a small volcanic island, totally without the muddy rivers delighted in by Crocodiles, and possessing nothing but streams, which during the rainy season are tumultuous mountain-torrents, with rocky beds.—*Proc. Zool. Soc.* 1857, p. 58.

Most probably Mr. Bennett's specimen came from the coast, and was only received through agents at Fernando Po.

Cuvier, in his Essay, described, under the name of *Crocodilus biscutatus*, and figured the nuchal shields at t. 2. f. 6, a species of Crocodile founded on a specimen in the French Museum, which is labelled in Adanson's hand "*Gavial du Sénégal*," and also on a very mutilated stuffed specimen which Cuvier found in the Museum of the Academy of Sciences at Paris (see *Oss. Foss.* v. 53, 65, t. 2. f. 6). He observes:—"the colour of these specimens is scarcely darker than that of the common Crocodile; therefore it cannot be the Black Crocodile of Adanson." And he further specially remarks that "the jaws are a little longer and narrower than those of *C. vulgaris*, but not so long and slender as those of *C. acutus*."

It resembles the latter in the dorsal shield of the vertebral line being only slightly keeled; but its peculiar character is that the middle of its nape is armed with two large pyramidal shields, and with two smaller ones in front of them.

This Crocodile has been a paradox until this time. MM. Duméril and Bibron regarded this mutilated specimen as only a specimen of the American Crocodile (*C. americanus*) with an anomalous development of the cervical and nuchal shields, observing that the specimens of this species are liable to variation in this respect; but yet they do not describe any as exactly resembling Cuvier's description or figure.

It does not appear that the specimen labelled by Adanson came under the examination of these naturalists; at least I cannot find any reference to it in their work. Cuvier unfortunately does not state its size; but I have a strong opinion that it must have been a very young specimen of *Mecistops cataphractus* before its elongated jaws were developed, and that the name of *Gavial du Sénégal* was very applicable to it; the back is grooved, by the flatness of the vertebral series of shields, as described by Cuvier, and as is characteristic of the American Crocodile (*C. acutus*) with which MM. Duméril and Bibron compared it. But this is a question that can only be solved by the examination of the original specimens.

Cuvier, in his Essay (vol. v. p. 58), observes, "When in England in 1818[1], I saw at the

[1] I recollect this visit with pleasure; for I was deputed by Dr. Leach to show this celebrated naturalist and wavering politician some of the natural-history treasures, and also some of the social and political peculiarities of the metropolis, such as the Tower, the Bell and Lancaster and other schools, &c. Among the rest, I took him to the Westminster election, at Covent Garden. Being known to Sir Francis Burdett, I took M. Cuvier on to the hustings, and introduced him to some of the Westminster notabilities, whom he knew by reputation, and was anxious to see in person. He was so interested in these bygone saturnalia that we lingered too long; for when Capt. Murray Maxwell attempted to speak, we were glad to "duck our heads" to avoid the cabbage-stumps, rotten eggs, and dead cats and dogs with which the Captain was assailed; and when the mob attempted to take the hustings by storm, and were only driven off by the men-of-war's men who were retained by Capt. Murray's committee, we found it difficult to retreat. Cuvier visited England again in 1830, during the short revolution which placed Louis Philippe on the throne. While here, the Zoologists invited him to a dinner at the Albion Tavern: he was greatly pleased with what he called the almost royal magnificence of the

Museum of the College of Surgeons a dried specimen of a Crocodile." This he describes and figures under the name of "*Crocodile à nuque cuirassée*" (*Crocodilus cataphractus*, nob.).

In 1834 Mr. Edward Turner Bennett (Proc. Zool. Soc. ii. p. 10) gave a notice of a specimen of *Crocodilus cataphractus* of Cuvier being alive in the gardens of this Society. At the meeting of the Society on the 22nd September, 1835 (Proc. Zool. Soc. iii. p. 129), after the animal had died, on more close examination, he described this animal as a new species, under the name of *Crocodilus leptorhynchus*; and Mr. Martin added some notes on its internal anatomy.

It is to be observed that Mr. Bennett and I were misled on this occasion by the erroneous breadth given to the animal in the figure published by Cuvier; for he speaks of the length of the head "being to its breadth as 3 to 1," instead of as $2\frac{1}{2}$ to 1.

In my Catalogue of the Tortoises, Crocodiles, and Amphibians in the Collection of the British Museum, published in 1844, I formed a genus under the name *Mecistops* for this animal, and for the first time described a full-grown specimen of it which we had received from the Gambia as *M. bennetti*; for Mr. Rendal considered it distinct from Cuvier's animal, but observed that they might be varieties.

This might all have been avoided if we could have seen the original specimen; but when I inquired for it, it could not be found.

The specimen described and figured by Cuvier is fortunately now to be seen in the Museum of the College of Surgeons, referred to under No. 710 in the Catalogue of Osteological Specimens of that collection. It is a young dried specimen of the Crocodile which is now so frequently brought from the west coast of Africa, and it affords no ground for the supposition of M. Duméril, expressed in his paper "On the Reptiles of Western Africa" (Arch. du Mus. v. 252), that these may be distinct species; and it shows that the figure of Cuvier, though characteristic, is not very carefully drawn, and that any difference that may appear results from the want of accuracy in the figure, and is not to be found in the animal itself,—supporting the opinion that I expressed in my paper in the 'Annals and Magazine of Natural History,' 3rd series, x. p. 274.

M. Auguste Duméril, in his paper "On the Reptiles of Western Africa" (Archiv. du Mus. x. 271), gives a good figure of a half-grown specimen of this species under the name of *Crocodilus leptorhynchus*, t. 14, and places by the side of it a tracing of Cuvier's figure of *Crocodilus cataphractus*, to show that they cannot be alike; but the

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entertainment. During the dinner the news arrived that the Orleans party had succeeded; he and his step-daughter, Miss Duvaucel (who was in the gallery with some ladies), immediately displayed the national colours. Cuvier's political predilections were not strong; for he had held office under Napoleon and under the Bourbons, and he made no secret that he came provided so as to acknowledge the success of either party: he had a white and a tricolour cockade *in* his hat ready to show as the occasion required. When I visited him in after times, he more than once referred to the events of his visits.

comparison of the specimens on which these species were founded shows how much better it is to refer to nature than to depend on figures and descriptions, which are liable to the imperfection attending human observation and record.

Dr. Falconer, in the 'Annals and Magazine of Natural History' for 1846 (xviii. 362, t. 6), described and figured a skull of this species under Cuvier's name, which was in the Belfast Museum, and said to have been sent from Sierra Leone.

Dr. Balfour Baikie described the skull of a specimen from the River Binuë (see Proc. Zool. Soc. 1857, p. 58).

Family III. ALLIGATORIDÆ.

The upper and eleventh lower teeth longer, like canines, the canines of the lower jaw fitting into holes or perforations on the edge of the upper jaw.

Alligatoridæ, Gray, Cat. Tortoises &c. B. M. 56, 1844. Huxley, Journ. Proc. Linn. Soc. iv. 3.
Alligator, Cuvier. Gray, Ann. Phil. x. 195.

Teeth strong, unequal; the hinder ones differ in shape from the anterior. The front pair of mandibular teeth, and the fourth pair (canines) are received into pits on the edges of the præmaxilla and maxillæ. The mandibular teeth behind these pass inside and not between the maxillary teeth. The premaxillo-maxillary suture on the palate is straight or convex forwards. The symphysis of the lower jaw is short.

Spix, in his work on Brazilian Lizards, gives very good figures of the Alligators, with the colours well marked. The Memoir on South-American Alligators by Natterer, contains very accurate and detailed figures of the head and the neck-shield of the different species. He has figured some varieties or species very nearly allied to those here noticed, which have not come under my observation.

Spix divided the Alligators into two genera:—*Jacaretinga*, with acute nose (1. *J. moschifer*, t. 1=*Caiman palpebrosus*, p. 161; 2. *J. punctulatus*, t. 2=*Jacare punctulata*, p. 159); and *Caiman*, or *Jacare*, with blunt nose (including 1. *C. niger*, t. 4=*Jacare nigra*, p. 167; 2. *C. fissipes*=*Jacare latirostris*, p. 167).

His figures are very good representations of the species—indeed, the best known.

MM. Duméril and Bibron admit the three species described and figured by Spix, thus:—

1. *A. sclerops*, p. 74; *Caiman noir*, Spix, Bras. t. 4. Head elongate, flattened, a ridge in front of each eye, the upper eyelid *finely* striated. *Nape with two rows of small oval compressed scales.* Back with two central longitudinal ridges, the three last cross bands of six keeled scales. Black, yellow-banded. I have no specimen agreeing with the account of the nuchal scales and the eyelid of *A. sclerops*: according to Spix the dorsal scales are elongate.

2. *A. cynocephalus*, p. 86, *Caiman fissipes*, Spix, Bras. t. 3. Head short, broad, thick, a ridge in front of each eye, the upper eyelid rugose. *Nape with two rows of*

large square keeled shields. Back scale keeled, the three last *cross bands of four scales* Sides with some strong keeled scales. Back green, black-dotted.

3. *A. punctulatus*, p. 91, Spix, Bras. t. 2. Head elongate, nose flattened, with a rounded point in front, *without any preocular ridges*, upper eyelid rugose. Nape with two rows of shields. Back flat, scarcely keeled. Sides with some larger scales. Yellow, black-dotted.

John Natterer, in his "Beitrag zu den Süd-Amerikanischen Alligatoren," edited by Fitzinger, describes eight species of the genus *Champsa*: five have partly bony eyelids, and three have them entirely bony. The five former belong to the genus under consideration.

The preorbital ridge distinct, beak broad with three lateral foveolæ, eyelid striated. beak broad and blunt. *C. nigra*, t. 21.

The nuchal scutella many, in three series. *C. fissipes*, t. 22.

The nuchal scutella many, in two series. *C. sclerops*, t. 23.

The preorbital ridge evanescent, beak without lateral foveolæ, eyelids rugose. The frontal ridge flexuous, bent in front. *C. vallifrons*, t. 24.

The frontal ridge arched, bent back. *C. punctulata*, t. 25.

M. Natterer gives the following proportional measurements of the heads:—

	Length of Head.		Width of Head.		Length of Crown before.		Width of Crown before.		Width of Beak above the eighth tooth.	
	in.	l.	in.	l.	in.	l.	in.	l.	in.	l.
Champsa nigra	16	0	8	0	3	6	4	9	5	1
——— fissipes	10	3	6	5	2	7	3	5	4	0
——— sclerops	6	6	5	8	2	8	3	3	3	3
——— vallifrons	7	10	4	6	2	0	2	9	2	3
——— punctulata	10	5	5	4	2	5	3	2	2	5

The figures of the heads of the last two species differ from that of *C. sclerops* chiefly in the nose being narrower (*C. punctulata* being the narrowest and very slender), narrower than in any specimens that have come under my observation; the lower jaws in the figure also differ in shape, that of *C. vallifrons* being the most slender. Dr. Strauch, who had M. Natterer's specimens to examine, regards the two latter as the same species, but distinct from *sclerops*.

Synopsis of Genera.

I. *The ventral scutella like the dorsal ones, bony and articulated together, forming a shield. The eyelids with an internal bony plate. The cervical scutella in pairs, forming an elongated shield. Nasal bone short.* Tropical America.

1. Jacare. The orbits united by a bony cross ridge. Eyelids partly striated or rugose.
2. Caiman. The orbits not united by a cross ridge. Eyelids bony, entirely smooth.

II. *The ventral scutella thin, the dorsal scutella bony, not articulated together. The eyelids fleshy, smooth. The cervical scutella in pairs, separate. Nasal bone elongate, separating the nostrils.* North America.

3. ALLIGATOR. The face broad, depressed.

Section I. *The ventral scutella like the dorsal ones, bony and articulated together, forming a shield. The eyelids with an internal bony plate. The cervical scutella in pairs, forming an elongated shield. Nasal bone short.* Tropical America.

1. JACARÉ.

Head moderately high, shelving on the sides. Orbits united by a distinct bony cross ridge. Eyelids striated or rugose, strengthened by a small internal bone. The cervical scutella four or five pairs, forming a shield; the dorsal and ventral scutella both consolidated together, forming a dorsal and ventral shield; the gular and ventral scutella smooth.

Jacare, Gray, Cat. Tort. Croc. &c. B.M. 64, 1844; Ann. & Mag. N. H. 3rd series, x. 327, 1862. Huxley, Proc. Linn. Soc. 1859, 4.

Jacaretinga, Spix, Lacert.

The pits in the maxilla are the cavities left by the preorbital ridges as they advance. The intermaxillary bone short, truncated behind, with an elongate-oval or lanceolate cavity between this and the front of the palate.

The figures of Natterer are excellent to general appearance, but they do not agree with the measurements of our specimen; that is to say, the nose of *Champsa fissipes*, from the ridge, is about the same length as the forehead, but in his figure it is represented as larger, and it is so in all the other figures: perhaps this is to allow for the perspective.

A. *Head elongate; interorbital ridges strong. Dorsal scutella elongate, keeled, keels of vertebral series highest; lumbar scutella in six longitudinal series. Nuchal scutella small, compressed. Eyelids striated, with a rather large internal bone. Back black varied with yellow.* Melanosuchus, *Gray, Ann. & Mag. N. H.* x. 328.

1. JACARE NIGRA. (Black Jacare.)

Crocodilus sclerops, Schn. Amph. 162. Blainv. Ostéogr. Crocod. t. 3. f. 2, t. 4. f. 13.

Crocodilus yakare, Daud.

Alligator sclerops, Cuvier, Oss. Foss. v. 35, t. 1. f. 6 & 7, t. 2. f. 3. Brühl, Skelet. Krokod. t. 12. f. 3, 5, 6, 7, t. 19. f. 21.

Alligator sclerops, var., Gray, Syn. Rept.

Caiman niger, Spix, Bras. t. 4 (good).

Champsa nigra, Natterer, Beitr. t. 21 (good).

Alligator niger, Owen, Cat. Osteol. Spec. Mus. Coll. Surg. p. 704. n. 166 (adult).
Jacare nigra, Gray, Cat. Tort. & Croc. 65; Ann. & Mag. N. H. x. 328, 1862.

Hab. Para, 13 feet long (*Graham*); Guiana (*Owen*).

I think it better to adopt Spix's name, as *sclerops* has been used for all the species.

B. *Head short; orbits with diverging ribs in front to edge of jaw. Dorsal scutella broad, slightly keeled, equal; the lumbar scutella in four longitudinal series. Nuchal scutella distinct, in two cross series. Eyelids rugose, with a small internal bone. Back olive, banded with brown.* Cynosuchus, *Gray, Ann. & Mag. N. H.* x. 328.

In many of the specimens the first scale of the nuchal shield has two keels, in others it has only one; but in several specimens the scale has two keels on one side and only one on the other.

a. *Head short, broad, depressed, with very distinct preorbital ridges to the edge of the jaw. Cervical disk short, broad, formed of four bands of scutella. Sides of jaws pale, with a series of dark spots.*

2. Jacare latirostris. (Dog-headed Jacaré.)

Dorsal shields in eight longitudinal series, four on each side. Ventral shields in twelve series.

Crocodilus latirostris and *C. yacare*, Daud. Rept. ii. 407, 417.
Caiman fissipes, Spix, Bras. t. 3 (good).
Champsa fissipes, Wagner, Icon. t. 17. Natterer, Beitr. t. 22 (good).
Crocodilus sclerops, Wied. Abbild. t. Blainv. Ostéogr. Crocod. t. 3. f. 2, t. 4. f. 13. Schinz, Rept. t. 112.
Jacare fissipes, Gray, Cat. Tortoises B. M. 64.
Alligator sclerops, Pr. Max. Abbild. t.
Alligator cynocephalus, Dum. & Bib. Erp. Gén. ii. 86.
Jacare latirostris, Gray, Ann. & Mag. N. H. x. 328.

Hab. Brazils; Pernambuco (*J. P. G. Smith*); Surinam.

The nose of the young specimen is as long as the width at the eighth tooth. The nose from the ridges nearly as long as the back of the head; width of the muzzle at the notch one-half the length of the head.

Var. 1 (three young, in spirit). Head short; side of face pale, with a dark spot under each ear, and another larger under each eye. The lower jaw pale, five round spots on each side, the middle one, under the eyes, the largest. Back black, with interrupted or irregular pale brown cross bars.

Hab. Pernambuco (*J. P. G. Smith*).

The smaller specimen is peculiar for the very small size of the ventral shield in front of the vent. The spots on the side of the face and lower jaw are to be seen in the older specimens when they are between 3 and 4 feet long.

Var. 2. Head rather larger and narrower. The nose from the ridge rather longer than the back of the head; width of the notch two-fifths the length of the head. Cheek and side of the lower jaw with five large black spots. Ventral shields in twelve series. Dorsal shields four.

Hab. South America; Lake of Santa Cruz de la Sierra.

3. Jacare multiscutata. (Brazilian Jacaré.)

With sixteen series of ventral shields; hinder ventral shields very narrow. Dorsal shields in ten longitudinal series, five on each side.

Hab. Brazil.

A skin in the British Museum (46. 7. 10. 41).

b. *Head elongate, longer than the width at the eighth tooth, with none or only indistinct evanescent ridges from the front of the orbit. Cervical disk oblong, elongate, of five series of scutella.*

* *Face depressed, broad; sides of the jaws with a series of large coloured spots.*

4. Jacare longiscutata. (Long-shielded Jacaré.) (Plate XXXIV.)

Dorsal scutella elongate, longer than broad, uniformly keeled, in ten longitudinal series on the middle of the body; ventral scutella elongate, in fourteen or sixteen longitudinal series. Sides of the jaws pale, with five or six band-like spots; the inner pairs of the first and second series of cervical scutella large and equal-sized.

Jacare longiscutata, Gray, Ann. & Mag. N. H. x. 328, 1862.

Hab. South America. Brit. Mus.

This is very like the following; but the head is rather broader, and the dorsal and ventral shields are much larger, and more numerous.

It is known from the young of *Jacare nigra* by its olive colour, the spots on the sides of the jaws, and the presence of the distinct nuchal scutella.

5. Jacare ocellata. (Eyed Jacaré.) (Plate XXXIII.)

Dorsal scutella broad, uniformly keeled, in eight longitudinal series in the middle of the body; ventral scutella in twelve longitudinal series, the hinder ones smaller, longer, and more numerous; the central pair of cervical scutella in the first series smaller than those that follow.

Jacare ocellata, Gray, Ann. & Mag. N. H. x. 329, 1862.

Hab. Lake of Santa Cruz de la Sierra. British Museum.

** *Face attenuated, rather high on the sides; sides of the jaws one-coloured.*

6. Jacare punctulata. (Dotted-jawed Jacaré.)

Back yellow, banded with brown; the sides of the head yellow; upper and lower jaws yellow, one-coloured, or minutely speckled; sides of the neck smooth, with flat scales. Nose rather high and square.

Jacare sclerops, Gray, Cat. Tortoises B. M. 64.

Crocodilus sclerops, Schn. Amph. 162. Cuvier, Ann. Mus., & Oss. Foss. v. t. 1. f. 6 & 7, t. 2. f. 3. Tiedem. Amph. 60, t. 5. Guérin, Icon. t. 2. f. 2 & 10. Gray, Syn. Rept. 62. Dum. & Bib. Erp. Gén. iii. 79.

Crocodilus americanus, Laur. from Seba, t. 104. f. 10.

Crocodilus caiman, Daud. Rept. iii. 394.

Caiman (Jacaretinga) punctulatus, Spix, Bras. t. 2 (good).

Champsa sclerops, Wagner, Syst. t. 7. f. 1, 2, and f. 42. Natterer, Beitr. t. 22 (heads good).

Alligator punctulatus, Dum. & Bibr. Erp. Gén. ii. 91.

Jacare punctulata, Gray, Ann. & Mag. Nat. Hist. x. 329, 1862.

Hab. Brazil (*Spix*); Surinam; Argentine Republic (*H. Christy*).

Natterer figures two other species, under the name of *Champsa vallifrons* (t. 24), (*Jacare vallifrons*, Gray, Cat. B. M. 65), and *Ch. punctulata* (t. 25) (*Jacare punctulata*, Gray, Cat. B. M. 65), which seem to differ from the former in the head being narrower and more tapering. I have seen no specimens agreeing with these figures; but they look very like varieties of the above. At the same time, some of our specimens appear to have a more attenuated snout than others; but when you apply the callipers to the nose and to other parts of the head, the absolute proportions of the parts are very nearly the same.

A stuffed specimen from the Argentine Republic measures 6 feet 9 inches long, the head from the occiput is $10\frac{1}{2}$, and the nose from the ridge $6\frac{1}{2}$ inches. In another, from the Zoological Society's Gardens, 5 feet 10 inches long, the head from the occiput is 10 inches, the nose from the ridge $6\frac{1}{2}$ inches long. A series of young specimens in spirits are pale brown, the back and tail with narrow brown cross bands, those on the back sometimes broken into square spots; the cheek and outside of the lower jaw pale yellow, without spots. The sides of the nuchal disk dark-coloured.

7. Jacare hirticollis. (Rough-necked Jacaré.)

The scales on the sides of the neck rough, spinulose, pale yellow; back and tail brown, cross barred; cheek and sides of the lower jaw yellow, not spotted.

Hab. Demerara. B. M.

I may observe that, characteristic as are the figures of Dr. Natterer's paper, none of them exactly agrees in measurements with the specimens in the British Museum.

In some specimens of the *Jacare* the first and, sometimes, even the second cervical scutella have two keels, in others only one; but this is no specific distinction; it is not rare to find species with two keels on one side of the neck, and only one on the other.

2. Caiman.

Head high, flattened on the sides, angulated above. Orbits without any ridges. The eyelids smooth, strengthened with a large, single, internal bony plate. The dorsal and ventral scutella bony, articulated together, forming a dorsal and ventral shield; the gular and lateral ventral plates keeled, the abdominal ones smooth; the cervical scutella four or five pairs, with sometimes one or a pair interposed between the second and third pairs.

Skull with the superior temporal fossæ obliterated, the circumjacent bones uniting, the eyelid with a single large bony plate covering the whole upper surface. Vomer not apparent on the palate.

Caiman, Gray, Cat. Tortoises &c. Brit. Mus. 66, 1844; Ann. & Mag. Nat. Hist. 3rd series, x. 330. Huxley, Proc. Linn. Soc. iv. 3.

This genus has been divided into two species—one having the cervical shields two, and the other four in a cross series; in all the latter there are two in a cross series, with one or two interpolated between the shields.

I have seen no specimen which agrees in the the nuchal shields with either of the figures in Cuvier, Oss. Foss., though our two species agree in other respects with his figures; and how such species with distinct organic characters could be regarded as varieties, I am unable to learn.

I cannot conceive what induced M. Cuvier in his 'Essay' to consider the two South-American Alligators with bony eyelids varieties; for he justly observes, "The Crocodile of St. Domingo is not more distinct from the Crocodile of the Nile than these two varieties are from each other." In the Latin synopsis of the species, which is appended to the paper, they are regarded as distinct, and the second one is called *C. trigonatus*. Yet MM. Duméril & Bibron, in their work, persist in following Cuvier's first idea of their being only varieties, and in regarding Adanson's specimens as belonging to the second variety, and also in doubting if the "two varieties," are both from America.

The specimen in the British Museum proves most distinctly that there are two very distinct Alligators with bony eyelids found in Tropical America; which agrees well with the character that M. Cuvier and MM. Duméril & Bibron give to the two varieties of that species; and these species are, as Cuvier observes, as distinct from one another as *C. americanus* from *C. vulgaris*. The heads of both these species are figured by Dr. John Natterer in his "Essay on American Alligators" in the Vienna 'Transactions.' This author also figured a third species, which he calls *A. gibbiceps*, which, if it is separable from *A. trigonatus*, must be distinguishable from it by very slight characters.

The *Black Crocodile* (*Halcrosia palpebrosa*) of West Africa has so much resemblance to this animal that Cuvier considered Adanson's West-African specimen a variety of this species.

Duméril & Bibron evidently considered the African and the American animals the same species; and we a short time ago received from M. Braconier, of the Jardin des Plantes, a skeleton of the African species under the name of *Alligator palpebrosus*, var.

A. *Head shelving on the sides. Nuchal scutella in a single cross series, cervical scutella five pairs; dorsal scutella highly keeled, irregular, in six series; the lumbar scutella in two longitudinal series; the gular and two outer lateral series of ventral scutella keeled. The flat upper disk at the base of tail broad and strongly crested.* Paleosuchus, *Gray, Ann. & Mag. N. H.* x. 330.

1. Caiman trigonatus. (Rough-backed Alligator.)

Crocodilus trigonatus, Schn. Amph. 161. 6. Tiedemann, Amph. 66, t. 67.
Crocodilus palpebrosus, var. 2, Cuvier, Oss. Foss. v. 40, t. 2. f. 1.
Caiman trigonatus, Gray, Cat. Tortoises &c. B. M. 66; Ann. & Mag. N. H. x. 330, 1862.
Alligator palpebrosus, Brühl, Skel. Krok. t. 19. f. 3.
Champsa trigonata, Natterer, Beitr. t. 26 (good).

Hab. Tropical America.

The largest specimen in the British Museum is rather above 4 feet long. The young specimens have the lateral ventral shields keeled.

B. *Head flat, and erect on the sides. Nuchal scutella many, in two cross series; cervical scutella three pairs; dorsal scutella slightly keeled; the lumbar scutella in four longitudinal series; the gular, the ventral, and the lateral abdominal scutella keeled. The flat upper disk at the base of the tail elongate.* Aromosuchus, *Gray, Ann. & Mag. N. H.* x. 330.

2. Caiman palpebrosus. (Banded Alligator.)

Brown; tail black-banded.

Crocodilus palpebrosus, var., Cuvier, Oss. Foss. v. t. 1. f. 6–17 and t. 2. f. 2.
Champsa palpebrosa, Natterer, Beitr. t. 27 (good).
Caiman (Jacaretinga) moschifer, Spix, Bras. t. 1 (skull).
Caiman palpebrosus, Gray, Cat. Tortoises &c. B. M. 67; Ann. & Mag. Nat. Hist. x. 330, 1862.
Crocodilus palpebrosus, Tiedem. Nat. Amph. t. 6.
Alligator palpebrosus, Merrem, Syst. 35. Gray's Syn. Rept. 63.

Hab. Tropical America.

Natterer figures the head of a species under the name of *C. gibbiceps*; but I do not see how it differs from the above, except that the head is a little higher—perhaps a sexual distinction. Dr. Strauch regards *C. gibbiceps* as the same as *C. palpebrosus*.

Section II. *The ventral scutella thin, the dorsal scutella bony, not articulated together. The eyelids fleshy, smooth. The cervical scutella in pairs, separate. Nasal bone elongate, separating the nostrils.* North America.

3. Alligator.

Head depressed, broad, without any ridges in front of the orbit. Snout very broad, flattened and rounded at the end; the ninth maxillary tooth the largest. The eyelids smooth, fleshy. The dorsal scutella not articulated together, in six longitudinal series; the ventral scutella thin; the gular and abdominal shields smooth; nuchal scutella one pair, small; cervical scutella three pairs, hinder smallest. Nostril separated by a bony septum. The feet webbed. Dorsal plates in six longitudinal series, the two vertebral closer together. The sides with a short series close to the others, sometimes reduced to only one or two shields.

Alligator, Gray, Cat. Tort. B. M. 66; Ann. Mag. N. H. x. 330, 1862. Huxley, Proc. Linn. Soc. iv. 3.
Champsa, Wagler, Syst. d. Amph. 140.

Alligator mississippensis. (Alligator.)

Alligator, Catesby, Carol. t. 63.

Crocodilus mississippensis, Daud. Rept. ii. 412.

Crocodilus lucius, Cuvier, Ann. Mus. x., and Oss. Foss. v. t. 1. f. 8; t. 2. f. 4. Tiedem. Amph. 58, t. 4. Merrem, Zool. 34. Owen, Cat. Osteol. Spec. in Coll. Surg. p. 165. n. 760, 761. Blainv. Ostéog. Crocod. t. 2. f. 1, t. 5. f. 1. Brühl, Skelet. Krokod. t. 8. f. 5, 6, t. 9. f. 3, t. 10. f. 3, 4, t. 11. f. 2, 3, t. 20. f.

Alligator mississippensis, Gray, Cat. Tortoises B. M. 66; Ann. & Mag. Nat. Hist. x. 331, 1862.

Crocodilus cuvieri, Leach, Zool. Misc. ii. 117, t. 102.

Alligator lucius, Merrem, Tent. 34. Dum. & Bibr. Erp. Gén. iii. 75, t. 25, 26.

Alligator cuvieri, Bory de St. Vincent, D. C. H. N. v. 104.

Hab. North America, New Orleans, Texas.

Var. 1. The nose very broad and short. The largest specimen of this variety in the British Museum is nearly 4 feet long.

Var. 2. The nose narrower and longer. The largest specimen in the British Museum is of the same size as the former, which is nearly 4 feet long. Are they the two sexes?

The young specimens in spirits have the back black, with narrow white cross bands. The head pale brown, black-varied. Ventral shields in eight or ten longitudinal rather irregular series.

There is a very young specimen of this species in spirits, from New Orleans, in the British Museum. It is black, with white cross bands. The beak is short, rather slender, with a ridge of skin in front of each eye, giving the appearance of a frontal ridge.

EXPLANATION OF THE PLATES.

PLATE XXXI.

Figs. 1, 2, 3. Skull of *Bombifrons indicus*. Adult.
Figs. 4, 5, 6. Skull of *Halcrosia nigra*. Half-grown*.

PLATE XXXII.

Figs. 1, 2, 3. Skull of *Mecistops cataphractus*. Adult. Length 21 inches.
Figs. 4, 5, 6. Skull of *Molinia intermedia*. Adult. Length 30 inches†.

PLATE XXXIII.

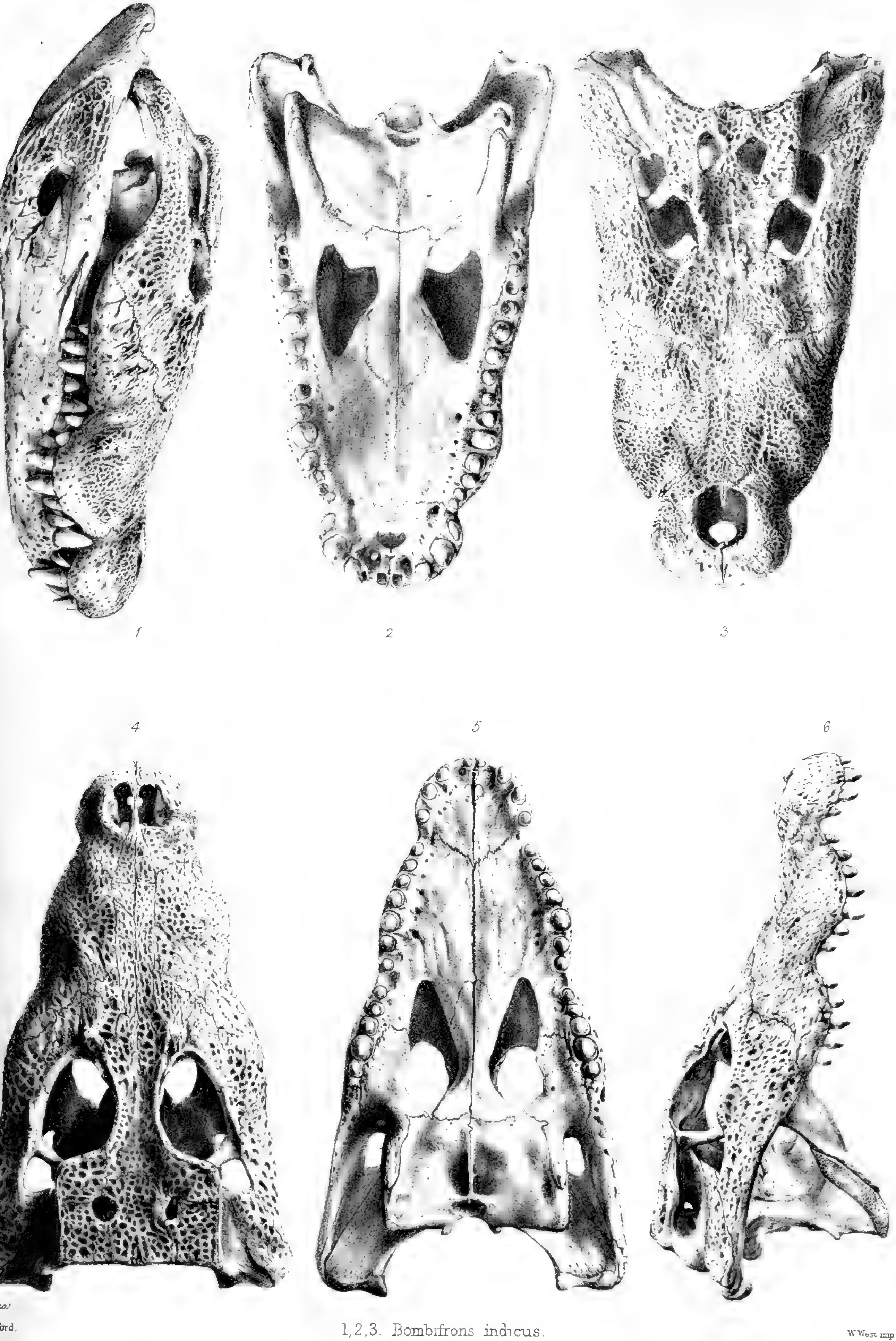
Jacare ocellata. Young: stuffed. Natural size.

PLATE XXXIV.

Jacare longiscutata. Young: stuffed. Natural size.

* Called on the Plate "*Halcrosia frontata*."

† Called on the Plate "*Crocodilus intermedius*."

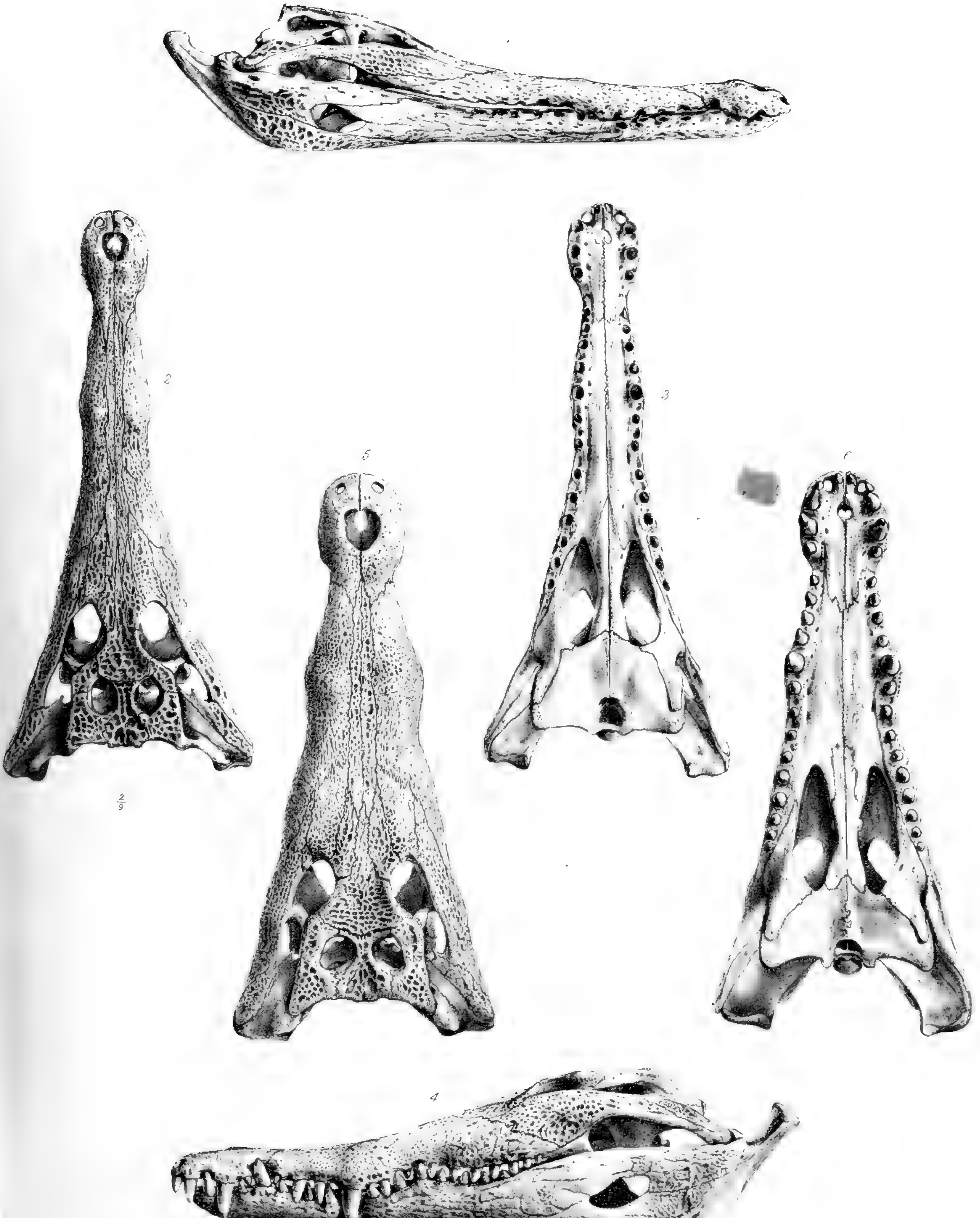


G.H Ford.

1,2,3. Bombifrons indicus.

4,5 6. Halicrosia frontata.

W West imp

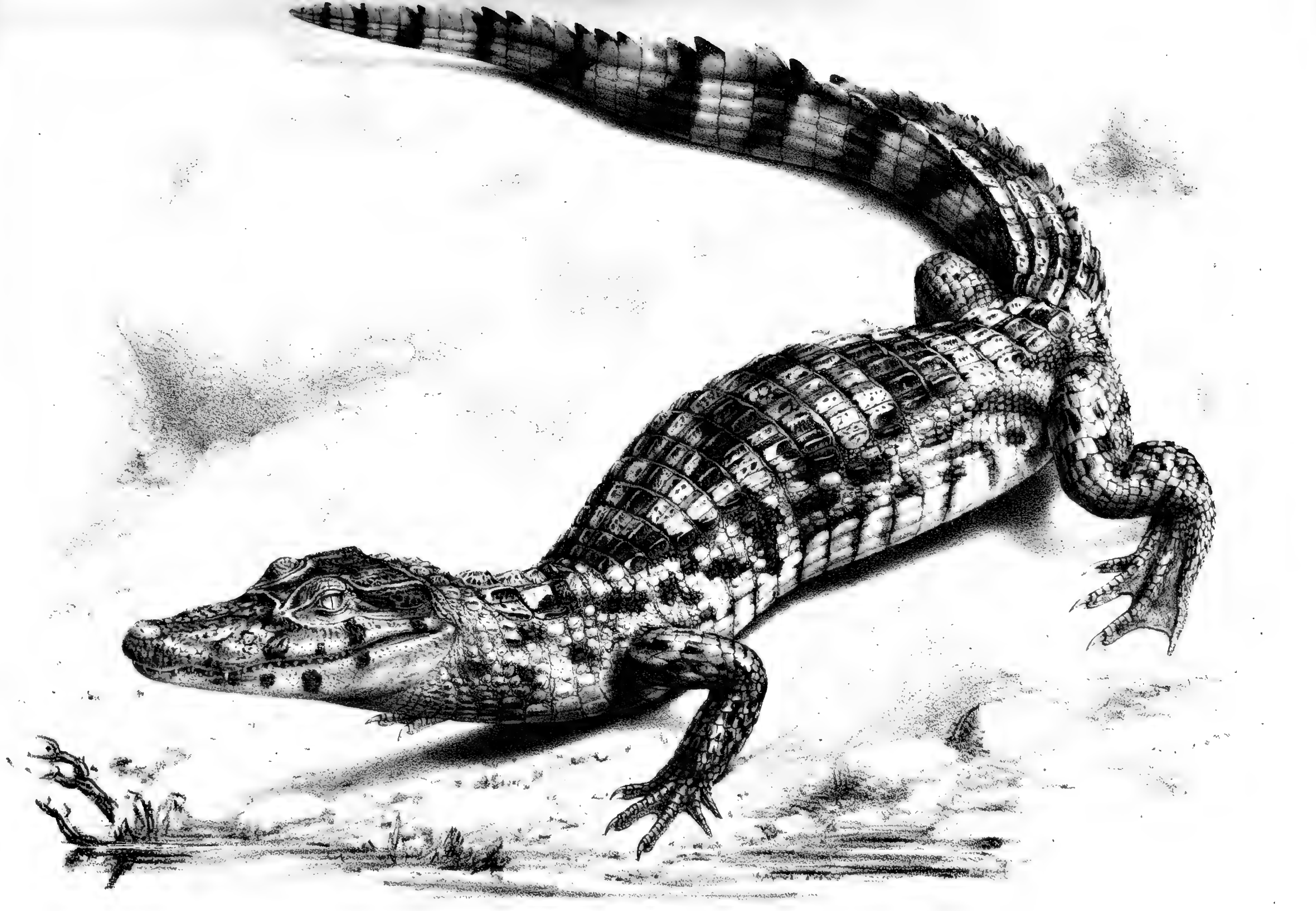


1, 2, 3, MECISTOPS CATAPHRACTUS
4, 5, 6, CROCODILUS INTERMEDIUS.

G.H.Ford. W.West imp.

G. H. Ford

JACARE OCELLATA.



JACARE LONGISCUTATA

VIII. *Note to Memoir on the Indian Cetacea collected by* Sir Walter Elliot. *By* Professor Owen, *F.R.S., F.Z.S., &c.*

Read May 9th, 1867.

In relation to my paper on Indian Cetacea, read before this Society on the 26th of June 1865, and published in the Society's 'Transactions'[1], I have received the following letter from Sir Walter Elliot, K.S.I., F.Z.S., to whom I was indebted for the specimens upon which my observations were based.

Travellers' Club, 15th April, 1867.

"Dear Prof. Owen,—Soon after my arrival in town a few weeks ago, my attention was called to some of the details in your paper on Indian Cetacea, in the Zoological Society's 'Transactions.' In replying to some inquiries of Mr. Flower, at the College of Surgeons, regarding the skull of *Physeter simus*, I noticed that you had described two individuals, a male and a female, whereas I had never met with more than a single female specimen of this animal. I was puzzled to account for this; but as Mr. Sclater, who was with me at the time, stated that the original drawings from which the Plates had been taken were at the Zoological Society's office, I took an early opportunity of referring to them. I also sent to Scotland for a note-book in which I had entered remarks on specimens as they were obtained. On comparing these with your paper I found that the inaccuracies I had observed had been caused entirely by my own carelessness in furnishing you with the scanty and imperfect materials on which your paper was founded, and by my omission to eliminate a faulty drawing.

"You may remember that I first brought the crania to you in 1863, to know whether you thought them of sufficient interest to be described. On my return to Scotland, I sent you drawings with some remarks of my own, but overlooked the faulty figure entirely, which thus remained in the packet with the true ones. In April 1865 you wrote to me for some further information with reference to the notes written on the drawings, and added that you could only find two skulls, although my notes referred to others. In reply I sent you copies of all the memoranda I could find, and said that the crania must be with you, as I had left them all at the Museum. I came to London some weeks later, and on calling to see you I found the crania were still missing; but they were subsequently discovered, and your paper was prepared.

"To account for the origin of the erroneous figure, I must premise that the office I held in Madras from 1849 to 1854 was a very laborious one, demanding my whole

[1] Vol. vi. p. 17.

time, and leaving little leisure for other pursuits. Having always been fond of natural history, I kept a draughtsman continually engaged in depicting objects of interest. My house was on the sea-shore, and the fishermen from several miles along the coast used almost daily to bring me something or other which they considered to be rare or curious. But as I went to my office at 10 o'clock A.M., and did not return till 6 or 7 P.M., my artist had orders to proceed with his sketches as soon as the specimens were brought to him. On my return home in the evening, my first business was to inspect his work. By dint of constant supervision, I brought him to the exercise of scrupulous accuracy. If I found the least mistake, I had another drawing made the following day. He was principally engaged on naked mollusks, crustacea, and the mutations of lepidoptera, which he drew with the aid of the microscope. To the exactitude of these, Messrs. Alder and Hancock's paper on the Indian Nudibranchs, in a former volume of the 'Transactions,' bears testimony.

"The Wongu or *Physeter* was brought to my house on the 28th of February, 1853. On examining the sketch the same evening, I was not satisfied with it, and therefore directed a more accurate drawing to be made, which was done, under my inspection, early the following morning. I was much interested in the specimen, which I believed to exhibit an entirely new form; and I made the following note in pencil on the back of the revised drawing, which is still legible:—'If the description of the Porpoise-family is correct, this must be a very different genus. The mouth is small, very much under the rounded snout, not reaching so far back as the eye, which is far above it, in a line with the rounded snout. The blow-hole is in front of the eyes, and (in this individual[1]) to the left of the middle line of the back, opening diagonally, with the points curving slightly backwards. Colour above shining black, smooth; beneath pale, and in this one discoloured with blood. Fore part (*i. e.* in front of the dorsal) depressed; behind the D. much compressed; the part nearest the tail rising into a sharp ridge.' On the face of the drawing I wrote in ink 'new sp. Tel. name, *wongu*: adult ♀: Waltair, March 1, 1853;' and under the mouth I noted the dentition '$\frac{1}{9}$. $\frac{1}{9}$.' On the first or cancelled sketch, the only writing was a note in the handwriting of the painter, 'Found at Waltair on the 28th Feby. '53,' and, in Telugu characters, the name '*wongu*.'

"Having completed the drawing, I made the following entry in my note-book:— 'March 1, 1853.—A large Porpoise was brought by the Vizagapatam fishermen, of which the following is the description:—

	ft.	in.	ft.	in.
Total length			7	2
From muzzle to spiracle	0	7		
From spiracle to dorsal	2	9		
From commencement of dorsal to end of caudal	3	10		
			7	2

[1] I then thought this circumstance was accidental.

	ft.	in.	ft.	in.
Length of dorsal from insertion in front to tip			1	0
Breadth of ditto.			0	11
Lateral measurements.				
Length from snout to insertion of pectoral	1	5		
Length from insertion of pectoral to vent	3	7		
Length from vent to centre of caudal	2	3		
			7	3
Inferior measurements.				
Length from snout to vent	5	0		
Length from vent to centre of caudal	2	3		
			7	3
From snout to eye			0	11
Length of gape			0	4
Girth where largest (in front of dorsal)			4	4
Length of pectoral			1	2
Breadth of caudal			1	10
Length of vent			0	7
Length of small apertures at either side of ditto			0	2

"'This very remarkable animal does not agree with any known genus or species. The fishermen call it *wongu*. The snout is rounded and blunt, the mouth, small and placed far below it, the teeth $\frac{1}{9}.\frac{1}{9}=20$. The eyes considerably above the mouth, and nearly over the termination of or a little behind the gape; the spiracle before the eyes, situated to the left of the dorsal or central line, obliquely placed as regards its length, slightly curved and the points turning backwards.

"'The colour is shining black above, growing gradually paler towards the belly, which is coloured in the drawing from the blood which had flowed over and stained it. The skin is quite smooth. The body in front of the dorsal large and much depressed. Behind the dorsal it becomes smaller and compressed more and more towards the caudal, the latter half (between the dorsal and caudal) being compressed into a sharp ridge, which runs into the base of the caudal fin.

"'This was an adult female, from which was taken a single perfect fœtus with the same peculiarities as the dam, viz. the diagonal spiracle on the left of the dorsal line, the points curving slightly backwards. The skin of this was stuffed, but was unfortunately carried away by a Jackal, when being dried in the garden.'

"On my return to England eight or nine years afterwards, I showed my drawings to several persons interested in such matters. Those of the mammalia were for some time in the hands of the late Dr. Coldstream, who exhibited them at a meeting of the Natural History Society of Edinburgh. They were subsequently lent to several others in Scotland, among them to a medical gentleman, surgeon to a whaling-vessel, who had paid much attention to cetacea, and who had them in his possession for some time.

"In the course of these migrations some liberties appear to have been taken with the drawings themselves. On the cancelled figure of the *Physeter*, I now perceive a faint pencil-note in an unknown hand, "wongao," which is wrongly spelt, and quite unauthorized. This has been followed by the addition of a male organ to the figure, also quite gratuitous. No wonder, then, that you were led into error; and I cannot sufficiently blame myself for not having made a more careful scrutiny of the drawings before despatching them.

"It also occurs to me that, owing to the fragmentary form in which my notes were communicated to you at different and distant dates, you may have overlooked the fuller and more careful description forwarded in my last letter; for the text corresponds more nearly with the pencil-note on the drawing; and the proportions assigned by you to the several parts of the specimen, which differ slightly from my measurements, appear to have been taken from the drawing above, which, though made by measurement, was not exactly according to scale.

"I have gone into greater detail than perhaps was necessary in explanation of these circumstances, to enable you to make such corrections as you may think necessary to your very valuable and interesting paper, with reference to matters of fact in which I unfortunately misled you.

"Yours very truly,

"WALTER ELLIOT."

"*To Professor Owen, F.R.S.*"

IX. *Contributions towards a more complete knowledge of the Skeleton of the* Primates. *By* St. George Mivart, *F.L.S., Lecturer on Comparative Anatomy at St. Mary's Hospital.* Part I. *The Appendicular Skeleton of* Simia.

Read December 13th, 1866.

[Plates XXXV. to XLIII.]

THE skeleton of the Orang-Outang, besides earlier notices, has been more or less carefully described by Owen[1], De Blainville[2], and W. Vrolik[3]. These descriptions, however, were anterior to the discovery of the Gorilla, which has necessitated fresh and more detailed examinations of and comparisons between the animals most nearly resembling Man.

Such detailed and elaborate investigations have been instituted, and similar descriptions published, by Professor Owen[4] with regard to the skull and spinal column of the Gorilla, the Chimpanzee, and the Orang; and Professor Huxley[5] has carried yet further investigations as to the condition presented by the skulls of those animals, and the modifications undergone by them during growth.

The limb-bones also of the Gorilla and Chimpanzee have been thoroughly investigated by Professor Owen[6]; but the appendicular skeleton of the Orang has not yet been described with similar care and minuteness.

Yet this highly interesting form, which in some respects resembles Man more than any other animal does, fully deserves to be made the subject of the most careful study, especially as it is more than probable that at no very distant date it will share the fate of the Dodo and *Dinornis*, while we may hope that tropical geology will one day cause a careful description and complete delineation of the bones of *Simia* to be much prized by some future palæontologist.

The opportunity of furnishing such a description and such delineations is presented by the rich osteological collection of the British Museum, containing as it does eleven skeletons of the Orang-Outang, four of these being fully adult.

I propose, then, to describe each bone of the Orang in detail, and to compare its characters with those of the Chimpanzee, the Gorilla, and Man.

Scapula. (Plate XXXV.)

The bladebone of the Orang is a triangular plate of bone, in some respects,

[1] Trans. Zool. Soc. vol. i. 1835.

[2] Ostéographie, "Primates: *Pithecus*," p. 27, 1839.

[3] Recherches d'Anat. Comp. sur le Chimpansé, 1841.

[4] Trans. Zool. Soc. vols. iii. & iv.

[5] Paper read before the Zoological Society on the 8th November, 1864.

[6] Trans. Zool. Soc. vol. v.

and perhaps on the whole[1], resembling Man's more than does that of any other animal.

If the bone is placed with the glenoid surface vertical, and compared with a similarly placed human scapula, the main difference will be seen to arise from the fact that, in the Orang, the inferior[2] vertebral angle is so much less produced downwards, while at the same time it extends more backwards, the angle formed by the axillary margin with the glenoid surface being only from 110° to 120°, instead of being from 135° to 140°, as in Man; while the prevailing direction of the vertebral margin, instead of being, as in him, nearly parallel with the glenoid surface, forms with it a marked angle open downwards. In both these respects *Simia* agrees more or less closely with *Troglodytes*; but in the direction of the spine of the scapula, the former genus differs from Man in a way opposite to that in which *Troglodytes* differs from him; for the angle (open upwards) formed by the spine with the glenoid surface, is from 65° to 70°, and therefore less than in Man, in whom it is about 82°; while in *Troglodytes* it is from 86° to 100°. Thus there is less obliquity in the position of the spine on the blade[3] than in *Troglodytes*, and the proportion borne by the supraspinous fossa to the infraspinous one[4] is much less, the latter sometimes[5] predominating more than even in Man.

The spine commences at the lower end of the uppermost fifth of the vertebral margin of the scapula, by a marked flat triangular space, which is sometimes larger both absolutely and relatively than the same part in Man, thus differing notably from *Troglodytes*, where the triangular surface is very indistinctly marked or absent (Pl. XXXV. fig. 1 *s*).

The spine, apart from the acromion, forms a more elongated triangular plate of bone than in *Troglodytes*, and slightly more so than in Man. Its upper surface is in general markedly concavo-convex[6], and its under surface concave, to a degree never existing in *Troglodytes*, and which would not be found in Man but for the flattened and overhanging free border of the spine. This projecting border is, in *Simia*, very rough, the roughness continuing backwards almost to the triangular space before mentioned, and thus differing from the same part in *Troglodytes* (where the roughness is both less in degree and less extended) and more resembling that of Man. *Simia*, however, differs from *Homo* in that this rough free margin is much narrower, and that its lower margin much less overhangs the infraspinous fossa[7].

[1] Professor Huxley says of the Orang, "the scapula, on the whole, bears a greater resemblance to that of Man than it does in either the Chimpanzee or Gorilla" (Medical Times, 1864, vol. i. p. 565). W. Vrolik also says it is "broader and more analogous to the scapula of Man" than in the Chimpanzee (Todd's Cyclopædia, vol. iv. p. 203).

[2] In describing the skeleton of such an animal as the Orang apart from quadrupedal forms, I think it better to describe it as if in the erect attitude, and to speak of that as "inferior" which in ordinary mammals would be "posterior."

[3] Duvernoy, Archives du Muséum, 1855, t. viii. p. 24.

[4] Duvernoy, *loc. cit.*

[5] This is especially the case in the variety described as *Pithecus morio* by Prof. Owen, No. 1179 *b* in the Osteological Collection of the British Museum.

[6] Not so in the type of the variety *Morio*.

[7] Owen, Trans. Zool. Soc. vol. i. p. 364.

There may or may not be a conspicuous foramen, for a nutritious vessel, towards the middle of the upper part of the infraspinous fossa; and one or two such foramina may exist in the anterior half of the supraspinous fossa, near the base of the spine.

This base, or attached border of the spine, sometimes extends forwards rather nearer to the margin of the glenoid surface than it does in Man, and always approaches it more nearly than in the Gorilla, though not more so than, sometimes not so much as, in the Chimpanzee. The antero-external border of the spine is concave, as in Man and *Troglodytes*, but, as in the latter, is somewhat shorter (apart from the acromion) than in the human scapula. The acromion is flattened in the direction opposite to that of the spine, but is longer and narrower[1] than in Man or *Troglodytes*; its surface also is more roughened, and the facet for the clavicle is closer to the extremity of the acromion than in the last-mentioned genera. The degree of curvature of the process, and its prolongation towards a point over the middle of the glenoid surface, vary somewhat from individual to individual (Pl. XXXV. figs. 4 & 5).

The supraspinous fossa is generally about equally deep at its anterior and posterior ends, the base of the spine (otherwise than in Man or *Troglodytes*) being nearly parallel to the upper margin of the scapula. Sometimes, however, it is decidedly deeper at its glenoidal end; and rarely the vertebral end very slightly exceeds the rest of the supraspinous fossa in depth.

The infraspinous fossa is concavo-convex, as in Man and *Troglodytes*, the convexity, however, being sometimes more marked than in the latter genus, and always more extensive than in the Chimpanzee. *Simia*, however, agrees with *Troglodytes* in that the ridge of the axillary margin does not expand, as in Man, into a wide flattened surface for the *teres major*, but, on the contrary, only into a very narrow one. The infraspinous fossa is always, in the Orang, narrower, vertically, than is the supraspinous one at the glenoidal end of the spine, reversing the conditions which exist in Man. This excess of the supraspinous fossa is greater than in the Gorilla, but rarely, if ever, so great as in the Chimpanzee.

The subscapular fossa is not so concave as in Man, on account of the less inflexion inwards of the part of the blade which forms the supraspinous fossa. It is also less concave than in the Chimpanzee, and than in some specimens of the Gorilla. As in *Troglodytes*, the oblique ridges traversing this fossa are less marked than in Man.

The superior border of the scapula is the shortest one, but is longer absolutely, and still more so relatively, than in Man and *Troglodytes*.

It is slightly concave and nearly horizontal, instead of, as in Man and *Troglodytes*, sloping sharply down to the coracoid process[2] (Pl. XXXV. fig. 2). There can scarcely be said to be a trace of the suprascapular notch[3]. The vertebral margin is no longer,

[1] Owen. Trans. Zool. Soc. vol. i. p. 364.

[2] This slope is much more gradual than is generally the case in Man, in the scapula of an Andaman Islander, No. 1 NB, in the British Museum.

[3] This notch is almost indistinguishable in the same Andaman Islander.

as in Man and the Gorilla, the most extended one, nor is it equal to the axillary one, as sometimes in the Chimpanzee; but it is absolutely shorter. The part of it which is superior to the origin of the spine is much shorter, as compared with the part below[1], than is the case in Man, and very much more so than in *Troglodytes*, from three-fourths to five-sixths of the vertebral margin being below the origin of the spine. If not straight, this margin is very slightly convex, and scarcely ever[2] presents a trace of sigmoid curvature, the part at or near to the origin of the spine being sometimes[3] more prominent than the rest, instead of less so as in *Troglodytes*.

The axillary margin is unlike that of the higher forms in that it is decidedly convex (Pl. XXXV. fig. 1) in almost all cases, though in the variety *Morio* it is more nearly straight (Pl. XXXV. fig. 3). The ridge near the glenoid surface, for the attachment of the *triceps*, is prominent, and, as in *Troglodytes*, is continued a longer distance, and bounds externally a much wider groove than is the case in Man.

The superior vertebral angle, though very distinctly marked, is much less produced than in Man and *Troglodytes*; hence the very slight concavity of the upper margin (Pl. XXXV. fig. 2).

The inferior vertebral angle is rather more obtuse[4] than in the higher forms, *i. e.* than in Man and *Troglodytes*.

The glenoid surface is pyriform (Pl. XXXV. figs. 4 & 5 *g*), with the broad end downwards, as in *Troglodytes*; it is more elongated in proportion to its breadth than in Man, but it is more concave vertically than in the Chimpanzee or Gorilla.

The coracoid process is shorter and thicker than in Man, and is broadest behind[5], being very much expanded and flattened at the posterior part of its upper surface. Its inclination towards the glenoid surface is much as in the Chimpanzee, and greater than in Man and the Gorilla, but it agrees with that of these Apes, and differs from Man's in being directed more downwards and less forwards (Pl. XXXV. fig. 2).

This process is subject to considerable individual variation as to its length[6] (Pl. XXXV. figs. 4 & 5), and as to the presence or absence of a smooth groove in its inner surface[7].

The coracoid is entirely separate from the rest of the scapula when the first true molar of each jaw has come into use[8].

Clavicle. (Plate XXXVII. figs. 1–4.)

The clavicle of the Orang is much elongated, and both absolutely longer, and longer as compared with the spine, than in Man or *Troglodytes*. Indeed in the Orang the

[1] Archives du Mus. t. viii. p. 24.

[2] There is a slight sigmoid curvature in the variety *Morio*.

[3] *E. g.* in the specimen No. 55. 12. 26 in the British Museum.

[4] Scarcely more so in the variety *Morio* than sometimes in the Gorilla.

[5] Also the case in the variety *Morio*.

[6] In the specimen 3 A in the British Museum it is very short, in 3 C, however, it is much longer.

[7] Present in both scapulæ of No. 3 C in the British Museum; also in the Gorilla No. 1011 I.

[8] Such is the case in the specimen No. 3 H in the British Museum.

clavicle decidedly exceeds one-fourth of the length of the spine (as measured from the atlas to the coccygeal end of the sacrum), while in Man and *Troglodytes* it always, as far as I have observed, falls short of that proportion. The clavicle of the Orang also more nearly equals the length of the scapula than in the higher forms[1].

Its curvature is very slight, much less than in Man and the Chimpanzee, and less also than that which often exists in the Gorilla. The sternal curve, convex forwards, is very much more extensive than is the backwardly convex curvature of the outer or acromial part[2]. The acromial end bends decidedly somewhat downwards. The curvature does not appear to be greater in young than in old individuals[3], nor in small adult specimens as compared with larger ones (Pl. XXXVII. figs. 3, 4).

The two extremities of the bone are more or less flattened, the sternal articular surface being generally long and narrow, compared with the form it presents in Man and *Troglodytes*. The long axis of this surface is sometimes nearly parallel with the greatest diameter of the acromial end of the bone.

The clavicle of *Simia* may be described as presenting three surfaces and three margins. Of these, the first or superior and the second or more or less anterior one extend the whole length of the bone; but the third or inferior surface does not reach to the sternal extremity of the clavicle, being replaced by an extension of the second or more or less anterior surface, which here assumes a nearly inferior position.

The first or superior surface is smooth and pretty well marked off (along its posterior margin) from the third or inferior surface by a ridge continued inwards from the tubercle for the conoid ligament, but which does not attain the sternal end of the bone, where the first surface is separated behind from the second one by the strong ridge for the rhomboid ligament. It is separated, towards the acromial end of the clavicle, from the second or more or less anterior surface by a very strong and rough ridge (Pl. XXXVII. figs. 1 & 2 *d*) for the *deltoid*[4]; but towards the sternal end of the bone a slight one (for the attachment of the *pectoralis major*[5]) serves as the line of demarcation between the first and second surfaces in front.

The second, a more or less anterior surface, is wide and concave towards the acromial end of the bone, where it is limited above by the very prominent and rough ridge for the *deltoid* before mentioned, and below by the anterior boundary of the third or inferior surface; towards the sternal end of the bone this surface becomes rather infe-

[1] De Blainville has found it to exceed the scapula in length (Ostéographie, "Primates: *Pithecus*," p. 30).

[2] Archives du Mus. t. viii. p. 25.

[3] As shown in the immature specimen No. 3 H, in the osteological collection of the British Museum.

[4] Judging from the representation given by Professor G. Sandifort in his treatise on the anatomy of the Orang Outang, in 'Verhandelingen over de Natuurlijke Geschiedenis der Nederlandsche overzeesche bezittingen,' Leyden, 1840, p. 48, and tab. 3. fig. 2 C; also from that of Cuvier in the 'Recueil de Planches de Myologie,' pl. 15. fig. 2 *k*.

[5] Mr. W. S. Church describes part of the pectoralis major as arising from the clavicle in the Orang (Nat. Hist. Review, vol. i. p. 513). Cuvier also so represents it (Recueil de Planches de Myologie, pl. 15. fig. 2 *j*).

rior in position, and presents a more or less marked and depressed triangular surface (Pl. XXXVII. fig. 3, between *p* and *r*), towards the sternal end of which there is generally a nutrient foramen. This triangular surface is bounded inferiorly and posteriorly by a more or less marked ridge and roughened tract (Pl. XXXVII. fig. 3 *r*), doubtless answering to the rough surface serving for the attachment of the costo-clavicular ligament in Man. Superiorly and anteriorly the surface is bounded by the much more faintly marked ridge already mentioned, which, no doubt, gives origin to the *pectoralis major* (Pl. XXXVII. fig. 1 *p*).

The third, or inferior surface, does not, as has been said, reach the sternal end of the bone, but terminates at a point about an inch and a half from that extremity. The first and second surfaces (which are separated from each other behind and below by the third surface for the outer four-fifths of the bone) come into juxtaposition, behind as well as in front, at the point where this third or inferior surface has its sternal termination. This last-mentioned surface is more or less concave till near the acromial end of the bone, where, in adults, it is very rough. There is a very large tubercle at the posterior margin of this surface (Pl. XXXVII. figs. 2 and 3 *c*), serving for the attachment of the conoid portion of the coraco-clavicular ligament, immediately in front of which tubercle there is sometimes a very conspicuous nutrient foramen. The line for the trapezoid portion of the same ligament is generally very prominent (Pl. XXXVII. fig. 3 *t*); and behind and external to it there is sometimes[1] a small, yet marked fossa; but the concavity beneath the acromial end of the bone is never so marked as it often is in *Troglodytes*[2].

The acromial end of the bone is very little expanded in *Simia*; and in this the Orang presents a marked contrast to the Gorilla; and it also differs from *Troglodytes* in the presence of the second or mainly anterior surface, with its strongly marked ridge above, in the great roughness of the inferior surface of the acromial end of the bone, and in its generally elongated sternal extremity.

If the Orang be compared with Man, it will be seen that his clavicle would resemble the Orang's, if it were much straightened, the sternal end compressed, and the front edge, towards the acromial end, widened out into a concave surface surmounted by a prominent ridge, the expansion of the acromial end restricted, but the tubercle for the conoid ligament considerably enlarged.

Humerus. (Plate XXXVI.)

This bone is of great size in the Orang, but nevertheless is not, as in Man and *Troglodytes*, the longest bone of the arm, being always exceeded in length by the ulna, and sometimes by the radius also.

As in the Gorilla, it exceeds three-fifths the length of the spine measured from the

[1] *E. g.* in Nos. 3 A and 3 C in the British Museum.

[2] See skeleton of a Gorilla, No. 1011 I, in the British Museum.

atlas to the lower end of the sacrum—a proportion decidedly exceeding that existing in the Chimpanzee, and greatly so that found in Man.

It is nearly twice the length of the scapula, which is less than in Man, though more than in *Troglodytes*.

The humerus of the Orang is not so straight as that of Man, the Gorilla, or Chimpanzee, but is more bent concave forwards, and sometimes[1] very much so (Pl. XXXVI. fig. 3). It is also more inclined ulnad at its lower end, the inner margin of the bone being decidedly concave (Pl. XXXVI. fig. 2).

As in Man and *Troglodytes*, the shaft may be described as consisting of three surfaces; but these are not well defined, the lowest fifth of the anterior surface not being so sharply prominent as in *Homo*. Thus the shaft is not so decidedly triangular at its lower part as in Man, neither is it so compressed laterally towards its middle as is generally the case in him, the Orang in both these respects agreeing more with *Troglodytes*.

The ridges proceeding upwards from the condyles are more marked than in Man or *Troglodytes*, especially the external one (or supinator ridge), which extends rather more than one-third up the shaft, and is sometimes limited above by a marked musculo-spiral groove. The ridge from the internal condyle extends about halfway up the shaft.

The posterior surface of the humerus is convex above, much as in Man, not flattened as in the Gorilla. Below, it is flat, as in the superior forms; it is not, however, turned so much outward as in them, but looks backwards, indeed almost equally with the upper part of the posterior surface (Pl. XXXVI. fig. 2).

The bicipital groove is sometimes more marked than in Man, and more sharply limited on each side at its upper part, though less so there than in *Troglodytes*. Lower down it is often more marked than in that genus, or than is generally the case in Man.

The surface probably serving for the insertion of the *coraco-brachialis* is extraordinarily rugose, more so than it ever is, as far as I have observed, in Man, and sometimes more so than in the Gorilla, much more so also than in the Chimpanzee; the roughness sometimes extends so far downwards as to join the ridge extending upwards from the internal condyle (Pl. XXXVI. fig. 4 *c*).

Near the surface for the *coraco-brachialis*, and a little below or a little above the middle of the bone, is the medullary foramen opening distad, as in Man.

The surface for the *deltoid* is not so much raised as is generally the case in Man; and below it is the more or less distinct oblique depression marking the course of the musculo-spiral nerve and artery (Pl. XXXVI. figs. 1 & 2 *s*).

The head of the humerus is very large[2] and rounded, its greatest diameter decidedly

[1] As in both the humeri of No. 3 B in the British Museum.

[2] Professor Owen says, "it is larger in *Simia satyrus* than in man, its extent equalling a complete hemisphere" (Trans. Zool. Soc. vol. i. p. 364). De Blainville remarks, "sa tête articulaire est surtout singulière par son énormité, son diamètre étant bien supérieur à celui de la tête du fémur" (Ostéographie, "Primates: *Pithecus*," p. 30).

exceeding the breadth of the two tuberosities, in which respect *Simia* differs from both Man and *Troglodytes* (Pl. XXXVI. figs. 5 & 6).

The posterior projection of the head is greater than in Man and the Gorilla, the bone immediately below the posterior part of the margin of the articular surface being more concave (Pl. XXXVI. fig. 4). The anatomical neck is more marked than in the higher forms, especially than in Man, and the head rises more above the summit of the radial (greater) tuberosity.

The angle formed by the groove separating the last-named tuberosity from the head, with a line connecting the two condyles, is in general much more acute than in Man and *Troglodytes.* There is nevertheless considerable individual variation, the angle being sometimes as near a right angle as in the Gorilla (Pl. XXXVI. fig. 5), while in other instances (Pl. XXXVI. fig. 6) it is only about 34°; yet, in all the specimens of *Simia* which I have examined, the head looks more directly backwards and less inwards than in Man and *Troglodytes.*

The radial tuberosity in the Orang is less prominent than in the Gorilla, and but little more so than in Man, though the surface for the *teres minor* is more sharply defined than in the higher forms (Pl. XXXVI. fig. 3). The surface for the *infraspinatus* looks more outwards and less upwards than in Man (Pl. XXXVI. fig. 3).

The ulnar, a smaller tuberosity, has its upper part next the bicipital groove less prominent than in Man or *Troglodytes.* Sometimes its lower part is more prominent than its upper portion. This tuberosity is more nearly approached by the margin of the articular surface of the head than in the higher forms; so that there is a small deep pit (Pl. XXXVI. fig. 4) between them, instead of a rather wide and slightly concave surface.

When the humerus is vertical, and its anterior surface opposite the observer, the ulnar tuberosity generally hides part of the lower margin of the neck of the bone, in which respect *Simia* resembles *Troglodytes* and differs from Man[1]. As in higher forms, no part of the head of the humerus is so hidden in the Orang.

At the lower end of the bone the ulnar, or inner, condyle is not so prominent as in Man or *Troglodytes,* nor does it extend so much downwards as in Man and the Chimpanzee, but appears as if it had been truncated obliquely from below upwards and ulnad, though this appearance is not so marked as in the Gorilla, on account of the less prominence of the condyle in the Orang. As in *Troglodytes,* there is not that concavity on its posterior surface which is more or less marked in Man.

The external, or radial, condyle is much as in Man and the Chimpanzee, and its most prominent point is situated lower down than in the Gorilla.

The inferior articular surface of the humerus is almost quite as in Man, except that its innermost part generally descends less below the rest of the surface than in him or the Chimpanzee, though more so than sometimes is the case in the Gorilla.

[1] Owen, Trans. Zool. Soc. vol. v. p. 4, pl. 3. figs. 1, 5, 8.

Whether, however, it descends more or less than in the Gorilla, it always differs from Man and agrees with *Troglodytes* in that the inner margin of the anterior surface of the trochlea (below the ulnar condyle) is vertical, and not inclined ulnad at its lower end as in *Homo*[1].

As in Man and the Chimpanzee, the surface above the capitellum, in front, is less concave than in the Gorilla.

The surface above the trochlea is almost always perforated[2].

The olecranal fossa is bounded on its radial side by a more marked and extended ridge than exists in Man and sometimes in the Gorilla (Pl. XXXVI. fig. 2). This ridge is the continuation upwards and backwards of that part of the articular surface which projects between the radius and the ulna.

Radius. (Plate XXXVII. figs. 5–8.)

The radius is very elongated and sometimes slightly exceeds the humerus in length, in which respect, as has been already said in describing the last-named bone, the Orang differs from Man and *Troglodytes.*

Its length as compared with that of the spine, measured as before, is much greater than in *Troglodytes*, being slightly upwards of three-fifths of that of the latter, instead of but little more or less than one-half. Of course the Orang differs much more still from Man in this respect.

The radius is always very nearly as much as, if not a little more than, twice the length of the scapula—a proportion not attained in the higher forms.

The shaft of the bone is considerably curved[3], with the concavity ulnad; but though much more so than in Man, the curvature is somewhat less than that which appears generally to exist in the Gorilla.

The radius of the Orang is so rounded a bone that it can no longer be said to have the three surfaces and three margins existing in that of Man.

The anterior face, however, is pretty well defined and expands distally; the surface for the *flexor longus pollicis*, however, is very slightly marked, much less so than in *Troglodytes*, while it presents nothing like the concavity whence that muscle takes its origin in Man.

The foramen for the nutrient vessels is situated towards the lower end of the upper third of the bone, and rather on the radial side of the anterior surface, instead of on its ulnar side as in Man and *Troglodytes.* It is, however, directed proximad, as in the higher forms just mentioned (Pl. XXXVII. fig. 5).

The lower end of the anterior surface is more concave transversely than in Man,

[1] See Trans. Zool. Soc. vol. v. pl. 3. figs. 1, 5, 8.

[2] It is imperforate in both humeri of No. 3I and in those of No. 3H 50. 8. 15. 1 in the British Museum.

[3] W. Vrolik remarks "Il me paraît que cette courbure est un produit de l'âge" (Recherches d'Anat. Comp. sur le Chimpansé, p. 13).

though the concavity which is in him produced by the projection forwards of the distal margin of the bone is wanting, that margin in the Orang, as also in *Troglodytes*, not being similarly prominent.

The posterior surface presents but a very slight flatness for the origin of the extensors of the pollex; and sometimes, indeed, there is no flattening perceptible. The external surface, which generally in *Simia* passes insensibly into the posterior one, presents a rough tract and a slight excavation for the *supinator teres*, extending downwards nearly to the middle of the bone.

Of the three margins which exist in Man, the posterior one is, in the Orang, never more than faintly marked, and that only towards the middle of the bone.

The external margin of the radius of Man may be said to have disappeared altogether in the Orang; but the internal margin, for the interosseous ligament, is distinctly marked, though it is never nearly so sharply projecting as in him and the Chimpanzee, and scarcely so much so as in the Gorilla.

The bicipital tuberosity is much less prominent than in Man; but its surface is more excavated, and, as in *Troglodytes*, is much more ulnad in position (Pl. XXXVII. fig. 6 *b*).

The bone is not so contracted at its neck as in Man and the Chimpanzee, and the rim or margin[1] of the head is not so sharply marked inferiorly as in them, the Orang in these points resembling the Gorilla. The proximal articular surface of the head is less concave than in the human radius.

A little above the styloid process there is a very prominent and rough surface (Pl. XXXVII. fig. 5 *a*) for the insertion of the *supinator longus*. The styloid process itself is not so pointed as in Man and *Troglodytes* (Pl. XXXVII. fig. 5 *f*).

The grooves for the extensor tendons are quite similar to those of Man, except that they are sometimes more marked than in him; and this is even the case with the groove for the *extensor secundi internodii pollicis* and that for the *extensor ossis metacarpi pollicis* (Pl. XXXVII. figs. 6 & 7).

The articular surface for the reception of the ulna looks more backwards than in Man, especially when the ulnar angle of the anterior side of the distal end of the bone is much produced forward and ulnad, as is sometimes the case (Pl. XXXVII. fig. 6 *g*).

The carpal surface at the inferior end of the bone has the internal quadrate surface for the semilunare larger, in comparison with the triangular one for the scaphoides, than is the case in Man (Pl. XXXVII. fig. 8).

Ulna. (Plate XXXVIII.)

This bone, which, unlike the radius, seems in the Orang to be constantly longer than the humerus, bears much the same proportion to the ulna of Man and *Troglodytes* that the radius of the Orang bears to the radius of those forms.

When its anterior (flexor) surface is opposite the observer (Pl. XXXVIII. fig. 1),

[1] Owen, Trans. Zool. Soc. vol. v. p. 7.

the shaft may be seen to have a sigmoid curvature, which is convex ulnad below, above concave. This curvature is more marked than is generally the case in Man, or than sometimes in the Gorilla; it is less so, however, than in the Chimpanzee. When the bone is viewed laterally (Pl. XXXVIII. figs. 2 & 4), the shaft is seen to present a curve, convex backwards, which is slightly more marked than in Man, but not quite so much so as in *Troglodytes*.

The body, or shaft, of the ulna is more rounded than in Man or *Troglodytes*, and can hardly be said to present the three surfaces and margins usually described as existing in the human ulna, the parts which correspond to the anterior and posterior margins of Man being so ill defined. The ulna tapers distally, but, on account of the length of the bone, more gradually than in the higher forms.

The anterior surface of the shaft has a more or less flattened, and even sometimes decidedly concave (Pl. XXXVIII. fig. 1) surface for the *flexor profundus digitorum*; and the nutrient foramen, much more conspicuous than in Man or *Troglodytes*, is more or less remote from the radial margin of the bone, and rather below the uppermost third of its total length (Pl. XXXVIII. fig. 1 *b*). As in the higher forms, its direction is proximad.

The internal surface of the shaft is smooth, but more convex than in Man and *Troglodytes*, except at its summit, where the concavity is more extensive than in them, reaching as it does somewhat more nearly to the superior limit of the olecranon (Pl. XXXVIII. fig. 2).

The posterior, or radial, surface of the shaft is less strongly divided into two parts than in Man and the Gorilla, though the lower and much larger one (serving to give origin to the extensors of the pollex and index) is generally as flat as in Man, and more so than in *Troglodytes*; very rarely it is strongly concave.

An anterior margin can sometimes hardly be distinguished, and never extends, as in Man, from the coronoid process to the lower extremity of the ulna. Sometimes, however, it can be traced from that process down to somewhat below the level of the medullary foramen. Similarly the posterior margin of the human ulna (which extends from the olecranon to the styloid process, and gives attachment to an aponeurosis common to the *flexor profundus digitorum*, the *flexor carpi ulnaris*, and the *extensor carpi ulnaris*) is in the Orang represented by a prominence which ceases to be distinguishable at about the middle of the ulna.

The external or radial margin begins above at the posterior margin of the lesser sigmoid cavity, and extends rather more than two-thirds down the bone. It is not so sharp as in man and the Chimpanzee, but it is more so than in the Gorilla. The sharpness, however, generally only extends along about the middle third of the bone, which at that part is considerably roughened for a greater or less extent close to the radial border (Pl. XXXVIII. fig. 1 *a*). Very rarely, however, the radial margin is enormously produced[1]. In the Orang, unlike the higher forms, the upper part of this margin does

[1] As in the specimen in the Collection of the British Museum, which bears the No. 32, from the MS. catalogue of the Zoological Society's Collection.

not bound anteriorly the surface for the *anconæus*, but is separated from that surface by a flattened tract of bone interposed (Pl. XXXVIII. fig. 4) between it and the ridge which does so limit the anconeal surface.

The olecranon process is small and scarcely broader relatively than in Man, and, as in him, it does not project so much ulnad as it does in *Troglodytes*. It is not in any way so prominent as in that genus, being even less so than in Man (Pl. XXXVIII. figs. 2 & 6).

The greater sigmoid cavity (Pl. XXXVIII. fig. 1 *g*) is formed nearly as in Man, except that it is broader in proportion to its length than in him, or indeed than in *Troglodytes*. The lesser sigmoid cavity is less extended from above downwards, and more from behind forwards, than in the Gorilla, thus resembling more the form it presents in Man and the Chimpanzee.

The coronoid process is broader both absolutely and in proportion to its projection forward than in the two last-named forms, and it is also relatively broader than it is sometimes in the Gorilla.

The tubercle for the *flexor sublimis digitorum* is, as in the Gorilla[1], well developed.

The fossa for the *brachialis anticus* is very marked and deeper than in Man or the Chimpanzee, or than is sometimes the case in the Gorilla (Pl. XXXVIII. fig. 1 *c*).

The fossa for the *anconæus* is much smaller relatively than in Man, and is less defined anteriorly by the ridge running downwards and backwards from the hinder end of the lesser sigmoid cavity, that ridge being (as also in the Chimpanzee, but not in the Gorilla) much less marked than in Man. On the other hand the posterior margin of the anconeal fossa is much more sharply defined than in the higher forms (Pl. XXXVIII. fig. 4 *f*).

As in the Chimpanzee, but not in the Gorilla, the surface for the *supinator brevis* is much less concave than in Man, and, indeed, is but slightly marked.

In Man and *Troglodytes* this surface for the *supinator brevis* is contiguous for almost its whole extent with that for the *anconæus*, the surface for the *extensor ossis metacarpi pollicis* only slightly intervening between them inferiorly. In the Orang, however, a wide flattened tract of bone (serving most probably to give origin in part to the extensors of the pollex) extends up almost to the lesser sigmoid cavity (Pl. XXXVIII. fig. 4). This tract is bounded in front by the upper end of the external or radial margin of the ulna; posteriorly it is limited by the ridge running downwards and backwards from the last-named surface (Pl. XXXVIII. fig. 4 *e*) and bounding anteriorly the surface for the *anconæus*.

At the lower end of the ulna on the inner side of its anterior face is a ridge serving to give attachment to the *pronator quadratus*[2] (Pl. XXXVIII. figs. 1 & 2 *x*). It is much more marked than in the higher forms.

As in *Troglodytes*, the distal articular surface of the shaft of the ulna is relatively

[1] See Owen, Trans. Zool. Soc. vol. v. p. 8.

[2] Noticed by Professor Owen, Trans. Zool. Soc. vol. i. p. 364. He refers to Webster and Treadwell's 'Boston Journal of Philosophy,' vol. ii. p. 570, and the 'Philosophical Magazine,' vol. lxviii. p. 186, 1826.

more transversely extended than in Man and is more reniform[1]; the concavity also between it and the styloid process is deeper (Pl. XXXVIII. figs. 5 & 6). This last-mentioned process appears to vary much as to size, from individual to individual (Pl. XXXVIII. figs. 2 & 6 *s*); but it is never so long, compared with the total length of the ulna, as in Man and the Chimpanzee[2].

The groove for the tendon of the *extensor carpi ulnaris* is generally very little marked, and less so than is the case in Man or the Gorilla, so far as I have been able to observe.

Manus. (Plate XLII.)

This segment of the skeleton attains, in the Orang, a greater absolute length than it does in Man or *Troglodytes.* Its proportion to the spine (measured as before) is also greater; but those borne by it to the rest of the pectoral limb and to the radius are less in the Orang than I have found them to be in the Chimpanzee, though greater than in Man or in the Gorilla. In its slenderness the manus of the Orang more resembles that of the Chimpanzee than that of the Gorilla or of *Homo.*

Carpus.

This segment differs very importantly from that of the higher forms, in that, as is well known, there is a separate and distinct ninth carpal bone[3], the os intermedium.

The proximal row of carpal bones forms a double arch, as in Man and *Troglodytes.*

The vertical arch (with its convexity proximad) is rather more acute than in Man; but the os pisiforme being small, its outline is not interrupted by that bone, as it is in *Troglodytes*, and so far it resembles more the homologous arch of the human hand than does the vertical carpal arch of the last-named genus (Pl. XLII. fig. 1).

As in the higher forms, the carpus in the Orang articulates directly with the radius only.

Scaphoides. (Plate XLII. figs. 2, 3, 4.)

This bone is very much narrower antero-posteriorly (from dorsum to palm), and relatively much more transversely extended, than in Man, and there is no transverse dorsal groove; so that the scaphoid of the Orang has very much the appearance that that of Man would have, if the part anterior to (or on the distal side of) his dorsal groove were cut away. Indeed the whole scaphoid of the Orang appears to answer to only the upper or proximal part of the human scaphoid[4] and of that of *Troglodytes.* It

[1] Owen, Trans. Zool. Soc. vol. v. p. 7.

[2] In a mounted specimen of the Gorilla in the British Museum, this process is very short indeed.

[3] Pointed out by W. Vrolik, Recherches d'Ant. Comp. sur le Chimpansé, p. 13; and Todd's Cyclopædia, vol. iv. p. 203.

[4] See De Blainville, Ostéographie, "Primates: *Pithecus*," p. 16; Professor G. M. Humphry, Limbs of Vertebrates, 1860, p. 4; Professor Huxley, Hunterian Lectures, Medical Times, 1864, vol. i. p. 565; and Dr. Lucae, Abhandlungen von der Senckenbergischen naturforschenden Gesellschaft, 1865, vol. v. p. 311. The

does not articulate with the trapezoides and os magnum, being separated from them by the os intermedium.

The proximal or superior side of the scaphoides articulates with the radius by a large rounded surface, which is decidedly less convex than the corresponding one of Man, or than that of the Gorilla, and is much like that of the Chimpanzee (Pl. XLII. fig. 2 *a*). It is less quadrate than in the Gorilla, and less transversely elongated than in Man.

The radial tuberosity (Pl. XLII. figs. 2–4, *b*) appears much produced, because of the narrowness of the bone. It is not, however, really very much more so than in Man, and is not so much so as in *Troglodytes*. There is a deeper concavity between the tuberosity and the radial articular surface than in Man.

The distal, or inferior, side of the bone presents a strong concavity divided by a transverse prominence into two articular surfaces. The smaller and more proximal of these (Pl. XLII. fig. 3 *c*) joins the semilunare, and, as in *Troglodytes*, is larger than the corresponding surface of Man. The one nearer the palmar (or more distal) surface is more concave, and articulates with the ulnar end of the os intermedium. Palmad and radiad of this is a small irregular surface, with several vascular foramina; and radiad, again, of this last surface is another smaller articular one (Pl. XLII. figs. 3 & 4, *e*) for the radial side of the third or proximal face of the intermedium. External again to this (*i. e.* on its radial side), and on the inferior aspect of the base of the tuberosity, is a small surface (Pl. XLII. fig. 4 *f*) which joins the trapezium.

On the upper part of the bone, towards its ulnar side and between the surfaces for the radius and semilunare, is a small irregular tract of bone with vascular foramina.

The interspace on the dorsal surface of the carpus, between the scaphoides and intermedium, answers to the dorsal groove of the scaphoid of Man and *Troglodytes*.

Intermedium. (Plate XLII. figs. 5, 6.)

The intermedium is a slightly crescentic bone, but not very dissimilar in shape to the cuneiforme, which about equals it in size; its extension, however, is mainly in the transverse direction.

It may be described as having three surfaces and three borders.

The first of these surfaces (Pl. XLII. fig. 5), and the one which looks backwards, downwards, and more or less radiad, consists for the most part of a transversely extended and slightly convex articular surface for the trapezoides. The ulnar end, however, presents a rough tract for the attachment of ligaments.

The second surface, which looks palmad, downwards, and ulnad (Pl. XLII. fig. 6), is concave, and articulates with the rounded head of the os magnum.

The third surface, the one which looks upwards and rather ulnad, is convex, and

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skeleton No. 5083 A, in the Museum of the Royal College of Surgeons, almost demonstrates this homology, as in that Chimpanzee the scaphoid has a development almost exactly corresponding to that of the scaphoid, plus the intermedium, of the Orang. See Philosophical Transactions, vol. clvii. (1867) plate xiv. fig. 1.

unites with the distal concavity of the scaphoides by a transverse articular surface, more or less interrupted towards its middle by a rough non-articular part.

The margin which separates the first and third of these surfaces has its middle portion produced into a more or less pointed process, projecting, proximad, over the groove which divides the bone from the scaphoides (Pl. XLII. fig. 5 *e*).

The radial end of the intermedium is obtusely pointed (Pl. XLII. figs. 5 & 6, *d*), but its ulnar end is truncated (Pl. XLII. figs. 5 & 6, *c*) and presents a small articular surface, more or less concave, which joins the semilunare. The angle at the junction of the distal end of this small surface with the ulnar end of the border separating the first and second of the before described surfaces, projects somewhat over the radial border of the dorsum of the os magnum.

Semilunare. (Plate XLII. figs. 7–9.)

This is very large in the Orang, and much larger, as compared with the scaphoides, than in either Man or *Troglodytes*. It is of about the same size as the semilunare of the Gorilla, and has very nearly the same shape. As compared with that of Man it is especially elongated from above downwards, and its proximal surface is more strongly convex from behind forwards, *i. e.* from dorsum to palm.

The surface for the cuneiforme (Pl. XLII. fig. 8 *c*) differs from the same surface in Man and *Troglodytes*, in that it is decidedly concave. The dorsum of the bone is narrower transversely than in Man or the Gorilla; and the concave surface for the magnum passes insensibly into that for the cuneiforme, though between the two is a very small part which joins the unciforme.

Cuneiforme. (Plate XLII. figs. 10 & 11.)

This bone is much elongated as compared with its homologue in Man and *Troglodytes*. It is of about the same size as the intermedium, and, as has been before said, it is of somewhat similar shape. It is, however, extended rather from above downwards than transversely, and its large articular surface is concavo-convex, instead of concave only, as in the intermedium.

It differs from the cuneiforme of both Man and *Troglodytes* in the convexity of the surface for the semilunare, and in the distance between the facet for the pisiforme and the proximal end of the bone.

The rough portion for ligaments of the anterior surface is continued as a wide and roughened groove (Pl. XLII. fig. 11 *c*), separating the articular surfaces for the unciforme and pisiforme. That for the last-named bone is smaller, absolutely as well as relatively, than in any of the higher forms. The smooth surface for the fibro-cartilage of the wrist joint (Pl. XLII. fig. 10 *c*) is more elongated than in Man or *Troglodytes*; but, as in the latter genus[1], the tubercle for the internal lateral ligament of the wrist is

[1] Trans. Zool. Soc. vol. v. p. 10.

small and less marked than in Man. The surface which joins the unciforme (Pl. XLII. fig. 11 *a*) is strongly concavo-convex, and thus differs much from that in Man, and more resembles the corresponding surface in *Troglodytes.*

Pisiforme. (Plate XLII. figs. 12–14.)

The pisiforme of the Orang is much smaller, both absolutely and relatively, than that of the Gorilla, and rather so than that of the Chimpanzee. It is always shorter than in the last-named form, but yet, sometimes at least, differs from the pisiforme of Man in being rather longer than broad. Its palmar surface (Pl. XLII. fig. 13) is slightly concave, and the bone projects downwards and ulnad near the unciforme process.

Trapezium. (Plate XLII. figs. 15–20.)

A striking difference exists between this bone in the Orang and the homologous one of the Gorilla, inasmuch as the two large tuberous processes which exist in the latter form[1] are here wanting. It differs in the same way, though to a less degree, from the Chimpanzee's; and even as compared with Man's, the tubercle and groove of its palmar aspect are somewhat less marked (Pl. XLII. fig. 17).

The saddle-shaped surface for the metacarpal of the pollex is always (as also in *Troglodytes*) much inferior in relative size to that of Man; indeed, even in absolute size, it is much inferior to his. There seems, however, to be considerable variation as to the development of this part, as sometimes (Pl. XLII. figs. 15 & 17, *a*) there is a very distinct, though small, saddle (the surface being strongly concavo-convex), while in other instances (Pl. XLII. figs. 16 & 18, *a*) both concavity and convexity are very slight. This variation is not confined to the Orang, but exists also in *Troglodytes*[2].

The surface for articulation with the metacarpal of the index (Pl. XLII. fig. 17 *b*) is generally very close to that for the metacarpal of the pollex—a circumstance in which the Orang differs from *Troglodytes*, and resembles Man. The surface for the index looks more palmad than in Man or *Troglodytes*, but, as in them, it is continuous with the articular surfaces for the trapezoides and scaphoides. The distal pair of these three surfaces form a more marked angle with each other than in Man and *Troglodytes*; while the proximal pair (for trapezoides and scaphoides) generally meet together at a rather more open angle than in those genera. A sesamoid[3] bone is interposed between the trapezium and the scaphoides on the radial side of those bones.

[1] Owen, Trans. Zool. Soc. vol. v. p. 10.

[2] The saddle is unusually little marked in the skeleton of a Gorilla, No. 5779 A, in the Museum of the Royal College of Surgeons; and in the detached and articulated manus of a Chimpanzee, No. 744, in the same collection, it is absolutely wanting. Professor Huxley has noticed the absence of a saddle-shaped surface in this species. See 'Medical Times,' 1864, vol. i. p. 428.

[3] Figured by Prof. Vrolik in Todd's Cyclopædia of Anat. and Phys. vol. iv. p. 204, fig. 124 *i*. Mr. W. H. Flower also informs me he observed its existence in the wrist of an adult male Orang in the Leyden Museum.

Trapezoides. (Plate XLII. figs. 21–23.)

As in *Troglodytes*, the relative extent of this bone from the dorsum of the manus to the palm is very much less in *Simia* than in Man. The two articular surfaces for the metacarpal of the index are of very unequal size—that on the ulnar side being very greatly in excess (Pl. XLII. fig. 22 *a*). The articular facet for the magnum is exceedingly small, and confined to the dorsal part of the ulnar side of the bone. That for the intermedium has its greatest diameter transversely extended, instead of from behind forwards (*i. e.* from dorsum to palm), as has the corresponding surface for the scaphoides in Man (Pl. XLII. fig. 23 *d*). The surface for the trapezium is concave. The proximal radial angle is a little produced, but not so much as is the case in Man.

Magnum. (Plate XLII. figs. 24–28.)

The distal part of this bone is much more transversely extended, as compared with the proximal part, than is the case in Man and *Troglodytes*; also there is a more marked lateral constriction below the head. As in the Gorilla[1], the antero-posterior (from dorsum to palm) extent of the distal surface is much greater than in Man; and, again, as in the Gorilla[2] and also in the Chimpanzee, the radial side of the distal articular surface is strongly notched (Pl. XLII. fig. 28 *a*). On the ulnar side of the same surface is a similar notch, which is much more marked than either in Man or *Troglodytes* (Pl. XLII. fig. 28 *b*). Indeed this distal articular surface has more the shape of the letter T than it has in the higher forms; but it resembles that of *Troglodytes* in being more concave towards its palmar margin than is the case in Man. The head of the bone, as also in *Troglodytes*, has a more radiad aspect than in Man; it articulates above with the intermedium and semilunare. As is the case in the higher forms, there is a small articular surface for the metacarpal of the index, towards the palmar border of the distal end of the radial face of the bone (Pl. XLII. fig. 26 *c*). The surface for the unciforme is, as in *Troglodytes*, more concave from above downwards than is the case in the human magnum.

Unciforme. (Plate XLII. figs. 29–33.)

This bone resembles its homologue in *Troglodytes*, and differs from that of Man in the large size and more downward production of the palmar process, also in the more acute angle formed by the surface for the magnum with that for the cuneiforme, and in the greater relative extent of the distal surface from before backwards (from the dorsum to the palm).

It differs from that of the Gorilla, as well as from that of Man, in the greater length from above downwards and the less relative transverse extent of the articular surface for the cuneiforme (Pl. XLII. fig. 32 *c*).

[1] Trans. Zool. Soc. vol. v. p. 10.

[2] *Loc. cit.*

Metacarpus.

The length of this segment of the limb (estimated by the third metacarpal), compared with that of the spine, is greater than in any higher species, namely about 18·2 to 100.

The relative length of the same metacarpal, as compared with that of the entire manus, is very much the same as in *Troglodytes*, namely about 39 to 100, and greater than in Man, in whom I have found it to be about 34·6 to 100.

The four outer Metacarpals.

As in the higher forms, these metacarpals in the Orang are thicker at each end than in the shaft; the distal extremities are wider than the proximal ends (though not so much so as in the Gorilla), and the shafts slightly broader distally.

The heads have their antero-posterior diameter (from dorsum to palm) about equal to their transverse dimensions.

The shafts are much elongated; and these metacarpals in the Orang are like the Chimpanzee's, and are more slender than those of the Gorilla or of Man. The shafts are also more rounded than in the higher forms, the dorsal flattening being less marked, while there are only faint traces (Pl. XLII. figs. 38 & 42) of those palmar tuberosities and ridges at the divergence of the interossei which are so marked in *Troglodytes*, especially in the Gorilla[1]. The processes on each side of the proximal ends of the palmar surfaces of the heads are much less marked than in any higher forms, especially than in *Troglodytes*. The fossæ on the sides of the heads are also less marked than in that genus. These metacarpals increase, not only in length but also in projection distad, from the fifth to the second successively.

First Metacarpal. (Plate XLII. figs. 35 & 36.)

This metacarpal presents a saddle-shaped surface for the trapezium, very like that of Man. The proximal prominence on the palmar side is less enlarged than in *Troglodytes*[2]; and the whole bone is more bent, with the concavity palmad, than in the higher forms. The shaft is sometimes slightly as it were twisted on its long axis.

Second Metacarpal. (Plate XLII. figs. 37–40.)

The shaft of this metacarpal is also somewhat twisted, and it is concave radiad. Its proximal end, like that of the same bone in the Gorilla, does not, as in Man and the Chimpanzee, bifurcate for the reception of the trapezoides; and its proximal surface is therefore less concave transversely. As in *Troglodytes*, the tubercle for the *flexor carpi radialis* (Pl. XLII. fig. 38–40, *a*) is stronger than in Man, but that for the *extensor carpi radialis longior* is not more marked than in him. Between these tubercles there is a deep groove (in which vascular foramina open), which is continued between the lower facet for the third metacarpal and the articular surface for the trapezoides. The ulnar

[1] Owen, Trans. Zool. Soc. vol. v. p. 11. [2] Owen, *loc. cit.*

lateral facets are, as in *Troglodytes*, divided by a deep groove; and, as in all the higher forms, the ulnar angle of the proxinal end of the palmar part is strongly inclined ulnad. Sometimes (Pl. XLII. fig. 34 II.) the proximal articular surface has a crescentic form, with the concavity of the crescent towards the dorsum.

Third Metacarpal. (Plate XLII. figs. 41–44.)

As in *Troglodytes*, so also in *Simia*, the proximal radial angle of the dorsum is less produced than in Man (Pl. XLII. figs. 41–43 *c*). Owing to this, the dorsal part of the proximal articular surface is less concave than in him, but the palmar part of that surface is more extensively convex. The Orang agrees with Man and the Chimpanzee, and, as far as I have observed, differs from the Gorilla, in having two facets on each side of this metacarpal, for articulation with the contiguous one (Pl. XLII. figs. 43 & 44). The proximal articular surface (Pl. XLII. fig. 34 III.) somewhat approaches the form of the letter T.

Fourth Metacarpal. (Plate XLII. figs. 45–48.)

The proximal end of this metacarpal is narrower transversely than in *Troglodytes* or *Homo*. The dorsal part of the proximal surface is more concave than in Man, though scarcely so much so as in *Troglodytes*. The palmar part of the same surface is much more convex, and is longer, from dorsum to palm, than in *Troglodytes*, and still more so than in Man. There are two articular surfaces for the third metacarpal, and the single one for the fifth metacarpal is larger than in any above (Pl. XLII. figs. 47 & 48).

Fifth Metacarpal. (Plate XLII. figs. 49–51.)

This metacarpal differs from the corresponding one in Man and *Troglodytes* in that its proximal surface is longer (from dorsum to palm), and is more convex, and at the same time less concave than in them (Pl. XLII. figs. 34 V. & 51).

Digits.

The proximal phalanges of the four outer digits of the manus are much curved, with the concavity palmad (more so than in Man or *Troglodytes*), though not so much so as are the homotypal segments of the pes.

They are also very broad, and have projecting lateral ridges (Pl. XLII. fig. 1), which are more developed than in Man, though not so much so as in *Troglodytes*[1].

The proximal phalanx of the pollex is more slender than in higher forms, and thus differs notably from its homologue in the Gorilla. The several second and third phalanges are formed nearly as are their homologues in the Chimpanzee; the second phalanges, however, are somewhat less conical. The distal ones, like those of *Troglodytes*, are more attenuated than those in the human manus. The proportion borne by

[1] Owen, Trans. Zool. Soc. vol. i. p. 365.

the first phalanx of the third digit to the length of the entire manus is greater than in Man or the Troglodytes.

The pollex, with its metacarpal, as compared with the spine, is longer in the Orang than in Man or *Troglodytes*; compared with the length of the manus it is, as in the last-named genus, much shorter than in Man. The proximal phalanx of the pollex is more slender than in *Troglodytes* or *Homo*, notably so as compared with that of the Gorilla.

The index, with its metacarpal, as compared with the spine, is longer than in the higher forms, as also in the third digit. Without their metacarpals these digits, when compared with the length of the manus, are scarcely longer proportionally than in the Chimpanzee, and but little more so than in Man or the Gorilla.

The difference between the length of the index and that of the pollex is greater than in the higher genera[1].

The fifth digit is the shortest, not counting the pollex; the second may or may not be somewhat longer than the fourth; and the third is the longest (Pl. XLII. fig. 1).

The order of projection is similar to that of length.

As in *Troglodytes*, the proportion, in the Orang, borne by the longest digit (without its metacarpal) to the longest metacarpal is less than in man, though it is somewhat greater than in the Gorilla.

The pollex does not reach to the distal end of the metacarpal of the index, but falls short by about one-eighth of the length of that metacarpal; it is therefore decidedly shorter, thus compared, than in the Chimpanzee, and still more so than in the Gorilla: and thus in this respect the Orang differs very widely from Man[2].

Os innominatum. (Plate XXXIX.)

This complex bone consists, as in the higher forms, of the ilium, ischium, and pubis anchylosed together. The ilium is wide, but less so in proportion to its height than in the Gorilla, and very much less so than in Man, being in fact much as in the Chimpanzee, though perhaps on the whole somewhat broader[3].

The external surface (Pl. XXXIX. fig. 1) is convex anteriorly, concave posteriorly; but generally the concavity is very much more marked and extensive than is the convexity, in which the Orang agrees with *Troglodytes*—as also in the depth of the concavity, which is much greater than in Man. The curved lines found on the human ilium are not to be distinguished in *Simia* any more than in *Troglodytes*; and the bone is somewhat less developed posteriorly than in that genus.

[1] Lucae, *loc. cit.* p. 308.

[2] As often before remarked or represented, Owen, Trans. Zool. Soc. vol. i. p. 365; De Blainville, 'Ostéographie,' Primates, *Pithecus*, p. 30; Huxley, 'Medical Times,' 1864, vol. i. p. 565; and Huxley & Hawkins, 'Atlas of Comparative Osteology,' plate x. fig. 3. Also Duvernoy, 'Archives du Mus.' vol. viii. p. 27; and Lucae, *loc. cit.* p. 305.

[3] As mentioned by Professor Owen, Trans. Zool. Soc. vol. i. p. 363, and by Professor Huxley, 'Medical Times,' 1864, vol. i. p. 565.

The internal surface (Pl. XXXIX. fig. 2) looks forwards, but not inwards, thus agreeing with the Chimpanzee, and differing from Man and the Gorilla. The part of the internal surface which is above the ilio-pectineal line is flat, or with only a very slight concavity[1]; this is sometimes supplemented, however (Pl. XXXIX. fig. 4), by an inflection of the anterior superior angle of the ilium. The "auricular" surface is more elongated in proportion to its breadth than in Man, in which respect it resembles *Troglodytes* (Pl. XXXIX. fig. 2 *m*). That part of the internal surface which is beneath the ilio-pectineal line is more convex than in Man and the Gorilla, the ilio-pectineal line itself not being so prominent as in these forms. This part of the inner surface (Pl. XXXIX. fig. 3) is also more elongated than in Man.

The crest of the ilium sometimes describes a decided sigmoid curve (Pl. XXXIX. fig. 5), though this is always much less marked than in Man, and is occasionally absent, namely, when the anterior end of the summit of the ilium is not at all inflected. In Man the crest is enlarged somewhat behind its anterior end, and more or less immediately over the acetabulum. In the Orang (as in *Troglodytes*) no such widening takes place; but on the other hand, there is sometimes at the anterior end of the crest (Pl. XXXIX. fig. 4 & 5 *a*) a very marked enlargement, which may answer to the one above-mentioned of Man; and if so, we may imagine that part of the ilium which in Man is anterior to it, to be altogether absent in the Orang. As in the higher forms, so also in *Simia*, the crest is always enlarged at its posterior end; but the crest, as a whole, is (as in *Troglodytes*) narrower in proportion to its length than in Man. The vertical curvature (as in the Chimpanzee) is much less than in Man or the Gorilla; but the crest is produced upwards somewhat suddenly at about the anterior end of its posterior third (Pl. XXXIX. fig. 1).

The anterior margin of the ilium is always concave, and often more so than in *Troglodytes*, though, as in the latter genus, the wide distance between the anterior spinous processes causes it to differ much from the form of the anterior margin of the ilium of Man (Pl. XXXIX. fig. 2).

As in *Troglodytes*, the anterior superior spinous process in *Simia* is not so marked and distinct a process as in Man; but the anterior inferior spinous process (Pl. XXXIX. fig. 2 *b*) is sometimes almost, if not quite, as prominent as in him. Sometimes, however, it is not more marked than in *Troglodytes*.

Within this process, and above the acetabulum, the ilium presents a smooth surface for the *psoas* and *iliacus* muscles; and no ilio-pectineal prominence marks the junction of the ilium with the pubis.

The upper part of the posterior margin of the ilium is, on the whole, nearly straight to the lower margin of the auricular surface; and though its outline is irregular, there is scarcely any trace of the concavity which exists in Man between the posterior termination of the crest of the ilium (or posterior superior spinous process) and the

[1] M. Duvernoy says "un peu creux," 'Archives du Muséum,' vol. viii. p. 28.

upper end of the auricular surface. This upper part of the posterior margin is, as also in *Troglodytes*, much longer than in Man.

The lower part of the posterior margin (below the auricular surface) is very decidedly concave, but, as in *Troglodytes*, the concavity is nothing like so strongly marked as in the human ilium (Pl. XXXIX. figs. 1 & 2 *g*). Indeed it is rather less marked than appears to be generally the case in *Troglodytes*.

The ilium forms a considerable portion of the acetabulum, but not quite so much of it as does the ischium. It is altogether superior to the depressed surface (for fat and vessels), which surface is entirely formed by the last-named bone.

The pubis has a horizontal ramus with three surfaces and three prominent lines, as in Man.

The superior or horizontal surface is broader than in *Troglodytes*, though it is nevertheless considerably narrower than in Man. This surface presents a narrow groove running from without inwards, and concave from behind forwards, the concavity being much increased by a very large process. This process (Pl. XXXIX. figs. 2, 3, & 4 *p*), which exists in almost all adults, is entirely formed by the pubis, and, being situated at the internal termination of the ilio-pectineal line, is probably (as Professor Owen[1] names it) the spine of the pubis. It is nevertheless so remote from the symphysis and so near the acetabulum that it has rather the appearance of an iliopectineal eminence.

The internal surface of the horizontal ramus (Pl. XXXIX. fig. 3) is smooth, and (not counting the just-mentioned spine) is narrower vertically, above the obturator foramen, than in Man.

The external or inferior surface is, as in Man, deeply grooved (Pl. XXXIX. fig. 4). Indeed it is often much more so than is sometimes the case in him, the Orang in this differing markedly from the Gorilla and Chimpanzee; in both of which (as far as I have observed) the groove is never more than slightly marked, while in the Chimpanzee it is often altogether absent.

The external extremity of the bone forms but a very small portion indeed of the acetabulum.

The body of the pubis is, as also in *Troglodytes*, thinner from within outwards, and more vertically extended than in Man; the margin bounding the obturator foramen is also thinner than in him.

There is no spine of the pubis other than the one already mentioned, and no process whatever near the symphysis, which, as also in *Troglodytes*, is much longer than in Man (Pl. XXXIX. fig. 2 *s*).

The descending ramus of the pubis resembles that of the Gorilla and Chimpanzee in being much wider than that of Man.

[1] Trans. Zool. Soc. vol. i. p. 363. W. Vrolik calls it "Épine pubienne ou éminence ilio-pectinée," 'Recherches d'Anat. Comp. sur le Chimpansé,' p. 10.

The ischium consists, as in Man, of a body and ramus; and part of the external surface of the former constitutes the greater portion of the acetabulum, including (as before said) the whole of its depressed tract. Below the socket for the femur the other part of the antero-external face (Pl. XXXIX. fig. 4) presents (as in *Troglodytes*) a wide surface of bone—concave from above downwards, and strongly convex from behind forwards—in the place of the narrow groove which in Man separates the acetabulum from the ischiatic tuberosity. The postero-external surface of this part of the ischium (Pl. XXXIX. fig. 1) is similarly elongated as compared with Man's structure, but in all the forms it is smooth and bounded inferiorly (as is also the outer surface) by the margin of the tuberosity of the ischium. In the Orang this surface is not prolonged backwards, as in Man, by so prominent an ischiatic spine, though this process is considerably more developed (Pl. XXXIX. figs. 1–4 *h*) than in the Gorilla, and sometimes than in the Chimpanzee also.

The tuberosity of the ischium is formed very much as in Man, and is less flattened beneath, and has its margin somewhat less everted than in *Troglodytes.* At the same time the Orang resembles the last-named genus, and differs from Man in that the rugose surface is prolonged more in the direction of the symphysis pubis (Pl. XXXIX. fig. 6), and less in that of the spine of the ischium than it is in him. It is, however, decidedly more prolonged up backwards towards the last-named process, than in *Troglodytes* (Pl. XXXIX. fig. 3 *l*).

The ramus of the ischium in the Orang agrees with that of the Gorilla and that of the Chimpanzee in being very much more vertically extended than in Man. Its external surface is also more concave, and its inferior border more everted, while the margin bounding the obturator foramen is thinner than in him.

The last-mentioned foramen is generally somewhat subtriangular, with one angle turned towards the outer end of the horizontal ramus of the pubis.

The acetabulum is longer vertically, in comparison with its breadth, than in Man. Its depressed surface and the cotyloid notch are very much smaller than in the higher forms (Pl. XXXIX. fig. 4 *f*).

The acetabulum is deepest superiorly, and more predominantly deep there than in Man, and somewhat more so than even in *Troglodytes.*

The anterior part of the pelvis does not descend so much as in the last-mentioned genus, but is more like that of Man in this respect.

The false pelvis is longer and more shallow than in the Gorilla, and still more so than in Man. As in *Troglodytes* the inlet of the true pelvis is "less[1] constricted anteriorly, less cordate, and more fully elliptical in shape" than in the human form. The ellipse, however, is, sometimes at least, less elongated than in *Troglodytes.*

As in the Gorilla and Chimpanzee, but a small part of the acetabulum is visible

[1] Owen, Trans. Zool. Soc. vol. v. p. 14.

when the outer surface of the ilium (Pl. XXXIX. fig. 1) is opposite the observer, instead of almost the whole of its cavity being so, as is the case in Man[1].

Femur. (Plate XL. figs. 1–7.)

This bone is exceedingly short in the Orang, both absolutely and relatively, as compared with Man and the Gorilla.

In *Troglodytes* it is more than half the length of the spine (measured as before), and in Man it is more than three-fifths of it; in the Orang, however, I find it less than half.

As compared with the length of the os innominatum the femur is somewhat longer in the Orang than in *Troglodytes*—as it is decidedly the longer of the two; still the proportion very much more resembles that existing in the last-named genus than Man's, as his femur is about double the length of his os innominatum.

A comparison of the femur with the humerus shows a greater difference from Man than that presented in *Troglodytes*, though even in the Chimpanzee the femur is slightly the shorter of the two, instead of very much the longer, as in Man.

When the femur of the Orang is made to rest with both condyles on a horizontal surface, and placed as nearly as may be in a vertical position, the bone does not incline outwards (peronead) superiorly so much as does that of Man when similarly placed; it does so, however, in a slightly greater degree than is the case in *Troglodytes*[2].

The body or shaft of the bone differs much from that of the femur of Man, and greatly resembles that of *Troglodytes*. This is the case as regards the absence of a strongly projecting *linea aspera*, the less transverse convexity of the anterior surface, the much greater antero-posterior compression of the bone, and its less degree of curvature convex forwards, the shaft being even straighter than in the Gorilla (Pl. XL. figs. 3 & 4). It also differs from Man's, and agrees with that of *Troglodytes*, in the large proportion borne by the transverse diameter to the length—though in this respect it resembles the Chimpanzee, it being more slender than in the Gorilla. The lateral expansion downwards of the shaft, though more gradual than in Man, is much less so than in the Gorilla; and the external margin of the same is more concave than in *Troglodytes*, and approximates, therefore, in its outline to Man's.

In the Orang, as in the Gorilla and Chimpanzee, the external and internal surfaces of the shaft are much narrower from before backwards than in Man. This arises from the non-projection of the *linea aspera*, which seems to be, as it were, flattened out in both *Simia* and *Troglodytes*, though least so in the Gorilla.

The anterior intertrochanteric line (Pl. XL. fig. 1 *e*) is continued into the spiral line (Pl. XL. figs. 2 & 3 *f*), and can be followed downwards to the entocondyloid prominence

[1] Owen, Trans. Zool. Soc. vol. v. p. 14.

[2] There is a certain amount of individual variation in this respect; in the specimen No. 3 *c* in the British Museum, the inclination is considerable, approaching that of Man.

(Pl. XL. fig. 2 *h*). About halfway down it approximates more or less towards the middle line of the posterior surface of the femur.

On the opposite side of the bone a more or less marked line, or rugose tract, extends from the base of the great trochanter downwards towards the external condyle[1]. The posterior surface of the femur, between these two lines, is more or less rough and irregular, and contrasts with the smoothness of the rest of the shaft.

As in *Troglodytes*, so also in *Simia*, there is no strongly marked ridge descending quite to the ectocondyloid prominence (as is the case in Man), neither does any ridge run downwards from the lesser trochanter.

Below the great trochanter, and more or less in the course of the long line descending towards the external condyle, there is a marked and rough depressed surface for the *gluteus maximus* (Pl. XL. fig. 4 *g*). The lower end of this depression does not reach to the middle of the bone's vertical extent.

As in *Troglodytes*, the popliteal space is flatter than is the case in Man.

The entocondyloid prominence (Pl. XL. figs. 1 & 2 *l*) is somewhat more developed than in *Troglodytes*, but not quite so much so as in Man. The ectocondyloid one is about the same as in the last-named genus, and therefore is more marked than in the human femur (Pl. XL. figs. 1 and 2 *k*).

I have not seen a conspicuous medullary foramen on the posterior surface of the femur in any one specimen of *Simia*.

As in the higher forms, the neck is considerably more vertically than antero-posteriorly extended. It forms with the shaft an angle (open inwards and downwards) of about 155°, which is considerably greater than that in Man, or than that in the Chimpanzee, and much more so than the corresponding angle in the Gorilla[2]. There is nevertheless some slight individual variation in this angle.

The great or peroneal trochanter never attains so high a level, compared with the head of the bone, as in Man, and still less than as in *Troglodytes*. In shape it is very like the corresponding part in the higher forms, except that it differs from that of the Gorilla, and resembles that of the Chimpanzee, and still more that of Man, in its peronead projection (Pl. XL. figs. 1, 2, 4, 6 *b*) beyond the line of the external margin of the shaft[3].

The lesser, or tibial, trochanter is shaped much as it is in the Chimpanzee, being less elongated than is sometimes the case in the Gorilla, and less conical than in Man. When looked at from above (Pl. XL. figs. 1, 2, 3, 4, 6 *c*) it appears, as also in Man and the Chimpanzee, closer to the head of the bone than is the case in the Gorilla[4].

[1] Giving origin in part, probably, to the femoral portion of the *Biceps*, as Mr. W. S. Church notes its origin as "extending from 2¼ inches below the great trochanter to within the same distance of the external condyle" (Nat. Hist. Review, 1862, vol. ii. p. 86).

[2] See Owen, Trans. Zool. Soc. vol. v. p. 15, plate 7.

[3] Owen, Trans. Zool. Soc. vol. v. p. 15.

[4] Owen, *loc. cit.* plate 7.

The trochanteric fossa is deeper than in the Gorilla, but, as also in Man, it is less deep than in the Chimpanzee. The intertrochanteric line behind is rather more sharply and strongly prominent than in any of the higher forms (Pl. XL. fig. 2 *d*).

The head of the femur is very large, especially as compared with that of the Chimpanzee, though absolutely exceeded by that of Man, and also by that of the Gorilla when of large size. It is sharply defined by a prominent border all round, except sometimes for a short space near the intertrochanteric fossa (Pl. XL. figs. 1, 2, 3, 4, 6, 7 *a*).

The sharp projection of its anterior margin is more like what exists in *Troglodytes* than in the general structure of Man.

It is commonly asserted that the ligamentum teres is absent in the Orang, as also the pit for its reception on the head of the femur[1]. I find no trace of the latter in either femur of any specimen, with one exception[2]; but in that exceptional specimen each femur (Pl. XL. fig. 7 *i*) exhibits a small but distinct depression on its head in the place occupied in other forms by the pit for the round ligament. This absence has not, as far as I am aware, been noticed in Man or the Chimpanzee; but in the Gorilla I have sometimes been unable to detect any trace of such a fossa on the head of the femur[3]. It may therefore be the case that this ligament is occasionally absent in the Gorilla, and occasionally present in the Orang.

The rotular surface (Pl. XL. fig. 1 *o*) does not, as in Man, project higher on the peroneal than on the tibial side, but more resembles in this respect that of the Gorilla than even that of the Chimpanzee; it extends, however, further up the shaft, and has its superior margin more acutely convex than in *Troglodytes*. It is even less concave transversely than in the Gorilla and Chimpanzee, and therefore still more widely differs in this respect from the rotular surface of Man than do the corresponding parts in them.

The external condyloid articular surface is somewhat narrower than is the internal one, but the difference is less than in *Troglodytes*[4] (Pl. XL. fig. 5 *m* & *n*).

The breadth of the intercondyloid fossa (which, as in the Gorilla, is generally shallower than in Man) is about equal at its anterior and posterior ends.

As in *Troglodytes*, the whole distal surface of the bone is broader in proportion to its antero-posterior extent than in Man[5], and the external condyle projects backwards less than the internal one does—the external one being, as in that genus, the shorter one from before backwards, instead of rather the longer of the two as in Man[6] (Pl. XL. fig. 5 *m* & *n*).

[1] Owen, Trans. Zool. Soc. vol. i. p. 365, and De Blainville, 'Ostéographie,' Primates, *Pithecus*, p. 31.

[2] No. 3 *i* in the osteological collection of the British Museum.

[3] *E. g.* in all four femora of the specimens Nos. 5179 A and 5179 B in the Museum of the Royal College of Surgeons.

[4] Owen, Trans. Zool. Soc. vol. v. p. 16, plate 7. fig. 3.

[5] Owen, *loc. cit.* p. 16, plate 7. fig. 3.

[6] Owen, *loc. cit.* p. 18.

Patella. (Plate XL. figs. 8 & 9.)

The patella of the Orang has its surface marked with vertical grooves, as in Man, but it agrees with that of *Troglodytes* and differs from the human patella in being more rounded and without the produced inferior apex, in having no median vertical projection on its posterior surface, and in the subequality of thickness of its outer and inner edges, as well as of its superior and inferior ones.

It differs from that of all the higher forms in its greater breadth, in the less convexity of its outer surface, in the almost complete flatness of its inner surface[1], and in its smaller size, as compared with the adjoining ends of the femur and tibia.

Tibia. (Plate XLI. figs. 1–5, 8, 9.)

The length of the tibia, as compared with that of the spine, is much as in *Troglodytes*, and nearly one-fifth less than in Man. The proportion borne by it to the femur I have found larger than in the Chimpanzee or Gorilla. As compared with the radius, the tibia of the Orang is much shorter than that of *Troglodytes*; but yet the difference is much less than between the latter genus and Man, in whom the tibia is about half as long again as is the radius.

Besides the relative length of the bone, the Orang differs from Man and agrees with *Troglodytes* in the great relative width and less lateral compression of the tibia, in the convexity, vertically, of its anterior surface, the vertical concavity of its outer or peroneal surface (Pl. XLI. fig. 1), the shortness and bluntness of the crest, and the more rounded form of the shaft, which renders it somewhat difficult to describe according to the three surfaces and three margins which exist in Man.

As also in *Troglodytes*[2], the transverse diameter of the superior surface is greater, compared with the antero-posterior diameter of the same, than is the case in Man.

In the greater projection, tibiad, of the internal tuberosity and in the stronger vertical concavity of the inner surface of the bone leading down from it to the shaft, the Orang resembles the Chimpanzee, and differs from the Gorilla, and still more from Man.

The tubercle, as also in *Troglodytes*, is less prominent than in Man; but there is some individual variation in this respect.

The external tuberosity is at least as large as, if not larger than, the internal one; and its thickness between the articular surface for the femur and that for the fibula is (Pl. XLI. fig. 2), as also in *Troglodytes*, relatively, and often absolutely, greater than in Man. The latter articular surface, again, as in *Troglodytes*, is also larger relatively than in Man (Pl. XLI. fig. 5 *k*), but it is flat, instead of, as in the Gorilla, strongly convex.

The groove for the tendon of the popliteus is very slightly marked; but the depression for the semimembranosus (behind the internal tuberosity) is very much so

[1] W. Vrolik, 'Recherches d'Anat. Comp. sur le Chimpansé,' p. 15.

[2] Owen, Trans. Zool. Soc. vol. v. p. 19.

(Pl. XLI. fig. 4 *i*), and, as in *Troglodytes*, is more rounded and less antero-posteriorly elongated than in Man.

Of the two articular surfaces for the condyles of the femur, the internal one has its inner margin (as in the Gorilla and Chimpanzee) more convex and prominent than in Man (Pl. XLI. fig. 8); and the concavity of its surface is mainly produced, as Professor Owen remarks of the Gorilla[1], by the elevation of that part of it which joins the spine.

The external articular surface (for the external condyle of the femur), though more convex antero-posteriorly than in Man, is less so than in the Gorilla; and sometimes, indeed, it is decidedly, though very slightly, concave antero-posteriorly.

The spine is also more human in its form than it is in either Troglodyte, being almost as bifid as in Man; while the groove which descends backwards from its apex, and divides the posterior ends of the articular surfaces for the condyles, is considerably deeper, and more marked than in any of the higher forms (Pl. XLI. figs. 2 & 8).

The lower end of the tibia is inclined so that the anterior margin of its distal end is much more oblique (downwards and tibiad) than in *Troglodytes*, and very much more so than in the human tibia. This obliquity arises from the large size of the lower articular surface for the fibula, and from the inclination inwards of the articular surface of the tibial malleolus.

The inner, or free, surface of the last-named process projects more strongly tibiad than in *Troglodytes*—the inner surface of the shaft immediately above it being more concave vertically than in that genus, though scarcely more so than in Man.

The anterior margin of the distal end of the tibia is more prominent than in the higher forms, the surface of the shaft just above it being more concave, vertically, than in them.

The distal end of the posterior surface of the tibia has a deeper groove for the *tibialis posticus* and *flexor longus hallucis* than I have observed in any of the higher forms (Pl. XLI. fig. 2 *p*).

As in *Troglodytes*, so also in *Simia*, the tibial malleolus is more truncated at its apex than is the case in Man.

The distal articular surface of the shaft of the tibia (Pl. XLI. fig. 9) is, as in the Chimpanzee[2], far more convex transversely than in the Gorilla or in Man. On either side of the strong median convexity there is (also as in the Chimpanzee) a slight transverse concavity; but the whole surface presents only a mere trace of an antero-posterior concavity, while, as in *Troglodytes*, its anterior margin descends as much (when the shaft is vertical) as does its posterior margin, instead of, as in Man, the latter margin descending further than the anterior one.

The articular surface on the outer (peroneal) side of the malleolus forms a more open angle with the distal surface of the shaft than even in *Troglodytes*, and its vertical extent is also much less (Pl. XLI. fig. 1).

[1] Trans. Zool. Soc. vol. v. p. 19.

[2] Owen, *loc. cit.* p. 20.

The articular surface for the lower part of the fibula is much larger than in Man and *Troglodytes*, being about the same size as the malleolar one for the inner side of the astragalus (Pl. XLI. figs. 5 & 9 *s*).

The shaft of the tibia is, as in the higher forms, triangular above its middle; but below that it is, as in *Troglodytes*, much more rounded than in Man.

The internal surface is convex, except at its upper part and just within the crest and below the tubercle, in which last situation there is, as also in *Troglodytes*[1], a rough and depressed surface (Pl. XLI. fig. 1) for the insertion of the *sartorius*, *gracilis*, and *semitendinosus* muscles.

The external, or peroneal, surface of the tibia is, as in *Troglodytes*, more strongly concave above than in Man, while from rather above the middle of the bone, it merges insensibly into the anterior surface. This external surface of the human tibia is much broader from behind forwards than is the part which corresponds to it in *Simia*, if the faint ridge (Pl. XLI. fig. 5 *l*) running downwards from the front of the upper surface for the fibula is that to which the interosseous ligament is attached.

The posterior surface of the tibia presents an oblique popliteal ridge, which, however, as also in *Troglodytes*, is much less strongly marked than in Man.

The medullary foramen (Pl. XLI. fig. 2 *n*) is much as in Man and the Chimpanzee, and more above the middle of the bone than I have observed it to be in the Gorilla.

The anterior border, or crest of the tibia, is less sharp, much shorter, and inclines more markedly tibiad below than in Man, agreeing in these points with *Troglodytes*, except that in *Simia* the crest is rather more sharp towards its upper end.

The inner border, as also in *Troglodytes*, is so little marked as to be hardly distinguishable, except for a short distance above the posterior border of the malleolus.

There is a well-marked external or peroneal border, which, however, does not correspond with the external border of the tibia of Man, inasmuch as it descends from behind, and not from in front of, the upper facet for the fibula; it becomes lost about halfway down the tibia.

Another and less marked external ridge (Pl. XLI. fig. 5 *l*) appears to correspond with the external margin in Man. It springs from a point anterior to the upper articular surface for the fibula, and descends to the apex of the lower articular surface for that bone. This ridge is rather more strongly marked in *Troglodytes*.

Fibula. (Plate XLI. figs. 1, 3, 6, 7, 10, & 11.)

As in *Troglodytes*[2], this bone is much more distant from the shaft of the tibia than in Man; it is also shorter, stouter, and straighter than in him, and has the ridges and depressions on its surface less marked,—in all which points the fibula of the Orang agrees with that of the Gorilla and that of the Chimpanzee.

The proximal articular surface (Pl. XLI. figs. 7 & 10) is more rounded than in

[1] Owen, Trans. Zool. Soc. vol. v. p. 19.

[2] Owen, *loc. cit.* vol. i. p. 366.

Man, and, though slightly concave, has not the marked depression existing in *Troglodytes*.

As in the Gorilla and Chimpanzee, the outer side of the head has a very marked prominence (Pl. XLI. figs. 1, 3, & 6 *t*) for the long external lateral ligament and the tendon of the biceps. There is no styloid process, that eminence being more completely absent than in *Troglodytes*.

As in the last-named genus, so also in *Simia*, one single anterior ridge appears to answer to both the external and internal anterior lines of Man[1] (Pl. XLI. fig. 1 *u*). This ridge descends along the anterior surface of the bone, and bifurcates very near its inferior end.

The margin answering to the posterior external one of Man (Pl. XLI. fig. 3 *v*) is quite indistinct, except at the lower part of the bone. It extends obliquely, from the inner side of the posterior surface of the malleolus, in an upward and outward direction, over the posterior surface of the shaft of the fibula, for a greater or less distance towards its head.

There is in the Orang, as in Man and *Troglodytes*, a posterior internal ridge (Pl. XLI. figs. 3 & 7 *w*) which runs obliquely downwards and forwards from the inner aspect of the head of the fibula, and joins the anterior margin before mentioned.

The medullary foramen (opening distad as in Man and *Troglodytes*) is placed more or less near to the middle of the bone (from above downwards) below and rather behind the posterior internal ridge (Pl. XLI. figs. 3 & 7 *y*).

The contraction of the anterior surface of the fibula in *Simia* and *Troglodytes*, through the coalescence as it were of the external and internal anterior margins of that bone in Man, is more than compensated for by the wide surface for muscular attachment offered by the interosseous ligament.

As in *Troglodytes*, the peroneal malleolus is shorter and blunter than in Man, and does not descend below the tibial one[2] (Pl. XLI. fig. 1).

Pes. (Plates XLI. fig. 12, & XLIII.)

The absolute length of this segment in the Orang exceeds that of the higher forms; as also its length as compared with the spine, with the rest of the pelvic limb, and with the tibia.

The proportion borne by the length of the pes to that of the manus is, as also in *Troglodytes*, much less than in Man.

Tarsus.

Unlike the carpus, the tarsus consists of the same number of bones as in the higher

[1] The fibula of Man is very lucidly described by Mr. A. T. Norton, in his convenient and carefully prepared 'Osteology for Students,' recently published.

[2] Owen, Trans. Zool. Soc. vol. v. p. 20.

forms. In absolute length this segment falls short of that of the Chimpanzee, and it is very much shorter than the homologous part in Man and the Gorilla.

Compared with the length of the spine, that of the tarsus is very slightly less than in the Chimpanzee, but falls more short of that in Man and the Gorilla. The proportion borne by it to the whole length of the pes is more characteristic, as in the Orang it appears to be only as about 26·6 to 100, while in *Troglodytes* it is 36 or 40 to 100, and in Man is as about 46 to 100.

Calcaneum. (Plate XLIII. figs. 2–7.)

The os calcis of the Orang is very unlike that of Man, or that of the Gorilla, and more resembles that of the Chimpanzee. The projection of the heel backwards beyond the hinder margin of the posterior articular surface for the astragalus, sometimes about equals, sometimes falls short of the antero-posterior extent of that surface. The Orang in this differs widely from Man, and still more from the Gorilla, in which last the length of the os calcis behind the posterior margin above-mentioned exceeds that of all the bone anterior to it. In the Chimpanzee the length of the os calcis behind the posterior articular surface for the astragalus does not quite equal the antero-posterior extent of that surface, which, again, exceeds that of the bone in front of it.

In the Orang the length of the os calcis anterior to the same surface (Pl. XLIII. fig. 6) sometimes equals, sometimes falls short of that of the bone behind it. The upper surface of the last-mentioned posterior portion is more or less concave antero-posteriorly (Pl. XLIII. figs. 2 & 3), more so than generally in the Gorilla, though not so much so as in the Chimpanzee.

The posterior surface of the tuberosity is more narrow[1] transversely than in Man or *Troglodytes*, and is prolonged both upwards and downwards, the latter making the plantar surface much concave antero-posteriorly (Pl. XLIII. figs. 2, 3, & 5). Although, when the surfaces for the astragalus are horizontal, the tuberosity inclines strongly tibiad at its plantar end,—yet this inclination is (sometimes at least) not so great as in the Gorilla[2]. The outer or peroneal face of the calcaneum has a somewhat more human aspect than has that of the Gorilla, inasmuch as it is vertically less convex and more extended, relatively, than in the latter; sometimes even there is a slight vertical concavity.

The posterior articular surface for the astragalus is not so convex as in *Troglodytes*, and it is more posteriorly placed, with respect to the anterior articular surface, than is the case in that genus or in Man. As in the Chimpanzee, there is no trace of a second posterior plantar tubercle; that for the external lateral ligament is more posterior in position than it is in any of the higher forms, though in this the Orang more resembles

[1] Professor Huxley remarks, "The calcaneal process is narrow from side to side," 'Medical Times,' 1864, vol. i. p. 565.

[2] Dr. Lucae remarks this, *loc. cit.* p. 304.

the Chimpanzee than it does Man or the Gorilla. Sometimes, in the Orang, there is a marked antero-posteriorly directed groove above this peroneal tubercle (Pl. XLIII. fig. 2 *e*), but it is never bounded inferiorly by such a strongly projecting ridge as exists in the Gorilla.

The tubercle for the calcaneo-cuboid ligament is distinct (Pl. XLIII. fig. 7 *f*), but not prominent as it is generally in Man.

The articular surface for the cuboid is nearly vertical; but the depression at the lowest part of the tibial side is extraordinarily deep, forming a funnel-shaped cavity (Pl. XLIII. fig. 4 *c*) for the reception of the very long conical and pivot-like prominence on the posterior surface of the cuboid[1].

Astragalus. (Plate XLIII. figs. 8–13.)

This bone, in *Simia*, has a very different appearance from that of any higher form, owing to the great length and strong tibiad inclination of its neck (Pl. XLIII. fig. 8 *a*).

The superior articular surface (for the shaft of the tibia) is sometimes rather more concave transversely than in Man or *Troglodytes*, and it extends backward somewhat less. The head of the bone (for articulation with the naviculare) is also more compressed from above downwards than in them (Pl. XLIII. fig. 12 *b*).

The difference in size between the articular surfaces for the two malleoli is greater than in *Troglodytes* or Man. That for the peroneal malleolus forms rather a slightly acute than a right angle, with the upper surface of the astragalus. That for the tibial malleolus forms, in the Orang, a very obtuse angle with the same, but yet not so obtuse a one as it does in the Gorilla. It encroaches more on the neck of the bone than in the higher forms. That part of the tibial face of the astragalus which is posterior to the surface for the malleolus, is much smaller than in Man or *Troglodytes*, but, as in the Gorilla, is separated from the latter by a deep groove (Pl. XLIII. fig. 10 *d*), behind which the surface is very smooth and rounded. On the other hand, that part of the peroneal face which is behind the surface for the outer malleolus (Pl. XLIII. fig. 11) is larger than in Man or *Troglodytes*, is more depressed, and has one or more small openings. The groove for the flexor tendon is wider than in Man or *Troglodytes*, and while more sharply limited on its peroneal side than in them, is less so on its tibial side (Pl. XLIII. figs. 9 & 13 *g*).

The posterior articular surface for the calcaneum has, as in the Gorilla, its anterior and inner margin more convex (Pl. XLIII. fig. 9 *i*), and its posterior and outer one more concave than in Man, its crescentic form being very marked. It is separated from the

[1] This is doubtless connected with the great mobility, in the Orang, of the joint between the anterior and posterior tarsals, which has been noticed by previous observers. Professor Owen speaks of this, Trans. Zool. Soc. vol. i. p. 367; and Professor Huxley remarks, "The mobility between the distal and proximal divisions of the tarsus is exceedingly great, and is the chief cause of the habitual turning inwards of the sole of the foot," 'Medical Times,' 1864, vol. i. p. 565.

anterior articular surface by a groove for the astragalo-calcaneal ligament. This groove, though somewhat deeper than in Man (Pl. XLIII. fig. 9 *k*), is not nearly so much so as in the Gorilla.

The anterior articular surface for the os calcis (Pl. XLIII. fig. 9 *h*) is much elongated, and is concavo-convex, but it is not very distinctly marked off from the rest of the articular surface of the head of the astragalus.

Naviculare. (Plate XLIII. figs. 14–16.)

This bone in the Orang has a rather more marked proximal concavity than has its homologue in the Gorilla, and a much more marked one than that of Man.

The vertical diameter of the same surface also predominates over the transverse one to a greater degree than in the human naviculare. *Simia* agrees with *Homo*, and differs from *Troglodytes*, in having the plantar end of the bone less antero-posteriorly expanded; and the tuberosity (Pl. XLIII. fig. 15 *e*) is less produced than in Man, and much less so than in *Troglodytes*.

The distal articular surface, as a whole, is narrower, in proportion to its vertical extent, in the Orang than it is in the Gorilla, and still more so than in Man. It agrees with that of *Troglodytes*, and differs from that of Man in the marked concavity of the surface for the ectocuneiforme (Pl. XLIII figs. 14–16 *b*), and in the convexity of those for the mesocuneiforme and entocuneiforme. Yet the angle formed by the first of these with the surface for the mesocuneiforme is smaller than in the Gorilla, and still more so than in Man. In the Orang there is generally a larger facet (Pl. XLIII. fig. 16 *c*) for the cuboid than in *Troglodytes*. The rough tract on the peroneal surface of the bone (between the facet for the cuboid and the peroneal margins of the proximal and distal articular surfaces) is much more extensive in the Orang than in Man or *Troglodytes* (Pl. XLIII. fig. 16 *d*).

Entocuneiforme. (Plate XLIII. figs. 22–26.)

The entocuneiforme of *Simia* differs much from its homologue in Man or *Troglodytes*, its tibial surface being strongly concave, as also the margin connecting the surfaces for the first and second metatarsals. The articular surface for the metatarsal of the hallux has a greater vertical concavity than in any higher species, being sometimes, indeed, truly saddle-shaped (Pl. XLIII. fig. 23 & 24 *a*). Sometimes, however (Pl. XLIII. fig 26 *a*), this vertical concavity is absent. This surface looks rather more tibiad than it does forwards[1], and it cannot be said to be notched on its inner side—as is the case in Man and *Troglodytes*. The greater part of the anterior aspect of the bone is occupied by a rough non-articular tract which extends upwards and widely separates the surfaces for the first and second metatarsals[2] (Pl. XLIII. figs. 23–26 *c*).

[1] M. Vrolik remarks that it is so placed "que le gros orteil doit s'écarter des autres." 'Recherches d'Anat. Comp.' p. 15.

[2] Noticed by Professor Huxley, see 'Medical Times,' 1864, vol. i. p. 565.

The bone, as a whole, tapers rather more upwards than in the higher forms, and would appear to do so more plainly but for the tibiad production of the anterior superior tibial angle, or summit of the surface for the hallux.

The postero-peroneal face of the entocuneiforme is, in the Orang, almost entirely occupied by surfaces which articulate with the naviculare, the mesocuneiforme, and the second metatarsal. These articular facets are well defined by sharp margins (Pl. XLIII. figs. 22–26 *b*, *d*, *e*), but are nevertheless continuous, and form an oblique band of articular surface extending from the posterior inferior angle of the bone to its anterior superior one.

Mesocuneiforme. (Plate XLIII. figs. 27–31.)

This bone in the Orang is less vertically and more antero-posteriorly extended than are its homologues in Man and the Gorilla. Its dorsum (Pl. XLIII. fig. 27) also is larger antero-posteriorly (as compared with its transverse dimensions) than in *Troglodytes*, in which it more resembles that of man. As in the Gorilla and Chimpanzee, its posterior surface (Pl. XLIII. fig. 31) is more concave than in the human mesocuneiforme. Its anterior surface (as also in the Gorilla) has its upper tibial part more bevelled off than in Man (Pl. XLIII. fig. 30), and the rest of that surface is more concave than in him or in the Gorilla. The tibial surface of the bone (Pl. XLIII. fig. 28) presents one large articular surface (for the entocuneiforme) which is mainly extended from behind forwards, instead of the two distinct facets which exist in Man.

The peroneal surface has, at its posterior plantar angle, a rather convex articular facet (Pl. XLIII. fig. 29 *d*) which articulates with the ectocuneiforme; and there is also a more or less marked articular surface extending antero-posteriorly along the top of this peroneal face.

Ectocuneiforme. (Plate XLIII. figs. 32–36.)

In the Orang the ectocuneiforme has its proximal articular surface (Pl. XLIII. figs. 32 & 36 *b*) much more oblique and much more convex than in either Man or *Troglodytes*. As in the latter genus, the posterior extension of the bone, below the hinder articular surface, is greater than in Man; and the posterior inferior angle is produced into a rounded head (Pl. XLIII. fig. 34 *e*). The distal articular surface is somewhat T-shaped (Pl XLIII. fig. 35) and more concave than in the higher forms. The tibial surface presents a strong convexity above, and near its posterior plantar angle is a small concave facet (Pl. XLIII. fig. 33 *c*) for articulation with the mesocuneiforme. The peroneal surface either presents two distinct facets for the cuboid, or these may coalesce and form one continuous articular surface for that bone (Pl. XLIII. fig. 34 *d*).

Cuboides. (Plate XLIII. figs. 17–21.)

This bone is shorter antero-posteriorly, as compared with its transverse extent, than is the case in Man; in this the Orang resembles the Troglodytes, as also in the greater distinctness of the distal surfaces for the fourth and fifth metatarsals respectively (Pl. XLIII. fig. 19 *a*, *b*). That for the fourth metatarsal is more concave in both the vertical and transverse directions than it is in the Gorilla, and therefore much more so than in Man. As in the Chimpanzee, this surface occupies a greater share of the distal surface than is the case in the Gorilla and in Man. The posterior surface of the cuboid (Pl. XLIII. fig. 21) is very much more concavo-convex than in the other and superior forms; and its tibial plantar angle is produced into the conical and pivot-like process before alluded to (Pl. XLIII. figs. 17 & 18 *c*). As in *Troglodytes*, the under surface of the cuboides, behind the prominent ridge, is less extensive than in Man; and (as also in *Troglodytes*) a small deep fossa exists just inside the angle formed by the junction of the above-mentioned ridge with the posterior margin of the plantar surface of the bone. On the tibial side of the bone there is a large articular surface for the ectocuneiforme, which surface is continuous behind with that for the naviculare (Pl. XLIII. fig. 20 *e*, *b*). As in *Troglodytes*, so in *Simia*, this surface descends nearer to the plantar margin than it does in Man.

Metatarsus.

The metatarsus attains a greater absolute length in *Simia* than in Man or *Troglodytes*. The length of this segment of the limb (estimated by that of the second metatarsal), compared with that of the spine, is considerably greater than in the higher forms—being as about 17·2 to 100, instead of from 10 to 12·5 to 100 as in Man and *Troglodytes*.

The relative length of the same metatarsal as compared with that of the entire pes is very much the same as in the others, namely about 32·1 to 100, while in Man, the Gorilla, and Chimpanzee I have found the proportion to be as 29·7, 28·5, and 30·6 to 100, respectively.

The four outer Metatarsals. (Plate XLIII. figs. 37 & 40–54.)

As in the higher forms, these metatarsals in the Orang are thicker at each end than in the shaft; but the distal extremities are almost as broad as the proximal ends, thus differing from the four outer metatarsals of *Troglodytes*, and still more from those of Man.

The shafts continue of nearly the same width throughout, and thus differ from those of *Troglodytes*, which taper distally, and still more from those of Man. On the other hand they do not broaden even slightly from behind forwards, as do their homotypes in the manus from above downwards.

The transverse diameter of each head does not nearly equal its vertical dimension; but still the difference is not so great as it is in the higher forms.

The metatarsals in *Simia* are rather more curved, with the concavity downwards, than are the metacarpals; they also diverge distad somewhat less. Their shafts are scarcely more laterally compressed than are those of the metacarpals; yet they are slightly more slender than the latter, though the difference is much less than in *Troglodytes.* They are not more flattened beneath than are their homotypes of the manus. Their distal articular surfaces are destitute of the dorsal transverse groove which limits each of them posteriorly in Man and *Troglodytes.* On their plantar aspect the same surfaces have not those lateral projections which exist in the other forms.

As in *Troglodytes*, so also in *Simia*, the dorsum of each distal articular surface slopes downwards towards its anterior end more than it does in Man. The extremities of the same surfaces of the fourth and fifth metatarsals of the Orang have also a very slight inclination peronead. A line connecting the proximal articular surfaces of the metatarsals of the Orang is almost at right angles with one following the antero-posterior direction of their shafts, these greatly differing from the condition presented by Man; and altogether the metatarsus and metacarpus are less differentiated in *Simia* than they are in Man and *Troglodytes.*

First Metatarsal. (Plate XLIII. figs. 38 & 39.)

As in *Troglodytes*, the proximal end of this bone in the Orang presents a much more decided concavity than does that of its serial homologue, and is very different in form from the corresponding part in Man.

In shape this metatarsal is very like that of its homologue in the Gorilla, and the direction of the distal groove (by which it articulates with the convex surface of the entocuneiforme) is oblique as in *Troglodytes*, and extends from above downwards and tibiad when the dorsum of the bone is placed horizontally. The shaft is also slightly twisted on its long axis. This bone in the Orang is sometimes a little longer, but generally a little shorter, than is the metacarpal of the pollex, being thus unlike the same bone in Man and *Troglodytes*, where it is much longer than is its homotype.

As in the other forms, so in the Orang, the proximal end of this metatarsal is larger than that of the corresponding metacarpal, but the difference is much less than in Man and *Troglodytes*; thus this metatarsal, like the four outer ones, has a greater resemblance to its homotype in the Orang than it has in the last-mentioned forms. As in *Troglodytes*, the process for the attachment of the tendon of the *peronæus longus* is largely developed (Pl. XLIII. fig. 39 *a*).

Second Metatarsal. (Plate XLIII. figs. 40–43).

The proximal surface of this metatarsal in the Orang is much shorter vertically and tapers less downwards than that of Man (Pl. XLIII. fig. 37 II.). It is also more concave transversely than in him, and is somewhat convex vertically on its peroneal side. Thus the posterior margin of the dorsum of this metatarsal presents a notch, and in this as in the preceding points it agrees, more or less nearly, with its homologue in *Troglodytes.*

This proximal surface resembles that of the homotypal metacarpal one more in the Orang than in the other and superior forms; but it may be readily distinguished by the less inclination distad of its upper part, and by the large articular facet for the entocuneiform (Pl. XLIII. fig. 37 II. *a*).

On the peroneal side of the bone there are two articular facets for the third metatarsal (Pl. XLIII. fig. 43 *b*, *b'*), which are sometimes connected at their proximal ends by a very small vertical articular surface for the ectocuneiforme.

As in *Troglodytes*, the tibial articular surface (for the entocuneiforme) in the Orang is relatively larger than it is in Man (Pl. XLIII. fig. 42).

There is a more or less marked tubercle at the proximal end of the plantar surface of the bone, between the articular surface for the entocuneiforme and that for the mesocuneiforme.

Third Metatarsal. (Plate XLIII. figs. 44–47).

The proximal surface of the third metatarsal of the Orang is less concave than that of man, and is, indeed, partially convex, as also in the Gorilla. It is more notched on its tibial side (Pl. XLIII. fig. 37 III.) than in the just-mentioned forms, by a deep groove, which divides the two articular facets for the second metatarsal. In the Gorilla the lower facet appears to be wanting.

On the peroneal side of the bone (Pl. XLIII. fig. 47) there are two distinct facets, instead of one as in Man and the Gorilla. These are divided by a groove, which, however, scarcely invades the peroneal margin of the proximal surface. This surface may be distinguished from the homotypal one in the manus by its becoming much narrower downwards and by the absence of a marked concavity on its upper part.

Fourth Metatarsal. (Plate XLIII. figs. 48–51).

In the Orang, as in the Gorilla, the proximal surface of this metatarsal is destitute of the concavity which exists in Man, and is besides much more convex.

Its inferior margin is straighter than in Man or the Gorilla, and the tibial side of the bone (Pl. XLIII. fig. 50) has two articular facets for the third metatarsal, instead of one as in them. These facets are separated by a wide and deep groove. The peroneal side of the bone (Pl. XLIII. fig. 51) has one long surface (for the fifth metatarsal) which is more vertically extended than in Man or the Gorilla. Compared with the homotypal surface of the manus, the proximal one of this metatarsal is more convex, the convexity extending on the peroneal side up to the dorsum, instead of being interrupted by a concavity as in the manus.

Fifth Metatarsal. (Plate XLIII. figs. 52–54).

The fifth metatarsal of *Simia* has a proximal surface which is both more convex vertically and concave tranversely than that of the Gorilla, and still more so than that of Man. The external proximal process, or tuberosity (Pl. XLIII. figs. 52 & 53 *a*) is smaller in the Orang than in the higher forms; and in this the fifth metatarsal differs less from the fifth metacarpal than in them.

As in the Gorilla, the tibial articular surface is less antero-posteriorly extended than in Man.

The proximal surface of this metatarsal is very much more concave and less convex than is the corresponding surface of the fifth metacarpal.

Digits.

The proximal phalanges of the four outer digits are very much curved[1], with the concavity downwards (Pl. XLI. fig. 12), much more so than are their homotypes of the manus. They are also narrower transversely, less flattened below and rather shorter, than are the latter. In these last three points, however, they differ less from their homotypes than do the same proximal phalanges of *Troglodytes* from their serial homologues, and of course very much less than do those of Man. The proximal phalanx of the hallux is *much* shorter than is the homotypal segment in the Orang[2], a circumstance in which it differs from all the higher forms. The second phalanges of the four outer digits are shorter and narrower than are their homotypes; but again the difference is less than in *Troglodytes*, and greatly less than in Man.

The second phalanx of the hallux is often absent[3], but when present is much shorter than is its homotype of the pollex[4], in which respect the Orang again differs from the superior forms. The third or distal phalanges scarcely differ in length from those of the manus, and at the most they are but a trifle shorter, thus agreeing with *Troglodytes* and differing much from Man.

The hallux with its metatarsal, when compared in length with the spine, I have found to be only as about 13·6 to 100, instead of from about 17 or 18 to 100 as in Man and *Troglodytes*; compared with the length of the entire pes, it barely exceeds a quarter, instead of approaching one-half as in them. The index with its metatarsal, as compared with the length of the spine, is very much longer than in the higher forms, as also is the third digit. Without their metatarsals, these digits, when compared with the length of the entire pes, are not so very much longer than in the Chimpanzee (39 and 42 to 100, instead of 32 and 34), but they of course greatly exceed those of Man.

The proportion borne by the whole hallux to the whole pollex is strikingly different

[1] Professor Huxley, 'Medical Times,' 1864, vol. i. p. 565.

[2] See Lucae, *loc. cit.* plate iii. figs. 5 & 9.

[3] See Lucae, *loc. cit.* plate iii. figs. 5 & 9.

[4] Camper found this to be the case in seven out of eight Orangs (Œuvres, tom. i. p. 54). Two phalanges, however, are recorded in two cases by Professor Owen, Trans. Zool. Soc. vol. i. p. 367. W. Vrolik, *loc. cit.* pp. 15 & 16, says, "One or two phalanges are present," and appears inclined to think that the distal one may disappear with age. De Blainville, *loc. cit.* p. 32, records five cases, in each of which the hallux had two phalanges.

from that existing in the superior forms, the former only being about four-fifths the length of the latter, instead of much exceeding it, as in Man and *Troglodytes*.

The proportion borne by the whole index of the pes to that of the manus is greater than that existing in the higher forms, the former being almost quite as long as the latter.

The difference between the length of the index and that of the hallux is vastly greater than that in Man or *Troglodytes*.

The fifth digit is the shortest, not counting the hallux; the second is somewhat longer, then the fourth, and the third is the longest (Pl. XLIII. fig. 1). The order of projection is similar to that of length.

The proportion borne by the longest digit (without its metatarsal) to the longest metatarsal, is greater than in *Troglodytes*, and of course very much greater than in Man.

The hallux only reaches as far forwards as from three-fourths to five-sixths of the length of the metatarsal of the index; and therefore the Orang differs from Man and *Troglodytes* in that its hallux does not reach so far forwards in relation to the contiguous digit as does its pollex, while in them the hallux, thus estimated, extends further forwards than does the pollex[1].

The appendicular skeleton of *Simia*, while in some respects it more nearly resembles that of Man than does the corresponding structure in *Troglodytes*, yet on the whole departs further from the human skeleton than does that of the Chimpanzee, or that of the Gorilla. This divergence is most marked in the extremities; and the small differentiation of the bony structure of the terminal limb-segments of the Orang is especially remarkable.

In addition to the various resemblances and differences offered by the limb-bones of *Simia* to the same parts in *Homo* and *Troglodytes*, I find that the Orang, when compared with all the species of the order Primates[2], presents the following more or less noteworthy conditions:—

The proportion borne by the pectoral limb to the spine is greater than in any other genus except *Tarsius* and *Hylobates*.

The proportion of the length of the radius to that of the spine is greater than in any other except *Hylobates*.

The length of the index, with its metacarpal, compared with the spine, is greater than in any except *Tarsius* and *Hylobates*.

The length of the metacarpal of the pollex is greater, in proportion to that of the spine, than in any other except *Hylobates* and *Tarsius*.

The spine of the ischium is more largely developed than in any other Primate except Man.

[1] See Huxley and Hawkins, 'Atlas of Comparative Osteology,' plate x. figs. 1, 2 & 3, and plate xii. figs. 1 *a*, 2 *a*, 3 *a*, & 4 *a*; also Dr. Lucae's paper before referred to, plate iii. figs. 2, 5 & 9, plate ii. fig. 5, plate i. fig. 2, and plate iv. figs. 1, 5 & 6.

[2] See a paper "On the Skeleton of the Primates," communicated to the Royal Society on November 22, 1866, read on January 10, 1867, and to be published in the 'Philosophical Transactions,' vol. clvii. (1867) p. 299, plates xi.–xiv.

The length of the pes is greater, in proportion to that of the spine, than in any except *Ateles*, *Cheiromys*, and *Tarsius*.

The proportion borne by the longest digit of the pes to the spine is greater than in any other Primate except *Tarsius*.

The length of the longest digit, without its metatarsal, compared with that of the tarsus, is greater than in any of the order except the *Nycticebinæ* and perhaps *Indris*.

The Orang differs from every other Primate without exception in:—the great absolute length of the pectoral limb minus the manus, of the manus itself, of its third digit both with and without its metacarpal, and of the metacarpal of the pollex; the great difference between the length of the pollex and that of the index; the large diameter of the acetabulum compared with the length of the spine; the small proportion borne by the femur to the humerus; the very obtuse angle formed by the neck of the femur with its shaft; the all but constant absence of the pit for the ligamentum teres on the head of the femur; the shortness of the tibia compared with the humerus; the length of the pes compared with that of the rest of the pelvic limb; the length of the pes compared with that of the tibia; the absolute length of the three middle metatarsals; the absolute length of the longest digit with its metatarsal; the very small proportion borne by the length of the hallux to that of the longest digit of the pes; the occasional absence of the second digit of the hallux; the great length of the index, with its metatarsal, compared with the length of the spine; the small length of the hallux (both with and without its metatarsal) compared with that of the whole pes; the great length of the index, without its metatarsal, compared with that of the whole pes; the nearly equal length of the indices of the pes and manus, both with and without the metatarsal and metacarpal; the shortness of the tarsus compared with the length of the pes. Thus the Orang is one of the most peculiar and aberrant forms to be found in the order Primates.

DIMENSIONS AND PROPORTIONS.

Scapula.

	Length from top of glenoid surface to inferior vertebral angle.	Length of axillary margin.	Length of vertebral margin.	Length of superior margin.	Greatest length of glenoid surface.	Greatest breadth of glenoid surface.
No. 3 A[1]	7·45	6·75	5·75	3·65	1·65	1·07
„ 3 B	7·00	6·45	5·20	3·70	1·55	1·00
„ 3 C	7·50	6·90	6·00	3·40	1·75	1·17
Average of the three	7·31	6·70	5·65	3·58	1·65	1·08
Variety *Morio*	5·49	4·82	3·98	2.98	1·22	0·81

[1] The skeletons which have been selected for measurement are those of three adult males in the Osteological Collection of the British Museum, and numbered respectively 3 A, 3 B, and 3 C.

	Posterior vertebral angle.	Angled formed by glenoid surface with axillary margin.	Angle formed by glenoid surface with spine of scapula.	Angle formed by spine of scapula with axillary margin.	Angle formed by spine of scapula with vertebral margin.
No. 3 A	35°	110°	65°	42°	105°
,, 3 B	35	113	70	41	103
,, 3 C	35	115	70	40	108
Average of the three	35	112	68	41	105
Variety *Morio* ..	35	120	70	41	106

Average axillary margin : 100 :: average vertebral : 84·3.

Average axillary margin : 100 :: average superior margin : 53·3.

Clavicle.

	Length measured in a straight line.	Length measured along curves.	Breadth about middle.	Greatest diameter of acromial end.	Greatest diameter of sternal end.
No. 3 A	7·50	7·80	·61	1·10	1·27
,, 3 B	6·55	6·75	·60	1·02	1·30
,, 3 C	7·20	7·40	·60	1·05	1·42
Average of the three	7·08	7·31	·60	1·05	1·33
Variety *Morio* .	5·28	5·40	·44	·77	·78

Average length of scapula from summit of glenoid surface to posterior vertebral angle : 100 :: the average length of clavicle measured in a straight line : 96·7.

Humerus.

	Length measured in a straight line from summit of head to lower end of inner margin of trochlea.	Transverse diameter of middle of shaft.	Extreme breadth of tuberosities.	Extreme breadth of head.	Extreme breadth between condyles.
No. 3 A	14·00	·93	1·59	1·72	2·50
,, 3 B	14·10	·92	1·68	1·72	2·59
,, 3 C	14·40	·90	1·67	1·82	2·69
Average of the three	14·16	·91	1·64	1·75	2·59
Variety *Morio* ..	11·35	·67	1·26	1·30	2·05

Average length of scapula : 100 :: average length of humerus : 193·5.

Average length of clavicle : 100 :: average length of humerus : 200·1.

Radius.

	Extreme length to end of styloid, *p s*, in a straight line.	Diameter of head.	Diameter of distal end.	Diameter of middle of shaft.
3 A	14·15	91	1·44	·64
3 B	13·90	93	1·55	·70
3 C	14·70	92	1·60	·63
Average of the three......	14·25	92	1·53	·65
Variety *Morio* ..	11·75	72	1·09	·47

Average length of scapula : 100 : : that of radius : 194·6.
Average length of humerus : 100 : : that of radius : 100·5.

Ulna.

	Extreme length to end of styloid process, measured in a straight line.	Greatest breadth of olecranon.	Length of styloid process.
3 A	14·70	·91	·34
3 B	14·20	1·00	·29
3 C	15·20	1·10	·28
Average of the three......	14·70	1·00	·30
Variety *Morio* ..	11·98	·66	·24

Average length of humerus : 100 : : that of ulna, measured in a straight line : 103·9.

Os innominatum.

	Extreme length.	From superior anterior to superior posterior spinous process along crest of ilium.	From superior anterior to superior posterior spinous process in a straight line.	Distance between anterior spinous processes.	Distance between posterior spinous processes.	Distance from posterior inferior spinous process to spine of ischium.	Distance from spine of ischium to ischiatic tuberosity.
3 A	9·90	6·25	5·10	3·50	2·65	2·62	1·90
3 B	9·69	6·45	4·82	3·40	2·75	2·58	1·83
3 C	10·25	6·42	4·60	3·25	2·40	2·50	2·10
Average of the three......	9·94	6·37	4·84	3·38	2·60	2·56	1·94
Variety *Morio* ..	7·84	4·55	3·51	2·75	2·50	1·90	1·75

	Distance from anterior inferior spinous process to symphysis.	Length of symphysis pubis.	Greatest vertical diameter of acetabulum.	Greatest horizontal diameter of acetabulum.	Ilio-pubic angle.	Ilio-ischial angle.	Angle of anterior margin of ilium with upper margin of pubis.
3 A	4·10	1·97	1·70	1·60	130°	175°	145°
3 B	3·90	1·45	1·68	1·52	132°	163°	137°
3 C	4·50	1·80	1·75	1·68	140°	167°	150°
Average of the three......	4·16	1·74	1·71	1·60	134°	168°	144°
Variety *Morio* ..	3·25	1·17	1·38	1·30	128°	172°	150°

Femur.

	Extreme length.	Greatest diameter of head.	Transverse diameter of middle of shaft.	Antero-posterior diameter of middle of shaft.	Breadth between the supracondyloid eminences.	Breadth between the outer and inner margins of the condyles.
3 A	10·40	1·40	1·05	·76	2·33	2·23
3 B	10·70	1·40	·95	·72	2·27	2·11
3 C	11·20	1·45	·95	·78	2·33	2·29
Average of the three......	10·76	1·41	·98	·75	2·31	2·21
Variety *Morio* ..	8·90	1·12	·71	·57	1·79	1·70

Average length of femur : 100 : : that of os innominatum : 92·3.
Average length of humerus : 100 : : that of femur : 76·0.

Tibia. *Fibula.*

	Tibia: Extreme length.	Tibia: Breadth of proximal surface.	Tibia: Antero-posterior diameter of middle of shaft.	Tibia: Greatest transverse diameter of distal end.	Fibula: Extreme length.
3 A	9·20	2·30	·83	1·60	
3 B	9·05	2·22	·78	1·70	8·75
3 C	9·80	2·39	·78	1·72	9·12
Average of the three......	9·35	2·30	·79	1·67	
Variety *Morio* ..	7·24	1·77	·59	1·25	7·23

Average length of femur : 100 : : that of tibia : 86·8.
Average length of radius : 100 : : that of tibia : 65·6.

Manus.

	Length of 1st metacarpal.	Length of second.	Length of third.	Length of fourth.	Length of fifth.	Length in straight line of longest proximal phalanx.	Length following curve of longest proximal phalanx.
3 B......	1·90	4·15	3·96	3·84	3·54	2·85	3·15
3 C......	2·00	4·22	4·18	3·97	3·60	3·00	3·55
Average ..	1·95	4·18	4·07	3·90	3·57	2·92	3·35

Pes.

	Length of 1st metatarsal.	Length of second.	Length of third.	Length of fourth.	Length of fifth.	Length in straight line of longest proximal phalanx.	Length following curve of longest proximal phalanx.
3 B......	1·85	3·90	3·80	3·63	3·45	2·75	3·14
3 C......	1·92	3·83	3·78	3·63	3·32	2·75	3·15
Average ..	1·88	3·86	3·79	3·63	3·38	2·75	3·14

DESCRIPTION OF THE PLATES.

PLATE XXXV. *Scapula of* Simia.

Fig. 1. Outer surface.

Fig. 2. Internal surface.

Fig. 3. Outer surface of the variety *Morio.*

Fig. 4. Glenoid surface of the specimen No. 3 A in the British Museum.

Fig. 5. Glenoid surface of the specimen No. 3 C in the same collection.

In all the above figures the letters indicate respectively :—*a*, the acromian process ; *c*, the coracoid process ; *g*, the glenoid surface ; *s*, the triangular surface at the origin of the spine ; *t*, the tubercle for the trapezoid ligament ; *v* 1, the superior vertebral angle ; *v* 2, the inferior vertebral angle.

PLATE XXXVI. *Humerus.*

Fig. 1. Anterior surface of the right humerus of the specimen No. 3 C in the British Museum.

Fig. 2. Posterior surface of the same.

Fig. 3. Outer surface of the humerus of the specimen No. 3 B.

Fig. 4. Inner surface of the humerus of No. 3 A.

Fig. 5. Superior surface of the humerus of No. 3 B.

Fig. 6. The same of that of No. 3 C.

Fig. 7. Distal surface of the humerus of No. 3 B.

In these last six figures, *a* represents the articular head; *b*, the bicipital groove; *c*, rough surface, probably for the *coraco-brachialis*; *d*, the lesser, or ulnar, tuberosity; *e*, the greater, or radial, tuberosity; *k*, the external condyle; *m*, the perforation in the coronoid fossa; *o*, the internal condyle; *p*, the capitellum; *q*, the trochlea; *s*, musculo-spiral groove.

PLATE XXXVII. *Clavicle and Radius.*

Fig. 1. Anterior surface of the right clavicle of the specimen No. 3 C in the British Museum.

Fig. 2. Superior surface of the same.

Fig. 3. Inferior surface of the same.

Fig. 4. Anterior surface of left clavicle of the variety *Morio*.

In these figures, *a* represents the acromial end of the bone; *c*, the tubercle for the conoid ligament; *d*, the prominence for the deltoid; *p*, ridge probably for *pectoralis major*; *r*, rough surface for costo-clavicular ligament; *s*, sternal end of the bone; *t*, ridge for trapezoid portion of coraco-clavicular ligament.

Fig. 5. Anterior surface of the right radius of specimen No. 3 B.

Fig. 6. Posterior surface of the same.

Fig. 7. Posterior surface of distal end of the same, showing the grooves for the extensor tendons completely.

Fig. 8. Distal surface of the same.

a, process for the supinator longus; *b*, tuberosity; *f*, the styloid process; *g*, surface for ulna; *h*, the surface for the scaphoides; *k*, groove for *extensor ossis metacarpi pollicis*; *l*, that for *ex. carpi radialis longior*; *m*, that for the *ex. carpi radialis brevior*; *o*, that for the *extensor secundi internodii pollicis*; *p*, that *for the extensor communis digitorum*; *u*, the surface for the semilunare.

PLATE XXXVIII. *Ulna.*

Fig. 1. Anterior aspect of right ulna of the specimen No. 3 C.

Fig. 2. Ulnar (or inner) aspect of the same.

Fig. 3. Posterior aspect of the same.

Fig. 4. Radial (or outer) aspect of the same.

Fig. 5. Posterior surface of the olecranon of the same.

Fig. 6. Side view of the distal end of No. 3 A.

Fig. 7. Distal surface of ulna of No. 3 A.

a, radial or outer margin; *b*, nutrient foramen; *c*, fossa for *brachialis anticus*; *d*, lesser sigmoid cavity; *e*, ridge running downwards and backwards from that cavity; *f*, surface for *anconæus*; *g*, greater sigmoid cavity; *h*, the distal articular surface; *s*, styloid process; *x*, ridge for attachment of *pronator quadratus*.

PLATE XXXIX. *Os innominatum.*

Fig. 1. Outer aspect of right os innominatum of No. 3 C.
Fig. 2. Inner aspect of the same.
Fig. 3. Posterior aspect of the same.
Fig. 4. Anterior aspect of the same.
Fig. 5. Superior aspect of the same.
Fig. 6. Inferior aspect of the same.

a, anterior superior spinous process; *b*, anterior inferior spinous process; *c*, posterior superior spinous process; *d*, posterior inferior spinous process; *e*, ilio-pectineal line; *f*, cotyloid notch of acetabulum; *g*, greater sciatic notch; *h*, spine of ischium; *i*, lesser sciatic notch; *l*, tuberosity of ischium; *m*, auricular surface; *o*, obturator foramen; *p*, spine of pubis; *r*, subpubic groove; *s*, symphysis pubis.

PLATE XL. *Femur and Patella.*

Fig. 1. Anterior aspect of right femur of No. 3 B.
Fig. 2. Posterior aspect of right femur of No. 3 A.
Fig. 3. Inner (or tibial) aspect of the same.
Fig. 4. Outer (or peroneal) aspect of the same.
Fig. 5. Distal end of right femur of No. 3 B.
Fig. 6. Proximal end of the same.
Fig. 7. Articular head of femur of No. 3 I, in the British Museum, showing the presence of a pit as for the *ligamentum teres.*
Fig. 8. Anterior surface of patella of No. 3 C.
Fig. 9. Posterior surface of the same.

a, articular head; *b*, greater (or peroneal) trochanter; *c*, lesser (or tibial) trochanter; *d*, posterior intertrochanteric line; *e*, anterior intertrochanteric line; *f*, its continuation as the "spiral line;" *g*, depression of the *gluteus maximus*; *h*, line leading down towards the entocondyloid prominence; *i*, pit for *ligamentum teres*; *k*, ectocondyloid prominence; *l*, entocondyloid prominence; *m*, external condyle; *n*, internal condyle; *o*, rotular surface; *p*, popliteal space; *s*, pit for *popliteus.*

PLATE XLI *Tibia and Fibula.*

Fig. 1. Anterior aspect of right tibia and fibula of No. 3 C.
Fig. 2. Posterior aspect of right tibia of No. 32, Z, S.
Fig. 3. Posterior aspect of right fibula of No. 3 I.
Fig. 4. Internal (or tibial) aspect of right tibia of No. 3 A.
Fig. 5. External (or peroneal) aspect of the same.
Fig. 6. External aspect of right fibula No. 3 C.
Fig. 7. Internal (or tibial) aspect of the same.

Fig. 8. Proximal surface of right tibia No. 3 C.
Fig. 9. Distal surface of the same.
Fig. 10. Proximal end of right fibula of No. 3 C.
Fig. 11. Distal end of the same.
Fig. 12. Lateral view of proximal phalanx of index of pes.

a, crest of tibia; *b*, tubercle; *c*, external tuberosity; *d*, internal tuberosity; *e*, articular surface for external condyle of femur; *f*, articular surface for internal condyle of femur; *g*, spine; *h*, groove behind spine; *i*, pit for *semimembranosus*; *k*, upper surface of tibia for fibula; *l*, ridge leading downwards from the front of that surface; *m*, ridge leading downwards from behind that surface; *n*, medullary foramen; *o*, internal malleolus; *p*, groove for tendons of *tibialis posticus* and *flexor longus digitorum*; *q*, articular surface for superior face of astragalus; *r*, articular surface of malleolus; *s*, lower articular surface of tibia for fibula; *t*, process of head of fibula for *biceps*; *u*, anterior margin of fibula; *v*, posterior external margin of fibula; *w*, posterior internal margin of fibula; *x*, peroneal malleolus; *y*, medullary foramen; *z*, articular surface of fibula for tarsus.

PLATE XLII. *Manus.*

Fig. 1. Palmar surface of the *manus* No. 5076 in the Museum of the Royal College of Surgeons, the bones of which are united by their ligaments only.
Fig. 2. Left scaphoides of skeleton No. 3 B in the British Museum: its proximal surface.
Fig. 3. Distal surface of the same.
Fig. 4. Dorsal (or extensor) surface of the same.

a, surface for articulation with the radius; *b*, radial tuberosity; *c*, surface for articulation with the semilunare; *d*, surface for the intermedium; *e*, that for the radial end of the intermedium; *f*, that for the trapezium.

Fig. 5. Left intermedium of No. 3 B: first surface.
Fig. 6. Second surface of the same.

a, surface for articulation with the trapezoides; *b*, that for the magnum; *c*, ulnar end of the bone; *d*, its radial end; *e*, the process which projects over the junction of the intermedium with the scaphoides.

Fig. 7. Left semilunare of No. 3 B: its radial side.
Fig. 8. Ulnar side of the same.
Fig. 9. Palmar side of the same.

a, surface for articulation with the radius; *b*, that for the scaphoides; *c*, that for the cuneiforme; *d*, that for the magnum.

Fig. 10. Left cuneiforme of No. 3 B: its ulnar surface.
Fig. 11. Radial surface of the same.

a. Surface for articulation with the unciforme; *b*, that for the pisiforme; *c*, groove separating these two surfaces; *d*, surface for the semilunare; *e*, that for the fibro-cartilage of the wrist-joint.

Fig. 12. Left pisiforme of No. 3 B: its dorsal (or extensor) surface.

Fig. 13. Palmar aspect of the same.

Fig. 14. Its articular surface for the cuneiforme.

Fig. 15. Left trapezium of No. 3 B: its outer (or extensor) surface.

Fig. 16. The same aspect of the right trapezium of the skeleton No. 3 A in the British Museum,

Fig. 17. Left trapezium of No. 3 B: its palmar surface.

Fig. 18. The same aspect of the right trapezium of No. 3 A.

Fig. 19. Left trapezium of No. 3 B: its proximal end.

Fig. 20. Distal end of left trapezium of No. 3 B.

a, saddle-shaped surface for articulation with first metacarpal; *b*, surface for second metacarpal; *c*, surface for trapezoides; *d*, that for scaphoides.

Fig. 21. Left trapezoides; its dorsal (or extensor) surface.

Fig. 22. Distal surface of the same.

Fig. 23. Proximal surface of the same.

a, the larger (or ulnar) surface for articulation with the second metacarpal; *b*, smaller (or radial) surface for articulation with the same metacarpal; *c*, facet for the magnum; *d*, surface for the intermedium.

Fig. 24. Left magnum of No. 3 B: its dorsal surface.

Fig. 25. Palmar surface of the same.

Fig. 26. Radial aspect of the same.

Fig. 27. Ulnar aspect of the same.

Fig. 28. Distal surface of the same.

a, notch on radial side of distal surface; *b*, notch on ulnar side of the same surface; *c*, palmar articular surface for second metacarpal; *d*, dorsal articular surface for the same metacarpal; *e*, surface for the trapezoides; *f f'*, surface for the unciforme.

Fig. 29. Left unciforme of No. 3 B: its dorsal surface.

Fig. 30. Palmar surface of the same.

Fig. 31. Radial aspect of the same.

Fig. 32. Ulnar aspect of the same.

Fig. 33. Distal surface of the same.

a, its palmar process; *b b'*, articular surface for the magnum; *c*, that for the cuneiforme.

Fig. 34. Proximal surfaces of the four ulnar metacarpals of the left manus of the skeleton No. 3 B.

Fig. 35. Dorsum of first metacarpal of the same manus.

Fig. 36. Radial side of the same (first) metacarpal.

Fig. 37. Dorsal aspect of second metacarpal of the same manus.

Fig. 38. Palmar aspect of the same metacarpal.
Fig. 39. Radial side of proximal end of same.
Fig. 40. Ulnar side of proximal end of the same.

a, tubercle for the *flexor carpi radialis*; *b*, groove between the two surfaces for the third metacarpal.

Fig. 41. Dorsum of third metacarpal of the same manus.
Fig. 42. Palmar aspect of the same metacarpal.
Fig. 43. Radial aspect of proximal end of the same.
Fig. 44. Ulnar aspect of proximal end of the same.

c, radio-proximal angle of dorsum.

Fig. 45. Dorsum of fourth metacarpal of same manus.
Fig. 46. Palmar aspect of the same metacarpal.
Fig. 47. Radial aspect of proximal end of the same.
Fig. 48. Ulnar aspect of proximal end of the same.
Fig. 49. Dorsum of fifth metacarpal of the same manus.
Fig. 50. Palmar aspect of the same metacarpal.
Fig. 51. Radial aspect of proximal end of the same.

PLATE XLIII. *Pes.*

Fig. 1. Plantar aspect of the *pes* No. 5079 in the Museum of the Royal College of Surgeons, the bones of which are united by the ligaments only.
Fig. 2. Right os calcis of skeleton No. 3 B in the British Museum: its peroneal aspect.
Fig. 3. Tibial aspect of the same.
Fig. 4. Anterior (distal) aspect of the same.
Fig. 5. Posterior aspect of the same.
Fig. 6. Dorsum of the same.
Fig. 7. Plantar surface of the same.

a, anterior articular surface for astragalus; *b*, posterior articular surface for astragalus; *c*, funnel-shaped cavity of articular surface for cuboides; *d*, tubercle for external lateral ligament; *e*, antero-posterior groove above the last.

Fig. 8. Dorsum of right astragalus of No. 3 B.
Fig. 9. Plantar surface of the same.
Fig. 10. Tibial aspect of the same.
Fig. 11. Peroneal aspect of the same.
Fig. 12. Anterior (distal) aspect of the same.
Fig. 13. Posterior aspect of the same.

a, neck; *b*, articular surface for naviculare; *c*, surface for tibial malleolus; *d*, groove behind the last; *e*, rounded surface posterior to the groove; *f*, surface for peroneal malleolus; *g*, groove for flexor tendon; *h*, anterior articular surface for os calcis; *i*, posterior articular surface for os calcis; *k*, groove for astragalo-calcaneal ligament.

Fig. 14. Right naviculare of No. 3 B: its anterior (distal) aspect.

Fig. 15. Tibial aspect of the same.

Fig. 16. Peroneal aspect of the same.

a, surface for entocuneiforme and mesocuneiforme; *b*, surface for ectocuneiforme; *c*, articular facet for cuboides; *d*, rough surface of peroneal side of bone; *e*, tuberosity.

Fig. 17. Right cuboides of No. 3 B: its dorsum.

Fig. 18. Its plantar surface.

Fig. 19. Anterior (distal) surface of the same bone.

Fig. 20. Tibial aspect of the same.

Fig. 21. Proximal aspect of the same.

a, surface for fourth metatarsal; *b*, surface for fifth metatarsal; *c*, pivot-like process of tibio-plantar angle; *d*, ridge of plantar surface; *e*, articular surface for ectocuneiforme; *f*, articular surface for naviculare; *g*, groove for tendon of *peronæus longus*.

Fig, 22. Left entocuneiforme of No. 3 B: its anterior (distal) aspect.

Fig. 23. Peroneal aspect of the same bone.

Fig. 24. Tibial aspect of the same.

Fig. 25. The same bone seen from above.

Fig. 26. Tibial side of right entocuneiforme of the skeleton No. 3 C.

a, articular surface for first metatarsal; *b*, articular surface for the second metatarsal; *c*, surface between the articular surfaces for the first two metatarsals; *d*, surface for mesocuneiforme; *e*, surface for naviculare.

Fig. 27. Right mesocuneiforme of No. 3 B: its dorsum.

Fig. 28. Tibial aspect of the same bone.

Fig. 29. Peroneal aspect of the same.

Fig. 30. Anterior (distal) surface of the same.

Fig. 31. Posterior surface of the same.

a, articular surface for metatarsal; *b*, articular surface for naviculare; *c*, articular surface for entocuneiforme; *d*, articular surface for ectocuneiforme.

Fig. 32. Right ectocuneiforme of No. 3 B: its dorsum.

Fig. 33. Tibial aspect of the same.

Fig. 34. Peroneal aspect of the same.

Fig. 35. Anterior (distal) surface of the same.

Fig. 36. Posterior aspect of the same.

a, articular surface for metatarsal; *b*, articular surface for naviculare; *c*, facet for mesocuneiforme; *d*, articular surface for cuboides.

Fig. 37. Proximal surfaces of the four peroneal metatarsals of the left pes of the skeleton No. 3 B.

a, facet for entocuneiforme.

Fig. 38. Dorsum of first metatarsal of No. 3 B.
Fig. 39. Lateral view of the same metatarsal.
a, process for attachment of tendon of *peronæus longus*.
Fig. 40. Dorsal aspect of second left metatarsal of the same skeleton.
Fig. 41. Plantar aspect of the same metatarsal.
Fig. 42. Tibial side of proximal end of the same.
Fig. 43. Peroneal side of proximal end of the same.
a, articular facet for entocuneiforme; *b*, *b'*, articular facets for third metatarsal.
Fig. 44. Dorsal aspect of third left metatarsal of the same skeleton.
Fig. 45. Plantar aspect of the same.
Fig. 46. Tibial aspect of proximal end of the same.
Fig. 47. Peroneal aspect of proximal end of the same.
Fig. 48. Dorsal aspect of fourth left metatarsal of the same skeleton.
Fig. 49. Plantar aspect of the same.
Fig. 50. Tibial aspect of proximal end of the same.
Fig. 51. Peroneal aspect of proximal end of the same.
Fig. 52. Dorsal aspect of fifth left metatarsal of the same skeleton.
Fig. 53. Plantar aspect of the same.
Fig. 54. Tibial aspect of proximal end of the same.
a, tuberosity.


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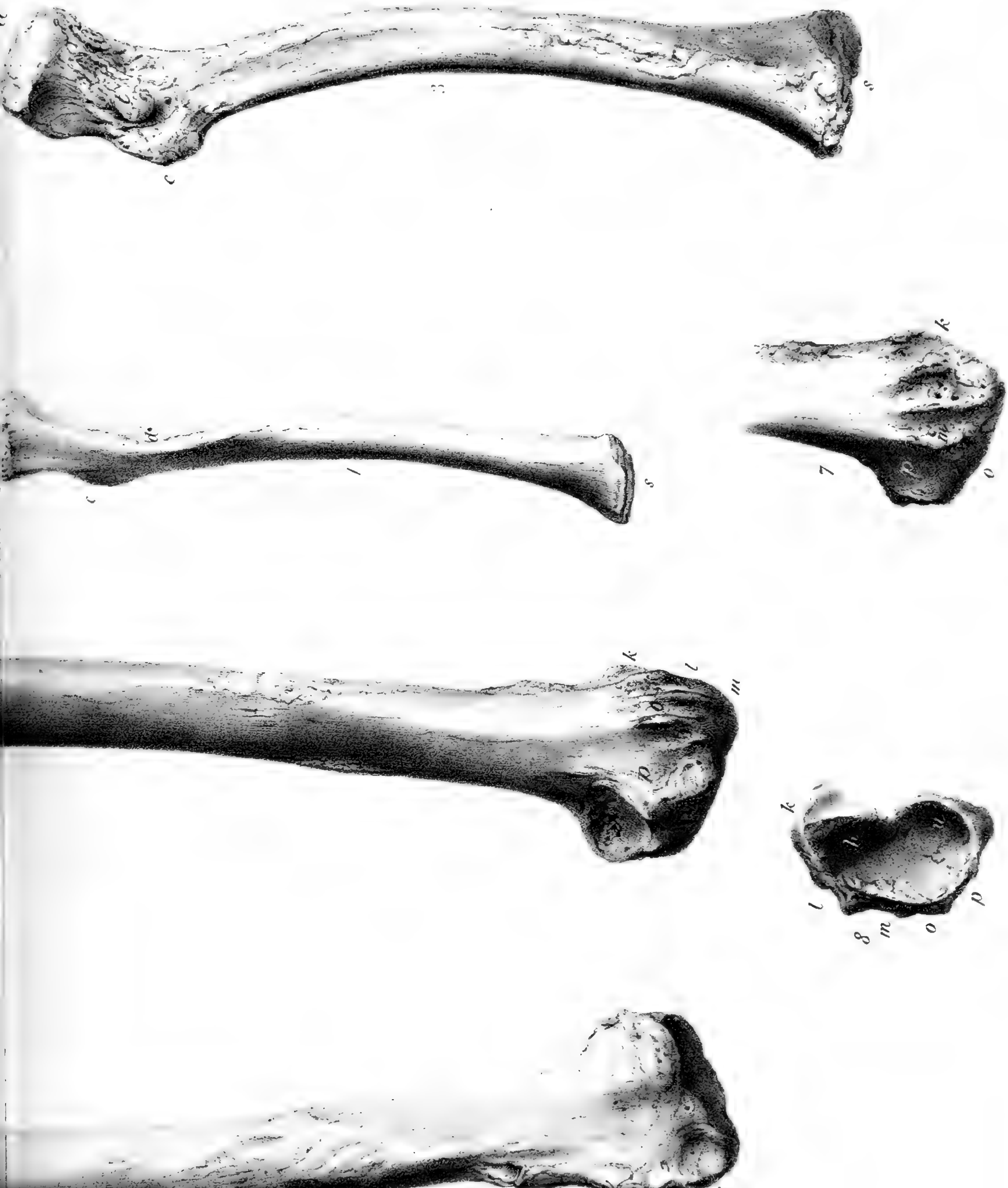

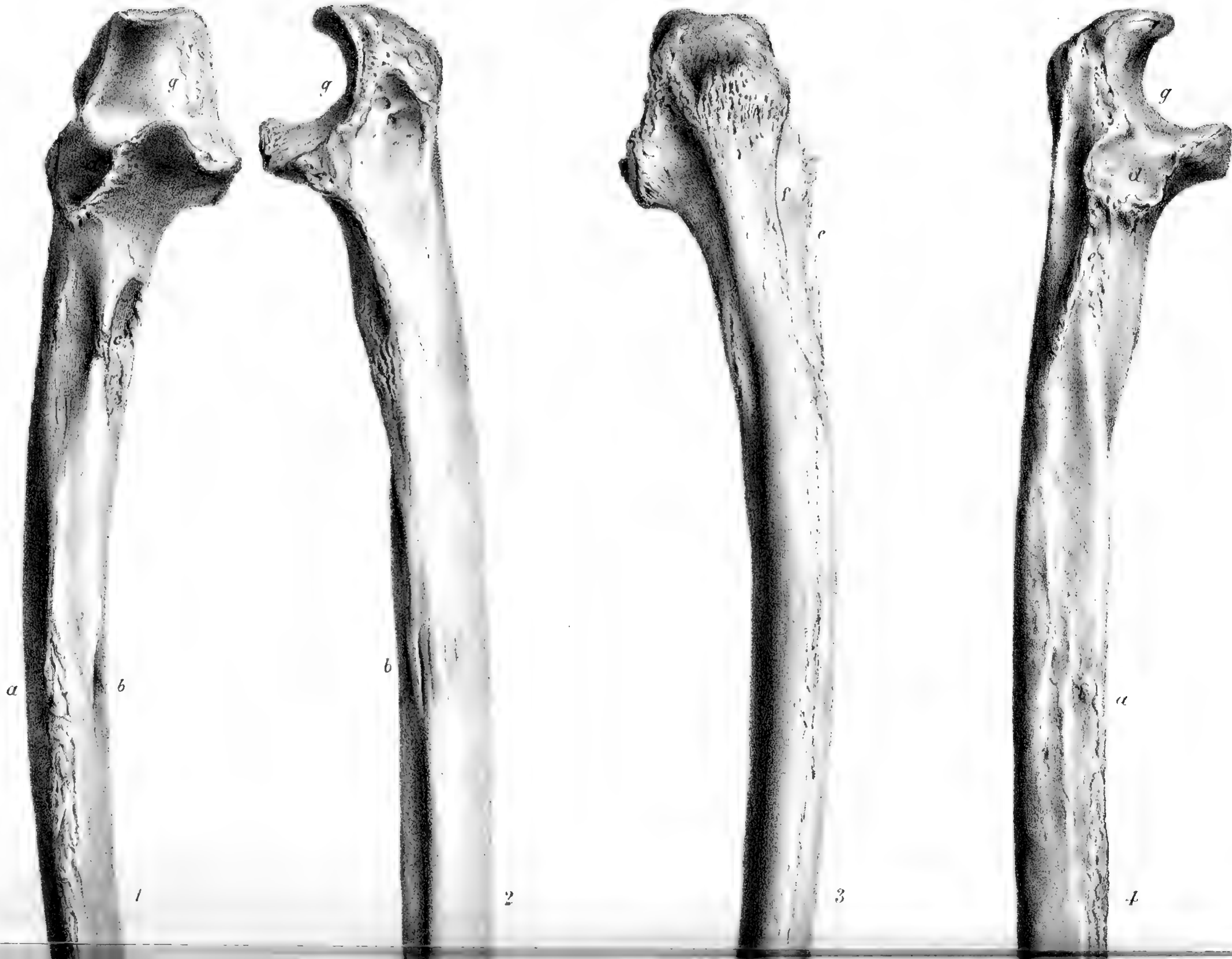
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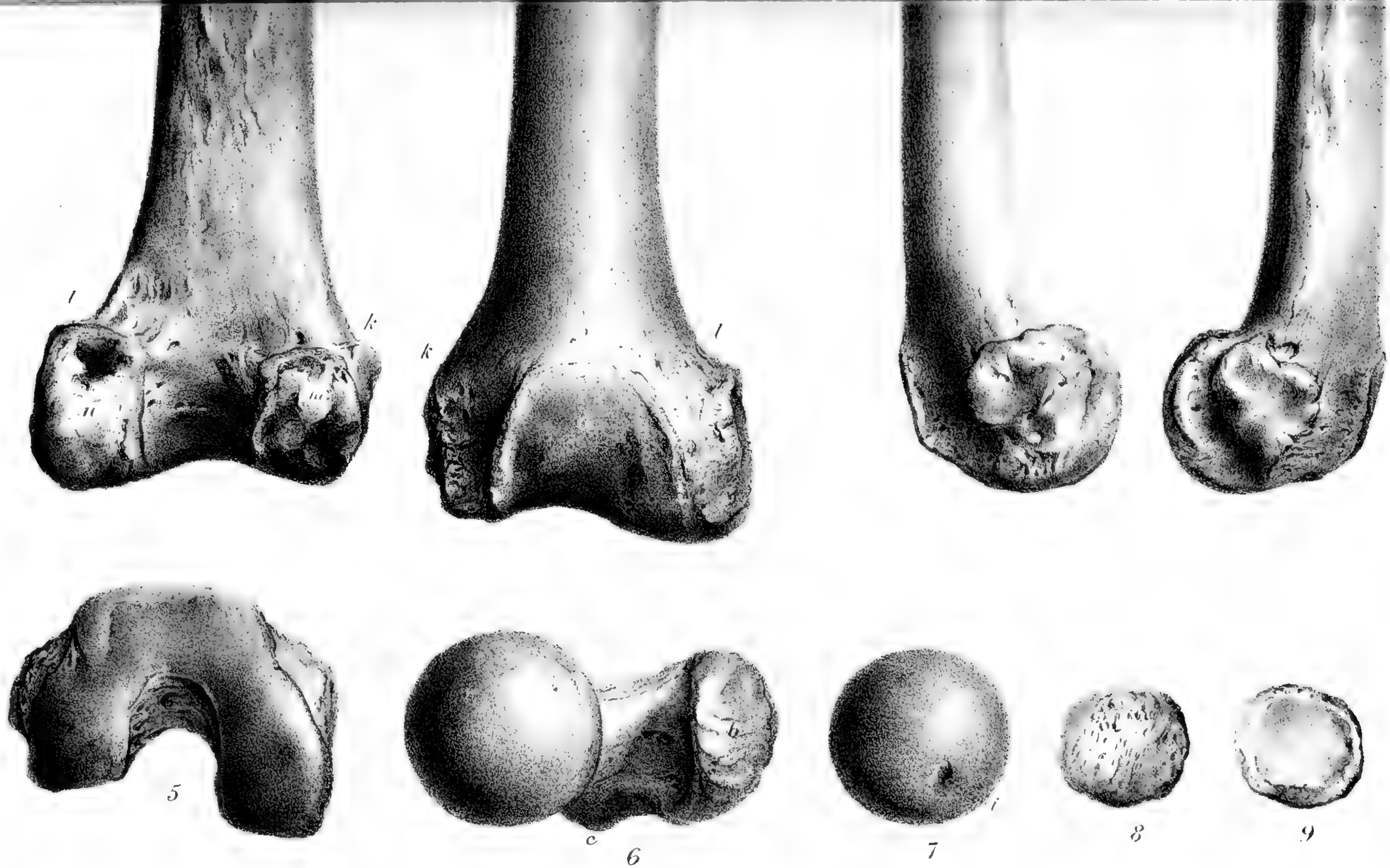

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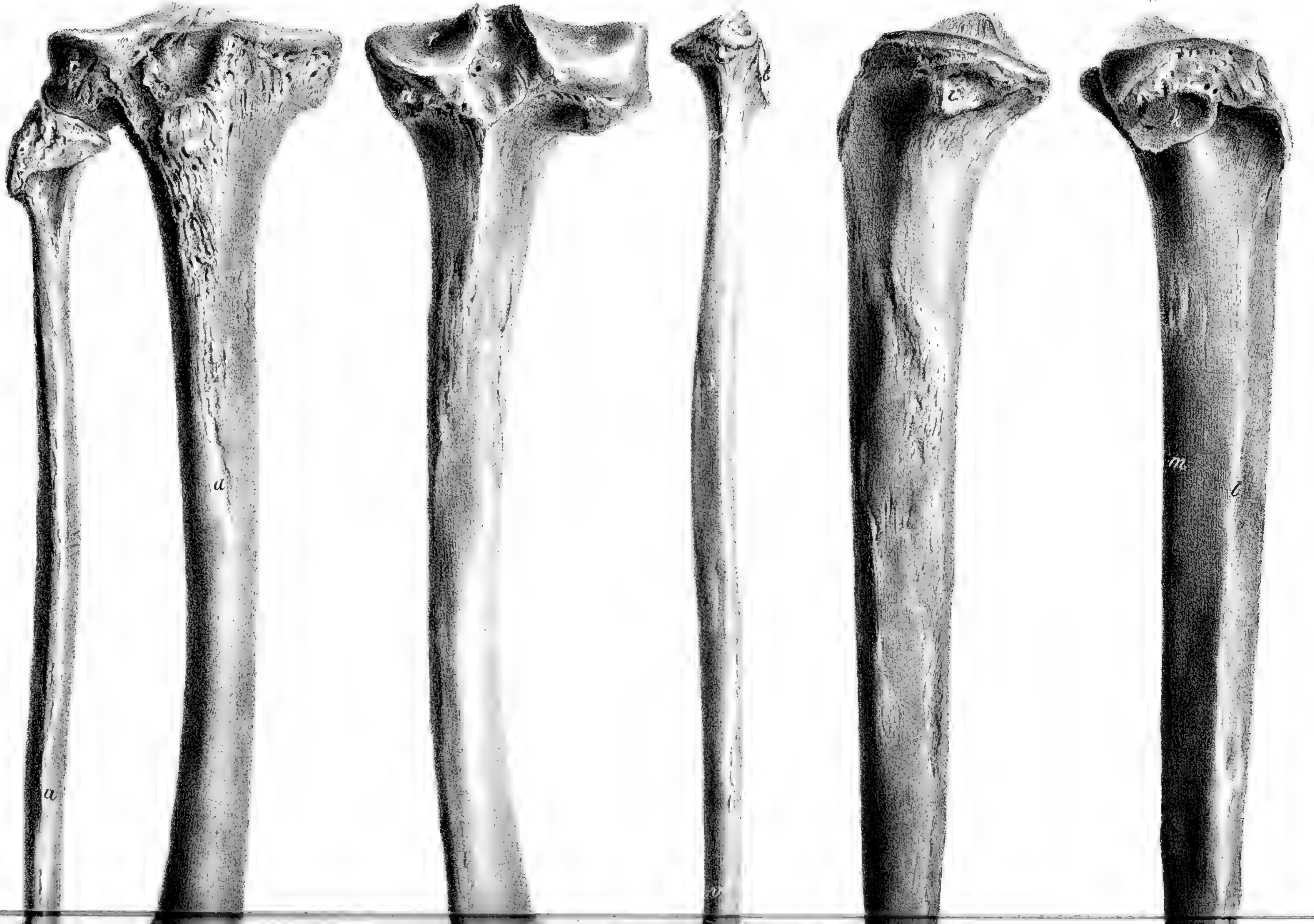

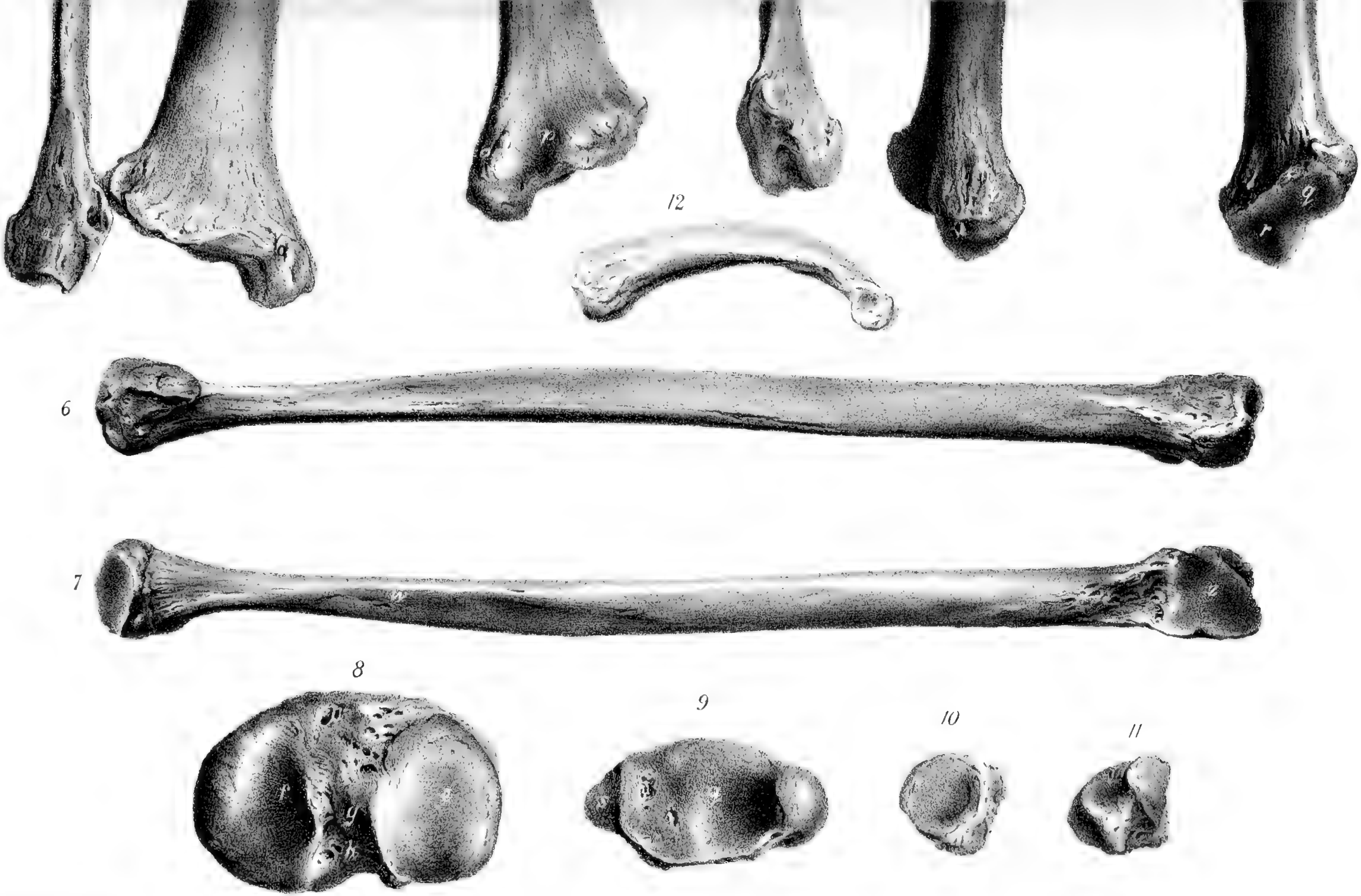

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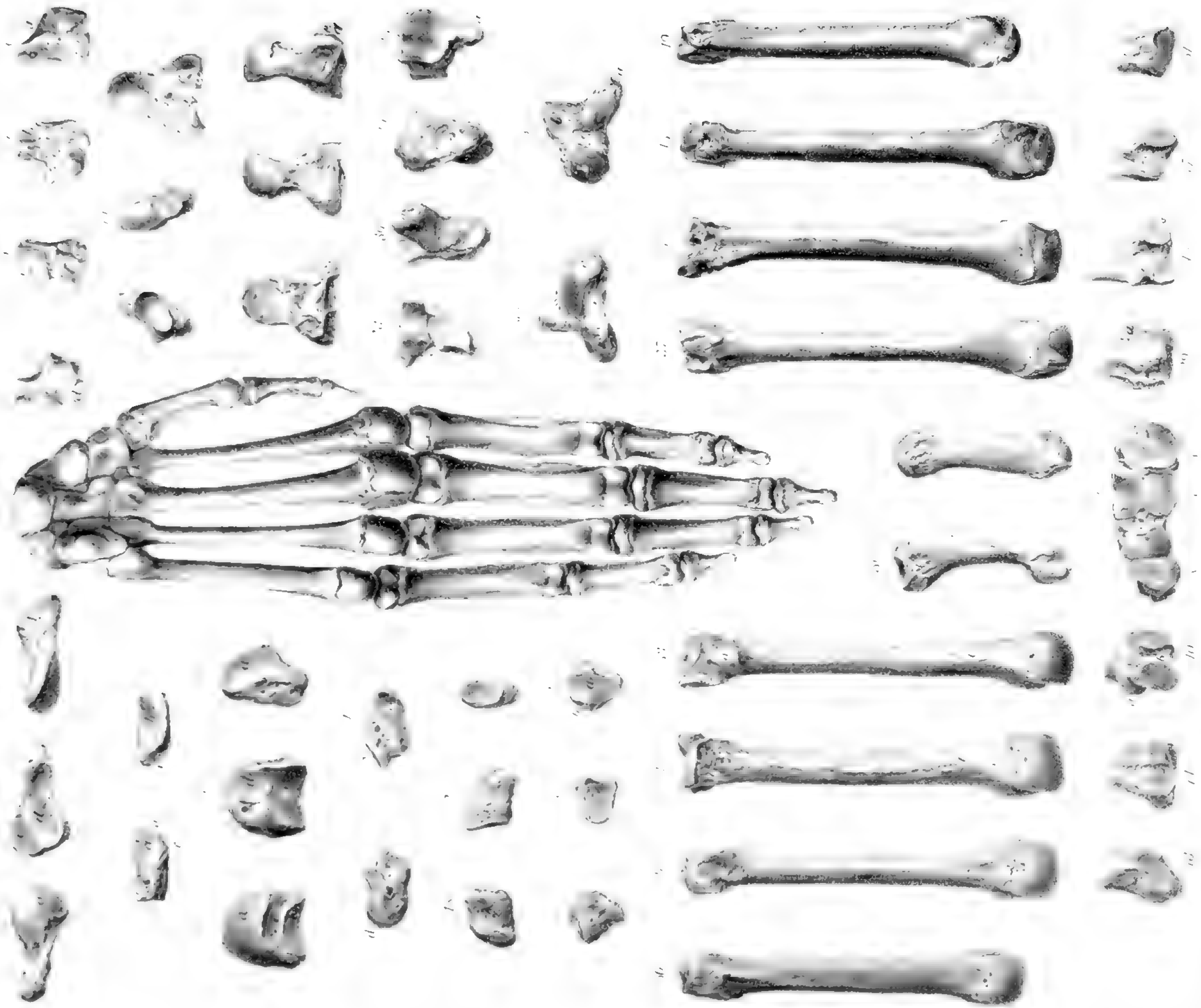
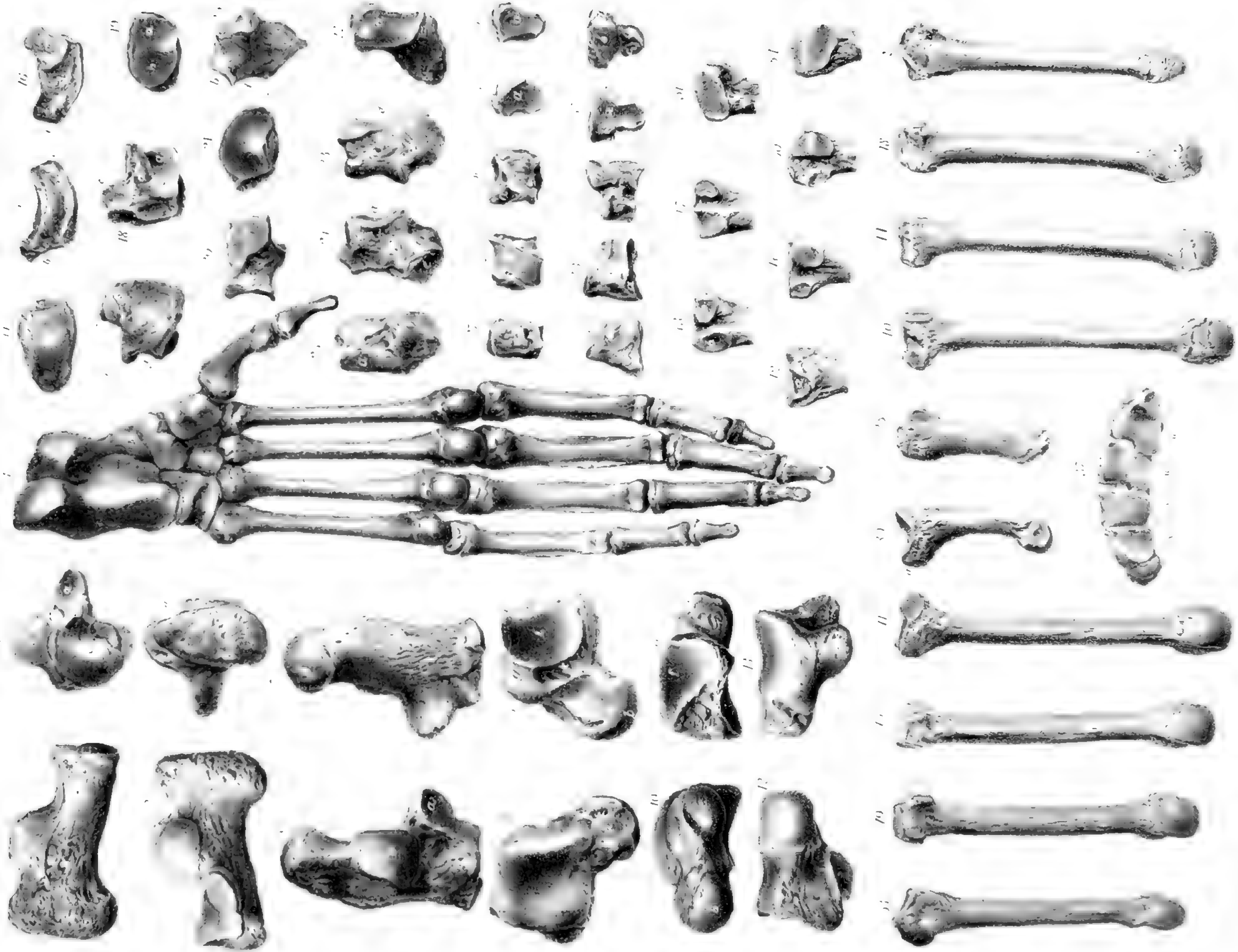




X. *Description of the Remains of three extinct Species of* Elephant, *collected by* Capt. Spratt, *C.B., R.N., in the Ossiferous Cavern of Zebbug, in the Island of Malta. By* George Busk, *F.R.S.; partly from the Notes of the late* H. Falconer, *M.D., F.R.S.*

Read June 27th, 1865.

[Plates XLIV. to LIII.]

§ I. *Introductory.*

In the following observations I have confined myself principally to the anatomical characters of certain proboscidian remains which were collected some years since (1859) by Captain Spratt, C.B., R.N., at that time in command of H.M. Surveying Ship 'Medina,' in an ossiferous cavern some distance inland in the Island of Malta, under circumstances which will be fully detailed by that gentleman elsewhere *.

As any extended geological account of the locality would be here out of place, it will suffice for the present occasion to state, from information supplied by Captain Spratt, that the cavern in question is situated on the north side of a rocky valley separating the town or *casal* of Zebbug from another town about a mile distant, called Siggieni. The cavern, when first opened, was filled to the roof with yellow and grey sandy clay, and it had no stalagmitic floor. Amidst this deposit, which had evidently been washed in by water, were numerous fragments of bones and teeth of at least two species of Elephant, manifestly widely distinct in size, some of the bones indicating an animal of very dwarf dimensions, as compared with all other known forms, recent or extinct. Besides these elephant-remains, those of other apparently extinct animals were also met with, all mingled with subangular but not waterworn fragments of the limestone rock. The cavern ran nearly horizontally from the face of the ravine or inland cliff, having a short branch terminating in a small chamber. It varied in height from $4\frac{1}{2}$ to $5\frac{1}{2}$, and in width from $1\frac{1}{2}$ to $2\frac{1}{2}$ feet.

Amongst the other bones associated with those of the Elephant were many of aquatic Birds, and especially of a large extinct species of Swan (*Cygnus falconeri*, Park.), a few jaws and other bones of perhaps more than one species of Dormouse, one of which

* Since this paper was read, Captain Spratt has communicated a paper on the "Geological relations of the Zebbug Cavern," which will be found in the 23rd volume of the Quarterly Journal of the Geological Society (1867). Two Reports, also, on other ossiferous Caverns in Malta, in which numerous remains of Elephants and other animals have been collected by Dr. Leith Adams, have appeared in the Reports of the British Association for 1865 and 1866; and I should also state that Dr. Leith Adams, who has been for some years indefatigable in his researches in the caves and fissures of Malta, has made an immense collection, more especially of Elephantine remains, an account of which, when they have been more fully worked out, will add very considerably to our knowledge of the various species, and more especially, as it seems to me, of the largest one, and of *E. melitensis*.—June, 1867.

was of gigantic size (*Myoxus melitensis*, Falc.), and, together with these, numerous remains of a land Tortoise, not as yet fully determined.

It should be mentioned also that, in several other localities in the island, caverns of a similar character have been discovered, containing chiefly bones of one or more species of *Hippopotamus* unmixed with those of the Elephant, and regarded by Captain Spratt, for certain geological reasons, as having been introduced into the caverns and fissures at a somewhat earlier period than those of the proboscidian pachyderm.

The occurrence of such abundant remains of large herbivorous mammals in so limited a spot as the present Island of Malta, taken in conjunction with other considerations of a geographical or, rather, hydrographical nature noticed by Captain Spratt, indicates beyond all doubt a former connexion of a very close nature with the African continent, and also points to the former existence in the site of the Maltese Islands of extensive currents of fresh water. It consequently becomes an extremely interesting problem to determine, with as much accuracy as the materials will allow, the zoological relations of these quaternary pachyderms to those at present existing, and also to those which have either been contemporary with them in other parts, or may have preceded them in order of time in the Mediterranean region.

The latter question, however, is one of such great magnitude, and so much more purely of palæontological interest, that, even were I able to do it justice, which is wholly out of my power, I should not here attempt to enter upon it—leaving its solution to more competent hands, to whom the present paper may, perhaps, be of some assistance.

With respect to the other extinct animals associated with the Maltese Elephants in the Zebbug cavern, I am happy to say that the determination of the birds, and more especially the description of *Cygnus falconeri*, has been undertaken by Mr. W. K. Parker, F.R.S., whilst there is reason to hope, from a letter from Dr. Leith Adams which I find amongst Dr. Falconer's notes, that the Gigantic Dormouse will find an able historian in him, who has met with the remains of that genus in extreme abundance in other localities in the island, in the exploration of which he is at present engaged, with the promise of the most fruitful results *.

Captain Spratt's valuable collections were originally committed by him to Dr. Falconer, whose irreparable loss we recently had so deeply to deplore; and a short notice respecting them was given, by him and Captain Spratt, to the Geological Section of the British Association, at the Cambridge Meeting in 1862. In this communication (a mere notice only of which appears in the published volume of Reports), Dr. Falconer announced the discovery, among these remains, of those of a diminutive or "pigmy" species of Elephant, for which he proposed the name of *Elephas melitensis*.

* The account of the Gigantic Fossil Dormouse, which was anticipated at the time this paper was read, has since been furnished by Dr. Leith Adams, and is given below, p. 307. That of *Cygnus falconeri* is already published, *anteà*, p. 119.

Naturally much struck with such an extraordinary deviation from the otherwise universally received conception of the proboscidians as animals of colossal size, Dr. Falconer entered upon the study of its remains with his usual zeal; and he appears to have contemplated the presentation to the Royal Society of a paper on the subject, including observations on the Mediterranean Cave-fauna generally,—a design the non-execution of which by such a man cannot be too deeply regretted. But, so far as I have been able to trace in his notes, he has left behind him no record of observations upon any of the bones except the teeth, doubtless having reserved the remainder for subsequent study. With respect to the teeth, however, he has left some very interesting and important remarks, the substance of which, and, so far as is possible, the words, will be recorded in the following pages.

Since the decease of Dr. Falconer, the collection of remains from the Zebbug Cave has been placed in my hands by Captain Spratt, with a request that I would undertake the completion of the task left unaccomplished by that distinguished palæontologist. This I have endeavoured to perform, though *haud pari passu*, and fully sensible of the loss that science has sustained from the change of hands into which the description has fallen, and especially since the only assistance I can derive from the notes of my lamented friend is, as I stated, on the subject of the teeth; but, in addition to these notes, I would remark that Dr. Falconer had had careful drawings made by Mr. Dinkel of some of the principal bones, under his own inspection, some of which will form part of the illustrations appended to this paper.

Under the circumstances, therefore, it is scarcely necessary to observe that I am alone responsible for nearly the whole of the descriptive part, so far as it relates to the bones of the skeleton, and that any errors or misconceptions contained in it must be laid to my charge alone.

It is proper also to mention that Dr. Leith Adams has, for the last year or more, been engaged in the exploration of fossiliferous caverns in various parts of Malta, and has been very successful in procuring abundant elephantine remains, both large and small, the examination of which will, doubtless, in his hands, supply many deficiencies in the account I now venture to lay before the Society.

Captain Spratt's collection of proboscidian bones and teeth is very considerable; but a great part of it is made up of broken and often much-rolled fragments; still among the remainder are several well-marked and characteristic specimens of many of the more important bones, and a very fine collection of milk- and permanent teeth in excellent preservation.

When I began to arrange the collection for examination, I found, to my extreme surprise, that it apparently comprised the remains of not less than three distinct species of Elephant—two of diminutive, and one of tolerably large dimensions. With the presence of the latter form, I was aware that both Dr. Falconer and Captain Spratt were acquainted; but neither of them were, I believe, at all cognizant of the existence of more than one dwarf species. Further attentive examination and comparison of the bones has only served to confirm this impression; and I hope in the following pages to be able to show that the Zebbug proboscidian remains, strange as it may seem, embrace those of not less than three species, two of which must be regarded as pigmy or dwarf forms (though one probably exceeded the other in size), whilst the larger one equalled in stature the smaller forms of the existing African or Asiatic species. It will doubtless be regarded as a remarkable circumstance that the distinction between the two smaller forms should have escaped the penetrating and long-experienced eye of Dr. Falconer; but I think this may be readily explained by the consideration that, so far as his notes show, he had not as yet entered upon the critical study of the bones of the skeleton, but had confined himself to that of the teeth alone, parts to which, as is well known, he attached such paramount importance in the study of the Proboscidia. And I have little doubt that, had he lived to resume his investigation of the Maltese fossils, which for the last two years or more had been completely interrupted by the attention he had devoted to the fossil remains from Gibraltar, he would, on turning to the bones of the skeleton, have become aware of the existence of more than one "pigmy" Elephant.

But under the circumstances, and having convinced myself of the existence of two such forms, I have felt some doubt as to the names that should be given to them. Both cannot of course be *E. melitensis* of Falconer; and I propose therefore to limit that name to the larger of the two small forms, and to designate the other by the name of one to whom palæontology, especially as regards fossil proboscidia, is so deeply indebted, and to term it *E. falconeri*.

As regards the large form associated with *E. melitensis* and *E. falconeri*, there are not in the present collection, as it appears to me, sufficient materials for the drawing of an accurate comparison between it and several other extinct species; and I shall therefore not venture at present to suggest any name for it, preferring to leave this in suspense until better-marked remains of its teeth and other parts may justify its being either referred to some already described species, or distinguished definitively from all with which we are at present acquainted. Reasons will perhaps be apparent, in what follows, for the suggestion that it may be identical with *E. antiquus*; but the evidence as yet in our possession is far too scanty to allow of this being affirmed with any degree of certainty *.

The collection, I would remark, is made up partly of the bones of adult, and partly of those of young or even, perhaps, fœtal animals; and these immature bones, like the mature ones, are plainly divisible into three sets, each of which it is fair to assume belongs to one or other of the adult forms indicated by the mature bones. No difficulty, of course, exists in referring the young bones of the large form to their proper place; but with respect to the other two, owing to their much nearer correspondence in size, the question of allotment is not so easily settled, and I am quite willing to believe

* *Vide* note, p. 227.

that any determinations I have made in this matter are open to future rectification. I have, however, in the following paper thought that it would be most convenient to consider what I regard as the remains of each species separately, in its mature and immature states, and I shall therefore commence with the large species.

§ II. Elephas, sp.? (Plates XLIV., XLV.).

There are between twenty and thirty fragments of bones belonging to an Elephant of considerable size, which in fact may be judged to have attained nearly, if not quite, eight feet in height. But of these fragments there are only three or four which it will be necessary or useful to describe in any detail. The remainder consist of various-sized irregular fragments of long and flat bones, including the cranium and pelvis, which are too imperfect to allow them to be turned to any useful purpose.

The more readily identifiable portions of the adult skeleton consist only of (1) the symphysial portion of the lower jaw, (2) a large portion of the head of the left (?) humerus, and (3) a nearly complete spine of probably the 17th or 18th dorsal vertebra. Beside these may be briefly noticed:—a large fragment of a femur, apparently of even greater proportional dimensions than the other bones; a considerable fragment of the spinous process of another dorsal vertebra; and a considerable fragment of a tusk near the base.

1. Of these, by far the most important fragment is the portion of the lower jaw (Pl. XLIV. fig. 1). It is evidently that of a mature, if not aged, animal; and it consists of the entire symphysis, and a portion of the ramus on either side, about 4 inches in length, measured along the lower border. The upper border on each side is broken off on a level with the large mental foramen and canal, which is thus represented on either side by a shallow groove, more than 0″·5 in width. The rostrum, or prolonged beak of the symphysis, if it existed, is broken off, the fracture extending chiefly to the left side. The fractured surface looks as if it were in part of ancient, and in part of recent date; and there are several other marks on the under surface of the bone, which show that it has been recently subjected to rough usage with a sharpish or pointed instrument, probably a pickaxe or geological hammer. Owing to the circumstance that the fracture at the apex of the symphysis is chiefly on the left side, the right border of the symphysial gutter remains almost entire, as does also a considerable portion of the left border above and behind the broken part; an accurate measure, therefore, of the width of the gutter can be taken, and its exact form perceived, whilst at the same time the angle at which its borders descend can be determined. The width of the gutter at the highest point at which it can be measured, and nearly on a level with the mental foramen, is about 2″; and its borders descend in front almost vertically downwards, as in *Elephas primigenius* and in old *E. indicus*. As before said, it is extremely doubtful, from the appearance of the borders of the gutter, whether there was any rostral prolongation whatever. The depth of the symphysis, measured in a vertical direction from the bottom of the symphysial gutter,

is 2″·15. In two lower jaws of a mature African Elephant, at the College of Surgeons, the width of the symphysial gutter at the same point as in the Maltese fossil is 2″·6, and in a third (female) 2″·3. In the Indian Elephant the mean width of the gutter at the same point is about 1″·9, varying from 1″·8 to 2″·0. As regards the width of this part alone, therefore, the Maltese specimen would seem to correspond more closely with the Asiatic than with the African species; but in the former the vertical depth of the symphysis is about 3″·5, and in the African 2″·7; so that, as compared with either of these species, the symphysial gutter is wider in the Maltese specimen in proportion to the depth of the symphysis. But when compared with a very perfect mandible of *E. primigenius* in the College of Surgeons, the width of the gutter is precisely the same, viz. 2″·0, and the depth of the symphysis also pretty nearly equal. Consequently we may conclude, so far as such a character will allow us, that the Maltese large Elephant had, as regards the mandible, more of the characters of *E. primigenius* than of either of the existing species. The mental foramen, which, as has been said, must have been about 0″·5 in diameter, is placed about 1″·0 behind the edge of the symphysial gutter. The distance between the two openings in a transverse line is about 2″·7, whilst in the Indian Elephant the corresponding distance is about 4″·0, and in the African 6″·5; whilst in the Mammoth already referred to it is 6″·8. It may here be remarked that the mental foramina are placed much nearer the border of the gutter in the Indian than in the African species, or, I believe, than in the Mammoth; consequently in their comparatively distant position from the edge in the Maltese fossil, the latter approaches the African more than the Indian Elephant.

From the very obtuse angle at which the rami meet at the symphysis (nearly 90°) it may be concluded that the jaw was broad and short.

There are no vestiges of any alveolar cavities.

2. The next well-marked fragment is a large portion of the articular head of the humerus. The remains of the antero-posterior arc of the articular surface indicate that it formed the segment of a circle having a radius of 2″·8, and, in the transverse direction, of 2″·7. The antero-posterior diameter of the head may therefore, in accordance with what obtains in the humerus of other Elephants, be regarded as nearly 6″.

In the table of measurements given by Cuvier * the diameter of the head of the humerus in an adult female Indian Elephant about 9 feet high ($2^{m}·76$) is stated to be 7″·28 ($0^{m}·185$), and the length of the humerus 32″·87 ($0^{m}·835$); whilst in a young but well-grown African Elephant in the British Museum the corresponding measures are 8″ and 36″; in a still younger (but not very young) specimen of the Sumatran Elephant they are 5″·2 and 28″·2; and in a very fine and perfect humerus of *E. primigenius*, in the British Museum, they are 7″·3 and 32″. According to these measurements the proportionate diameter of the head to the length of the entire humerus would stand in the respective cases as follows:—

* Ossem. fossiles, 4me éd. 1834, 8vo, tom. i. p. 504.

E. africanus (young)	1 to 4·00
E. indicus (female)	1 „ 4·53
E. indicus (Sumatra)	1 „ 5·42
E. primigenius	1 „ 4·50

From this we may probably consider that the usual length of the entire humerus in a fully grown mature Elephant is rather more than four times (4·3) the antero-posterior diameter of the head. In the young animal, in which the head has probably not attained its full size, the length would seem to be greater in proportion. From these data as compared with those afforded in Cuvier's table, it may be concluded that in all probability the Maltese Elephant to which the above-mentioned fragment belonged was about 8 feet high.

3. A third well-characterized bone, belonging apparently to an animal of the same proportions, is the nearly entire spinous process of the 17th or 18th dorsal vertebra (fig. 2). The fragment is 5″·6 long; and the neural spine itself measures along the anterior border 5″·2, and along the posterior 4″·7. Its smallest antero-posterior diameter is 1″·3, and at the base 2″·3. Its least tr. d. is 0″·5; and the ap. d. of the expanded outer end 1″·65. It is grooved behind for about half its length, whilst the anterior edge is acute nearly throughout. The right articular facet is present and entire; it measures 1″·2 * in length, by 0″·9 in breadth, and it is of an oblong form. The corresponding spinous process in the African Elephant (No. 708 *h*, B.M.) with which comparison has before been made, measures 5″·5 along the anterior, and 3″·8 along the posterior border, its least ap. d. being 1″·2, and at the base 3″·7, the least tr. d. 1″·0, and ap. d. 3″·8, at distal end 1″·5.

Of the teeth of this species, I have been able to detect only innumerable fragments of the tusks, which from their size must be referred to an animal of considerable bulk. The majority of these are too imperfect for description; but amongst them is a fragment, nearly five inches long, of the solid part of a tusk, 2″·8 in diameter. The fragment has been split off nearly down the middle; and the interior is thus shown to be quite solid; the portion, therefore, of the tusk to which it belonged was some distance above the base, which must have been greater in circumference. It is also to be observed that the outer surface of the fragment is strongly sulcate, showing that the outermost layer or layers have been removed; we may conclude, therefore, that the fragment does not represent the real diameter of the tusk, which may consequently be regarded as having been of considerable size, and quite commensurate with an animal 8 feet high or more.

Among the immature bones, are two well-marked fragments which, from their size appear to belong to the young of the same species as that whose remains have just been described. The portions in question are—(1) a left exoccipital, and (2) a considerable portion of the shaft of the left femur.

The exoccipital bone (figs. 3 and 4, Pl. XLIV.) corresponds pretty nearly in size, and

* This facet appears much too small in the figure, owing probably to its having been drawn foreshortened.

entirely in the appearance of the surface of the bone, with that of a young African Elephant in the British Museum, in which specimen all the bones of the cranium and face are perfectly separate; and in the lower jaw the 3rd molar is in full wear, no vestiges remaining of the 2nd molar. The dimensions of the two bones are as under:—

TABLE I.—Measurements* of Exoccipital Bone, in Maltese and African Elephants.

	Height or greatest length of exoccipital.	Breadth of exoccipital.	Width between borders of condyloid fossa at foramen magnum.	Length of basioccipital synchondrosis.	Width of basioccipital synchondrosis.	Thickness in region of mastoid cells.	Length of condyloid articular surface.	Greatest width of condyloid articular surface.
Young African Elephant, No. 708, B.M.	4·5	3·5	1·6	1·9	·95	1·3	2·2	1·35
Young Maltese fossil.	4·7	3·9	1·6	1·8	1·15	1·9	2·35	1·55

It will thus be seen that in general dimensions and proportions the two bones are remarkably alike; but they present certain differences, which would appear, as I think, clearly to indicate that they belong to different species.

In the first place, notwithstanding the apparent similarity of age, it will be observed that the fossil is very much thicker in the part occupied by the paramastoid cells, and that the proportions of the condyloid articular surface are not the same. But the most striking distinction consists in the circumstance that, in the African Elephant, the cerebellar fossa is very concave or deep, and that the sulcus for the lateral sinus is also very deep, and separated from the opening of the paramastoid cells by a sort of vertical wall; whilst in the Maltese fossil the cerebellar fossa is only slightly hollowed, and there is scarcely any trace of a sulcus for the lateral sinus. And in another very young (or perhaps fœtal) cranium of the African Elephant (No. 708 *j*, B.M.), in an exoccipital having a greatest diameter of 3″·1, and least of 2″·9, the sulcus for the lateral sinus is quite as well marked as in the above,—whence it may be concluded that this character is not dependent upon age, and may probably be relied upon as indicating a distinction between the Maltese form and *E. africanus*. I have not had an opportunity of comparing the exoccipital of the Indian Elephant of the same age. In the young African Elephant the opening into the paramastoid cells is triangular, and a transverse septum may be observed within, dividing the main cavity into two primary loculaments, of which the posterior is shallow, and the anterior very deep, communicating at the bottom with two deeper cells. In the Maltese fossil the same primary division into two chambers is observable; but the slender trabecular septum between them is absent, and replaced simply by an angular ridge. It should be remarked in addition, that in the African species the concavity or sulcus above the condyle is much deeper than in the Maltese, and that the curve of that part of the *foramen magnum* which is formed by the exoccipital is different in the two cases.

* Throughout this paper the measures are given in inches and tenths.

The portion of the shaft of a femur (fig. 5) like the exoccipital, and probably belonging to the same animal, presents all the external characters of a very young bone. It is broken at either end at some distance from the epiphysial termination. The entire fragment measures 8″·4 in length, and its least tr. d. is 2″·15, and least circumference 5″·9. In a young *E. indicus* in the British Museum, in which all the epiphyses are separate, and the ossification of the articular ends themselves very incomplete, the length of the shaft is 21″, the least tr. d. 2″·4, and the least circumference 6″·7. In general form the two bones resemble each other very closely, except that in the Maltese fossil the posterior surface rises more into an angle than it does in the other, in which it is uniformly rounded and even. The nutrient foramen in both is on the inner side, about the junction, as it may be estimated, of the upper and middle third, or a good way above the middle of the bone, whilst in the African species it is much lower down; and this I am inclined to believe will be found a constant and not unimportant character. At any rate, so far as it goes, it further tends to show a distinction between the Maltese and existing African species.

Besides the above bones belonging to the largest of the three Maltese forms, there are numerous fragments of others, most of them apparently of an old animal or animals, and including portions of the cranium, pelvis, and of some of the larger long bones. All manifestly indicate a species of comparatively large size; but as they afford no special characters, I have not thought it necessary to enter into further details respecting them.

§ III. Elephas melitensis.

Bones or fragments of bones belonging to the larger of the two dwarf species of Elephant to which I have assigned the name of *E. melitensis* constitute a very considerable part of the collection. They are exceedingly numerous; but amongst them are very many much broken and scarcely recognizable portions of the cranium, with respect to some of which it is impossible to determine whether they belong to this or to the next species. But, as in their present condition these broken fragments offer no distinctive characters, their determination is not a matter of any great importance. The remaining fragments amply suffice at any rate to indicate the comparative bulk and many of the distinctive characters of *E. melitensis*.

Separating the mature from the immature bones, and excluding the teeth, there are about 18 fragments which it will be necessary to describe:—

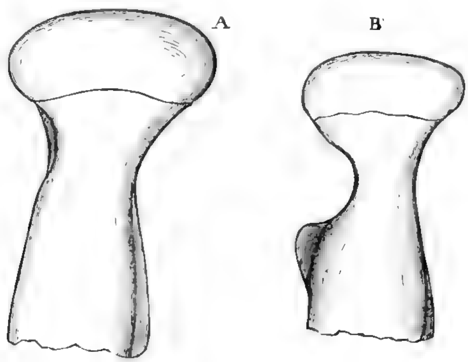
These are:—(1 & 2) portions of the right ascending ramus of the mandible; (3) the right half of the atlas; (4, 5, & 6) the 7th cervical, 7th dorsal, and 3rd lumbar vertebræ; (7) the neural spine of one of the anterior dorsal vertebræ; (8, 8^a) the proximal end, including the head of the second rib on the right side, and a portion of the body of one of the larger ribs; (9) a portion of the left scapula; (10) the nearly entire head and part of the shaft of the right humerus; (11) a small fragment of the articular head of the humerus (side uncertain); (12) the upper end, minus the olecranon of the right ulna; (13) a detached olecranon of the left ulna; (14) a fragment of the shaft of the left ulna; (15) a portion of the right os innominatum, including part of the acetabulum; (16) a portion of the articular head of the femur; (17) a great part of the shaft of the right femur; (18) the lower end of the left tibia.

1. *Bones of Cranium and Face.*

The ascending ramus of the mandible in the Elephant appears to afford very distinctive characters, at any rate between the African and Indian species; and the acquisition, therefore, of a considerable portion of this part of the skeleton of *E. melitensis* is of great value. The two fragments both belong to the same side. They are of exactly the same dimensions, and, so far as they can be compared, of the same age, and that probably of a fully mature animal in which the third molar had advanced into the horizontal ramus. The larger of the two fragments (Pl. XLVII. fig. 13) is about 4″·6 long, and about 2″·2 in ap. d. at the lower part, or at about three inches below the upper border of the dental foramen. The condyle or head appears to have been broken off through the smallest part of the neck; and this is at a level of about an inch above the middle, or thereabouts, of the dental foramen. The bone is broken on the external border at this part, so that the entire width or tr. d. of the neck cannot be determined; but it may be estimated at about 1″·3. The ap. d. of the ramus on a level with the lowest part of the dental foramen is 1″·7. The posterior or, rather, interior angle is rather acute, and it descends evenly till the angularity merges in the inner surface of the bone about 1″·5 below the dental foramen; immediately exterior to this angular border the surface presents a shallow sulcus, bounded on the outside by a second ridge, beyond which the posterior and outer surface is flattened or slightly concave. The anterior, and internal angle is somewhat acute, especially at the lower part. The anterior surface is too much broken to demand any special description; but it may be remarked that the peculiar pock-like pitting which is exhibited on that surface within the base of the coronoid process in all Elephants, but which is much more pronounced in the African than in the Indian species, is very well shown in the jaw of *E. melitensis*. As these markings represent a muscular insertion, their distinctness in the present case is an additional indication, if the proof were required, that the bone was that of a mature animal. The inner surface is concave, and presents at the upper part the inferior dental foramen. As nearly as can be estimated, this opening is about 1″ in ap. d. It is very oblique; and the inferior margin is interrupted by a deep and wide fissure. The anterior border is very thick, the posterior very acute.

Compared with the corresponding part of the mandible in the African and Indian Elephants, that of *E. melitensis* exhibits striking peculiarities beyond its size, though on the whole its resemblance may be said to lean much more towards the African than towards the Indian type. In order to make this plain, it will be as well to point out one or two of the differences which exist in this part of the skeleton between the two existing species. In the first place, as above remarked, the inner and posterior angle of the neck in the African Elephant descends evenly till it is lost, below the level of the dental foramen, in the general surface of the ramus; at most it exhibits, in older animals, a slight roughness about the level of the dental foramen. But in the Indian Elephant, of all ages, this border or angle, at about the level of that foramen projects into a distinct sort of *crochet*, which, as it were, protects the dental foramen from behind.

This striking difference of form, seen on viewing the ascending ramus of the mandible. between the Indian and African species, is shown in the accompanying woodcuts *,



The tr. d. of the neck at the smallest part, as compared with that of the condyle, is rather less in the African than in the Indian species. In two specimens in which the comparison was made, the tr. d. of the head in the Indian Elephant was 4″, and that of the neck 1″·9; whilst in the African the head was 3″·7 in tr. d., and the neck 1″·5. In general form also, a considerable difference may be remarked. Viewed laterally, the ascending ramus in the African Elephant is more rounded than in the Indian, in which it is comparatively straight in the vertical direction. The coronoid process rises much higher, in fact nearly to the level of the condyle, in the Indian Elephant; and its anterior border is nearly vertical, which in the African overhangs very much, and is at the same time much thicker and rougher, whilst it descends very rapidly from the condyle to a level considerably below it. A striking difference is also seen in the configuration of the dental foramen. In the Indian Elephant this orifice looks, as it were, directly upwards, owing to the distinct elevation of the inner border, which forms, in fact, a sort of spine or projection opposite to the posterior crochet above described, the border of the opening between these two points being interrupted by a deep angular notch. In the African Elephant the dental foramen, which is pro-

* A. *E. indicus*. B. *E. africanus*.

portionately also of much larger size, is so much bevelled off below as to look, as it were, directly inwards instead of upwards; and the anterior and lower borders are thin and continuous. Several other distinctions might be pointed out; but the above are sufficient for the purpose of comparison with the jaw of *E. melitensis.* This will be found to exhibit the comparatively slender neck, and the obliquely bevelled dental foramen of the African, together with the absence of any posterior crochet, the presence of which is so strikingly characteristic of the Indian species. But it differs from the African in the presence of the sulcus on the posterior border, in the much thickened anterior margin of the dental foramen, and in the deep emargination of its lower border. With respect to comparative dimensions, it may be stated that the tr. d. of the ramus on a level with the middle of the foramen, in the African Elephant, is 4″·3, and in *E. melitensis* 1″·8; so that the general dimensions of the bone may be taken at about half those of the African species.

2. *Bones of the Trunk.*

1. The portion of the atlas (Pl. XLVII. fig. 12) is unfortunately very imperfect; and what remains is much injured, presenting some appearance of its having been gnawed. It consists of the right half, including the entire superior and the greater part of the inferior articular surfaces. The transverse process is broken off, leaving only a deep and wide sulcus to represent the foramen for the vertebral artery, but which is continued into a perfect posterior condyloid foramen. The ap. d. of the fragment, which is probably pretty nearly that of the entire bone, is about 3″·5. The ap. d. of the superior articular facet is 2″·5, and its tr. d. about 1″ 8. The inferior facet is not sufficiently complete to admit of accurate measurement. The greatest height of the bone, measured just behind the roof of the transverse process, is 2″·4; the diameter of the posterior condyloid canal about 0″·4 *.

In a young Indian Elephant (No. 2678, C. S.) the ap. d. of the condyloid facet is 4″, and its tr. d. 3″, the former being nearly, and the latter exactly, twice the corresponding measures in *E. melitensis.* In a rather younger specimen of the Indian Elephant, termed *E. sumatrensis,* in the British Museum, the same measurements are 3″·3 and 2″·4 respectively; and in an African Elephant of mature age, 4″·7 and 3″·2. In the latter instance a considerable difference is apparent in the form of the facet. In *E. indicus* (var. *sumatrensis*) the surface is kidney-shaped, having a deep sinus on the inner border, whilst in *E. africanus* that border is entire; but I am not aware that this difference exists in all cases between the Indian and African species.

2. The seventh cervical vertebra (Pl. XLVI. fig. 9) is a beautifully perfect specimen of that important and highly characteristic element of the vertebral column. Its principal dimensions, contrasted with those of the same bone in an African Elephant, and in the B. M. specimen of *E. sumatrensis,* are as follows:—

* Other fragments of the atlas of this species are shown in Pl. LI. fig. 35, and, as I believe, but am not sure, in fig. 33.

TABLE II.—Dimensions of 7th Cervical Vertebra.

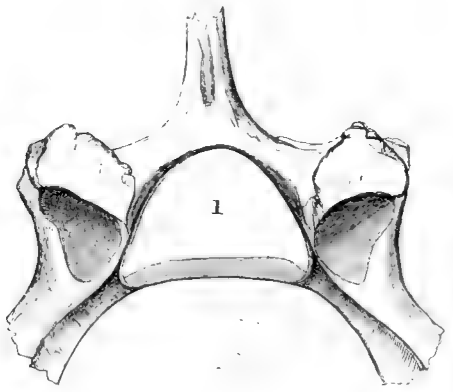
	Height.	Length of Spine.	Transverse diameter at articular processes.	Transverse diameter at transverse processes.	Transverse diameter at costal facets.	Transverse diameter of body anteriorly.	Vertical diameter of body.	Transverse diameter of vertebral canal.	Vertical diameter of vertebral canal.
E. melitensis	6·8	2·5	3·55	5·7	3·5	2·9	2·85	2·0	1·7
E. africanus	8·20	4·9	7·15	9·8	6·1	6·35	5·4	3·85	2·1
E. sumatrensis . .	7·5	2·5	5·6		5·4	4·65	3·5	2·8	1·9
E. indicus	14·0	7·0	6·5	10·25	6·8	5·5	4·25	3·75	3·0

The body, which is about 1″·3 in its greatest thickness, is almost circular, slightly convex in front, and well hollowed behind, especially towards the lower part. The neural canal is triangular and, viewed anteriorly, very nearly equilateral; the laminæ or neurapophyses flat and very thin, about 0″·8 wide, and not more than about 0″·15 thick. The neural spine is also thin and slender, of the same width at the base as the laminæ, and it is curved very slightly forwards. The transverse processes are broad and strong, and the outer surface of the process of bone connecting them with the articular processes is flat, or very slightly concave. The posterior sulcus for the exit of the spinal nerves is 0″·4 across, at the base of the posterior articular process. The costal articular facets are subtriangular, the sides of the triangle being about 1 inch in length. The entire bone presents all the appearance of mature, if not of advanced age.

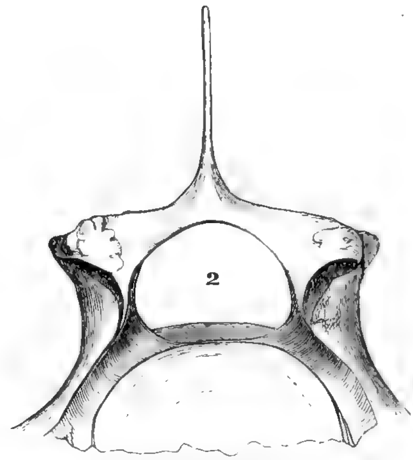
Compared with the corresponding vertebra of the young African Elephant, many points of great dissimilarity, besides those shown in the Table, at once present themselves.

In the African species the neural spine is flattened and sulcate behind, whilst in *E. melitensis* it is acute and without any sulcus. In both, the neural spine inclines a little forwards. Inspection of the measurements will show another remarkable distinction, in the comparatively much greater lowness of the neural arch in the African as compared with the Maltese species. Had the respective diameters of this arch borne the same proportions to each other in *E. melitensis* that they do in *E. africanus*, the height, instead of 1·″7, would have been only 1″·09. There is reason, however, to believe that the lowness of the arch in the specimen of African Elephant employed for the purpose of comparison is in part owing to its younger age.

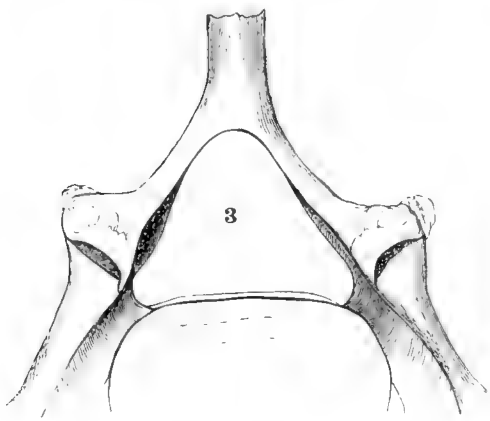
When we compare the 7th cervical vertebra of *E. melitensis* with that of the Sumatran Elephant (younger than the African example), the differences are still more striking, especially in the form and proportional dimensions of the neural arch, neurapophyses, and spine. The arch, instead of being triangular, is more of an oval form; and the vertical diameter is little more than half its transverse width. The neurapophyses or laminæ, instead of being thin and flat, or riband-shaped, are very thick and square, and the neural spine in proportion very slender, its base not being nearly equal in ap. d. to the width of the neurapophyses; and it is curved slightly backwards instead of forwards as it is in *E. africanus* and *E. melitensis.* The transverse processes also are very convex in front, instead of concave as they are in the latter species; the outer surface of the process of bone connecting the transverse and articular processes is rounded in the Sumatran Elephant instead of concave. Many of these differences are doubtless attributable to difference of age; but on the whole we may presume that the 7th cervical vertebra of *E. melitensis* has more of the African than Asiatic character. In order to render more distinct some of the diversities presented by this vertebra in the different instances cited, I have subjoined the accompanying woodcuts, which are drawn to a scale of one-third the natural size—



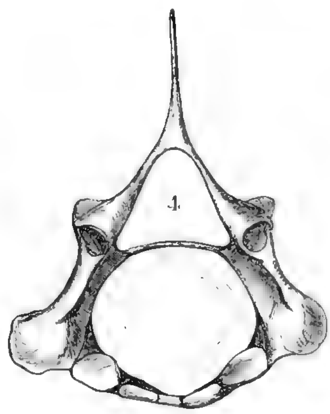
E. africanus.



E. (var.) *sumatrensis.*



E. indicus.



E. melitensis.

all of which represent the posterior view of the neural arch.

3. A dorsal vertebra (Pl. XLVI. fig. 10), either the 6th or 7th, but in all probability

the former, if the ribs are articulated as in the Indian Elephant, seeing that the remains of an articular surface are visible on the anterior aspect of the left transverse process. The bone is remarkably perfect, wanting only the extremity of the neural spine and a small portion of the right transverse process.

Its principal dimensions are as follows:—Transverse width from the end of one transverse process to the other, as they are, 4″·7, but in the perfect state probably 5″ or more. Height of body 1″·85. Thickness 1″·5. Width of anterior surface of body 2″·15, of posterior 2″·2; anterior costal facets 1″·1×0″·9; of posterior 1″·05×0″·65; ap. d. of neurapophyses 1″ 2; extreme distance between the outer borders of the two posterior articular facets 1″·6. The neural arch, especially when viewed from behind, is cordiform, about 1″ high, and 1″·4 wide; the body is also cordiform in figure, very concave behind, and but slightly convex in front. The neural spine is inclined backwards almost to a horizontal position. It is sharply carinate above, with a deep irregular hollow on one side only; beneath it is deeply and widely sulcate beyond the expanded base, whilst between the posterior articular facets it presents an elevated ridge.

4. The second or third lumbar vertebra (fig. 11), evidently belonging to the same animal as the other two. It is unfortunately not quite so perfect as either of the others, but still sufficiently so to afford a very good idea of its characters. Its dimensions are:—Height of body 1″·7; thickness or ap. d. 1″·5; width of anterior surface 2″·1, and of posterior 2″·4; ap. d. of neurapophyses 1″·1; extreme distance between the outer borders of the posterior articular facets 1″·5. The neural arch is depressed, its height about 0″·8, and width in front 1″·65. The body is suboval, very concave behind, and nearly flat in front. Both transverse processes are broken short off, as is also the greater part of the apparently small neural spine.

In the second lumbar vertebra of *E.* (var) *sumatrensis*, which approaches the nearest in size to the Maltese specimen, the diameter of the body behind is 3″·45, and its thickness 2″·8; whilst the distance between the outer borders of the posterior articular surfaces is 1″·95, and the transverse diameter of the canal 2″·2, and its height 1″·68.

5. The only other fragment belonging to the spine, and appearing from its dimensions to correspond very closely with the three vertebræ just described, is one of the anterior dorsal spines (Pl. XLV. fig. 7). It is broken off through the roots of the neurapophyses, so that a small segment of the medullary canal is left. Measured from this point to the extremity, which, though chipped on one side, yet shows very distinctly that it was tipped with cartilage, the length of the spine along the anterior border is about 5″. It is very slender and subtriangular in shape, with an acute angle in front, and rather obtuse ones on the sides. Behind, it exhibits a shallow groove towards the outer end; but below the middle the surface rises into a ridge which descends nearly, but not quite, to the border of the vertebral canal.

6. A portion of the second rib of the right side (Pl. XLV. fig. 8) measuring about 4″·5

in length. The epiphyses are perfectly united, and no trace whatever of the junction remains, so that the bone must be regarded as mature. The head measures 1″ in its longest, and 0″·85 in its shortest diameter. The distance between the inner border of the head and the outer surface of the tubercle is 2″.

The corresponding rib in the young Asiatic Elephant in the B. M., denominated *E. sumatrensis*, has the greatest diameter of the head 1″·5, and least 1″·1. And in that species the tuberosity is differently formed, having a considerable elongation at the bottom, whilst in *E. melitensis* (a much older animal), the neck is fully as thick as in the so-termed *E. sumatrensis*. It is also to be remarked that in *E. melitensis* the notch or depression between the head and tuberosity is deeper than in the Asiatic form, in which also there is no depression below the tuberosity, such as is seen in *E. melitensis*. The comparison between the second rib of *E. melitensis* and that which I refer to *E. falconeri* will be drawn when I come to the description of the latter.

7. Another, and in some respects a most important and interesting, fragment belonging to the bones of the trunk is a small and much mutilated portion of the pelvis (Pl. XLVIII. fig. 26). It consists of part of the right ischium, including a small segment of the acetabulum, and a length of about three inches of the body of the bone. The surface on the outer, anterior, and inner aspects is almost entire or uninjured; but posteriorly there is merely an apparently fresh fracture. The fragment, however, broken as it is, is amply sufficient to afford some very important characters.

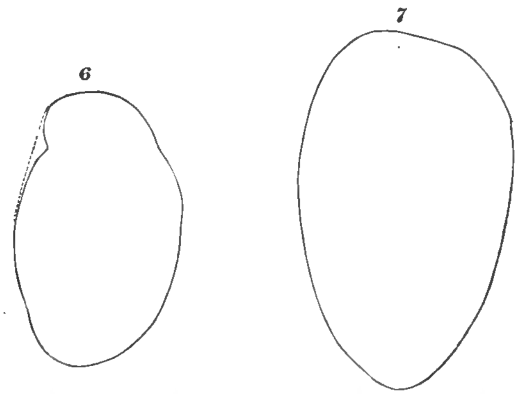
From the small remaining segment of the acetabulum it is evident that the curve of the articular surface must have had a radius of about 1″·6. The cup was consequently fitted to receive a femoral head of about $3\frac{1}{4}$ inches in diameter. The anterior surface of the bone is slightly hollowed, excepting quite at the upper edge, where the border of the acetabulum projects considerably and forms one margin of a wide and shallow sulcus or excavation, which was continued upwards into the cotyloid notch. The outer surface exhibits part of a large rough tubercular elevation. The inner is smooth and nearly even, marked only by a slight eminence. The outer angle is round and smooth; and the inner, or that which forms the ischial border of the obturator foramen, though not so obtuse, is also rounded and quite even.

It is to the latter character more especially that I should wish to direct attention, in drawing a comparison between this part in *E. melitensis* and the corresponding part, fortunately also preserved, in *E. falconeri*, as it shows, perhaps as strikingly as any other single part, a considerable distinction between the two forms.

I am not aware that the circumstance has been previously noticed; but it is nevertheless the case that a considerable difference in the form of the obturator foramen exists between the African and Indian species.

In both the foramen has somewhat of an oval shape; but in *E. africanus* the wider part of the oval is towards the upper or inner end, whilst it is towards the lower end in *E. indicus*. In *E. africanus*, again, the margin is tolerably even all round, whilst in

E. indicus the upper or anterior part of the oval appears to be constricted, as it were, by an eminence, usually on both sides, ischial and pubic, but at any rate on the former. It is to be observed, moreover, that in the African species the ischial border is thick and rounded, whilst in the Indian it is thin, or might almost be termed acute. The difference in the outline of the foramen in the two species is shown in the accompanying figures, taken from specimens of *E. africanus* and (so termed) *E. sumatrensis* in the British Museum.



E. indicus. *E. africanus.*

I have had no opportunity as yet of examining this part in *E. primigenius*, or in any other fossil species; but, from the figures of the Elephant's pelvis given in pls. xiii. & xvi. of the 'Ossemens fossiles,' it would seem that the ischial eminence above noticed and the peculiar constriction of the upper part of the obturator foramen are as well marked in fossil bones which in all probability belonged to the Mammoth as they are in the figure given, pl. xiii. fig. 4, of the pelvis of the Indian Elephant.

Should the distinction here pointed out be found to hold universally, it would follow that, so far as the apparent form of the ischial border of the obturator foramen is concerned, *E. melitensis* very closely resembles *E. africanus*. It will afterwards be seen that in *E. falconeri* the configuration of this part more nearly resembles that of *E. indicus* and *E. primigenius*.

3. *Bones of the anterior extremity.*

The well-recognizable fragments of bones belonging to the anterior extremity of *E. melitensis*, comprise:—

1. A fragment of the left scapula.
2. The entire upper end of the right humerus.
3. A portion of the upper end of the right ulna.
4. The left olecranon.
5. A fragment of the shaft of the left ulna, of probably a younger animal.

1. The portion of scapula (Pl. XLVIII. fig. 23) consists of the greater part of the neck and the adjacent bone, about three inches in its greatest length. It fortunately retains the greater part of the glenoid fossa, of which perhaps the lower two thirds remain entire. The remaining portion is about 2 inches long in a vertical direction, whilst the greatest width of the fossa is about 1″·2. The articular surface is perfectly smooth, and its curve in the vertical or longest direction has a radius of about 2″, and in the transverse of about 1″·75. The entire fossa may be estimated at about 2″·3 long by 1″·7 broad. Its sides are pretty nearly parallel, and the lower margin is accurately semicircular; the upper margin (as already stated) is wanting; but it may be concluded that when entire the fossa was of a broad oblong form, and had none of the constriction on the sides which is usually seen in the Asiatic Elephant and, I believe, also in *E. primigenius*. In this respect therefore it would seem more to resemble the glenoid fossa of the African than that of the Indian species. The following are the dimensions of this part in different specimens of Elephant taken for the purpose of comparison:—

E. indicus (young)	3·5×2·6
E. indicus (mature)	
E. indicus (var. *sumatrensis*, young)	4·7×3·0
E. primigenius (Cuvier)	8·5×4·4
E. africanus (mature)	6·7×4·3
E. melitensis (mature)	2·4×1·7

The part of the bone immediately supporting the articular fossa is thick, massy, and rugose, especially on the dorsal aspect. The entire bone is compact and heavy, and it has manifestly belonged to a perfectly mature animal.

2. The portion of humerus (Pl. XLVIII. fig. 22) is in many respects one of the most instructive specimens in the entire collection. It is the entire head and upper part of the shaft of the right humerus of an animal which had arrived at full maturity; for the proximal epiphysis is completely united to the shaft, although the line of junction is still apparent, except to a small extent on the inner side, where it is completely obliterated. And this is an important circumstance as indicative of the maturity of the individual, since the proximal epiphysis of the humerus would appear to be one of the latest to become united to the shaft. The fragment is remarkably perfect; it appears to have been recently broken from the shaft; and a small fragment has been chipped off the anterior part of the head, probably at the same time. It is also slightly and, to all appearance, recently chipped at the hinder border of the head; and the tuberosity is slightly abraded. The bone presents no distinct trace of rolling or morsure. The articular surface of the head is somewhat remarkable for its comparative narrowness in the transverse direction; so that, had it been completely detached from the rest of the bone, it might very readily have been regarded as fitted more for a ginglymoid than an enarthrodial joint. In all Elephants the head of the humerus is somewhat compressed,

or, as it were, elongated in the antero-posterior direction, and perhaps more so in the African than in the Asiatic species, as is, in fact, in some measure, shown in pl. vii. fig. 3 of the 'Ossemens Fossiles;' but in the present case this compression appears to be carried to the extreme. There does not appear to be anything distinctive in the form or size of the tuberosity; but the bicipital groove, even as compared with that of the African Elephant, is remarkable for its great width and extreme shallowness. In fact, after making every possible allowance for the portion of bone which has been detached from the anterior border of the head, it would seem that there could scarcely have been any distinct bicipital groove, and certainly none at all comparable in depth with that in *E. primigenius*, *indicus*, and *africanus*, as may be seen in Cuvier's figures above cited. And from these, as well as from an observation in the text (tom. ii. p. 218), it would appear that this groove is still narrower in the Mammoth than it is in *E. indicus*. It should also be mentioned that both borders of the groove arch over it in the mature *E. indicus*; whilst in *E. africanus*, and still more so in *E. melitensis*, there is no incurvation of the kind on either side.

3. *Ulna*.—Of this bone the collection contains seven well-recognizable fragments, three of which from their size would appear to belong to *E. melitensis*, and four to the smaller species. One of the best-marked specimens of the former is represented in Pl. XLVIII. figs. 24 and 24 *a*. It is a portion, about four inches long, of the upper part of the right ulna, which has been fractured transversely through the shaft, at about that distance below the articular surface. The olecranon is broken off obliquely downwards, on a level with the horizontal part of the articulation. The remaining part of the articular surface is nearly entire, being only slightly eroded at the anterior part of the outer cusp. The surface of the bone elsewhere, except at the upper part of the posterior angle, as above noticed, is quite uninjured.

The bone is evidently that of a fully mature animal; and from its colour and condition, both externally and within, it is not unreasonable to consider that it may have belonged to the same individual as that which owned the upper end of the humerus just described. The form of the articular surface is shown in the figure. The tr. d. of the inner condyloid facet, measured from the middle of the radial sulcus, is 1″·65, and its ap. d. at right angles to the same line, 1″·65; so that it is circular; whilst the radius of the curve of the concavity is about 1″·3*. The transverse diameter of the upper end of the bone at the level of the lip of the articular surface is 2″·6. The transverse section at the lower end of the fragment exhibits a nearly equilateral triangle, the anterior side (*a*, fig. 5) of which rises into an angular eminence towards the inner side; the outer side of the triangle is slightly convex, and the internal is nearly straight or slightly convex,—the respective lengths of the three sides being:—*internal*

* The tr. d. of the outer facet cannot be exactly determined, as it is partly destroyed; but its extreme length, measured from the bottom of the radial sulcus, may be estimated at 1″·1, and its width, from the same point in a line at right angles to its length, is about 0″·95.

1″·25; *external* 1″·15; and *anterior* 0″·75, and 0″·5 on either side of the radial ridge. The anterior aspect of the remaining portion of the shaft presents at the upper part a very deep and spacious radial fossa, from which is prolonged obliquely downwards and inwards a shallow uneven sulcus, about 0″·6 wide, the outer border of which is formed below by the prominent ridge, the situation of which is indicated by the letter (*r*) in the accompanying figure, which is intended to show the outline of the transverse section of the shaft at a distance of about 3″·6 below the middle of the radial sulcus, or at a distance equal to about twice the transverse diameter of the internal condyloid facet. The external surface of the bone is smooth and concave above, slightly convex below; the internal is also very smooth, even, and nearly flat below, passing above into a rather deep sulcus between the inner articular head and the base of the olecranon. The posterior angle is very acute, but above it is broken obliquely off. The internal angle is thick and rounded, and the external rounded and slightly carinate.

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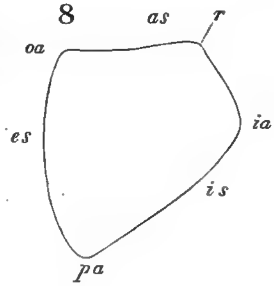


4. A second well-marked fragment of the ulna is shown in fig. 25. It is the *olecranon*-process of the left ulna. Anteriorly it exhibits nothing but an irregularly fractured surface, and no vestige of the articular surface. It is also slightly broken on the inner face, and below it is fractured transversely 3″ below the summit. The ap. d. of the upper end, measured at a point where the bone is entire, on the outer side of the median line, is about 2″; but it doubtless projected considerably in front of this in the median line when entire. In size, colour, and general condition this fragment closely corresponds with the one just described, and it may probably be regarded as belonging to the opposite ulna of the same individual.

5. A third portion of a left ulna, corresponding in dimensions with the above, is also contained in the collection. Though clearly referrible to the same species, it would seem to have belonged to a younger animal; and as it is a good deal injured, apparently by recent fracture, it is needless to enter into any particular description of it.

If we compare the characters of the ulna of *E. melitensis* as displayed in the specimens above described, with those of the same bone in *E. africanus*, very considerable differences, besides mere size, will at once be perceived.

(1) A very striking dissimilarity exists in the form and proportions of the articular surface. In an ulna of the African Elephant 31″ long, the transverse diameter of the upper articular end is 7″·6; the tr. d. of the inner facet measured from the middle of the radial sulcus 4″·1, and its ap. d. 3″·1; whilst the length of the outer facet is 3″·4, and its width 2″·1.

These dimensions of the facets therefore, as compared with the transverse diameter of the articular head, taken at 1·000, in the respective cases, stand thus:—

	E. africanus.	E. melitensis.
Transverse diameter of inner facet	·539	·634
Antero-posterior diameter of inner facet	·400	·634
Length of outer facet	·447	·423
Width of „ „	·276	·360

(2) The differences between the ulna of the African and Indian species, as regards the upper end are not very striking, but so far as they go they tend to show a nearer approximation, in *E. melitensis*, to the African form. These differences are—the radial sulcus is more rounded and shallower in *E. africanus*, and the inner articular facet wider at what may be termed the neck, though in both the existing species that facet is much more elongated than it is in *E. melitensis*. The outer facet in all three is much alike, except that in *E. indicus* it has a small prominent tuberosity in front. In both species also there is a rather deep pit or fossa in front of the inner condyle, for the insertion probably of the *brachialis anticus*, which is scarcely indicated in *E. melitensis*.

(3) Another character in which *E. melitensis* approaches *E. africanus* is in the deeper concavity at the upper part of the outer surface of the shaft, which part is nearly flat in *E. indicus*.

As is well known, the lower articular surface of the ulna varies very materially in the existing species; but as no means exist of comparing this part in *E. melitensis*, it is needless here to notice it further.

4. *Hinder Extremity.*

1. The principal fragment belonging to the hinder extremity of *E. melitensis* is a considerable portion of the shaft of the right *femur*, represented in Pl. XLV. fig. 6.

It measures 9″·2 in length; and its least transverse diameter, which is at a distance of about 2 inches below the nutrient foramen, is 1″·9; whilst the antero-posterior at the same part is 1″·5, and the circumference 5″·5; from which dimensions it may be computed, according to the data given in the Table of comparative measurements, that the total length of the femur was somewhere about 20 inches. The upper extremity, including all trace of an epiphysial suture, has been broken off irregularly about two inches above the nutrient foramen, which is situated on the inner side of the bone, close behind the anterior and internal angle of the shaft. The lower end is also broken off in the same irregular manner, just where the shaft is beginning to expand; and there is consequently no trace of the distal epiphysial surface. The compactness and thickness of the cortical substance, together with the well-marked muscular and vascular impressions, and the general aspect of the bone, all show that it is that of a mature animal, though it is not possible to determine whether the epiphyses were fully united. Its comparative dimensions, actual and computed, in relation to those of the humerus and portion of pelvis &c., already described, leave no doubt that it must have belonged to an animal of the same size as that indicated by those bones.

The data upon which this conclusion is based will be found in the Table of comparative measurements.

The shaft presents all the general characters distinctive of the elephantine femur, but at the same time exhibits, in several respects, differences (besides its size) which distinguish it from that of either the Indian or African species.

In order to render this more evident it will be necessary to say a few words with respect to the distinctive differences of the femur in those species, concerning which but little seems to have been recorded.

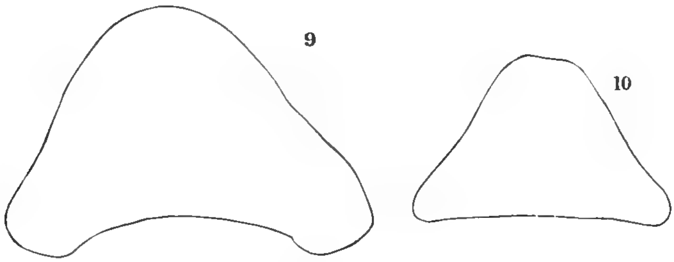
On this point all that Cuvier * remarks is—"that in the African Elephant the bone is slenderer [*plus grêle*] and has a shorter neck, in consequence of which the upper end is not so wide transversely as in the Indian species;" whilst M. de Blainville †, on the other hand, states that the African femur is thicker (*plus gros*), less flattened, and rather more convex in front, with a shorter and more upright neck. He also remarks that it presents the rudiment of a *trochanter minor*, and that the external side is straighter, and the *trochanter major* not so high, and furnished with a less-expanded (*évasée*) fossa behind. He states that, at the lower end, the condyles are more equal, especially in length, closer together, and consequently separated behind by a narrower sinus. Neither of these statements conveys much information; and that of M. de Blainville contains several particulars which are in direct variance with what I have myself been able to observe. In the first place, there is every reason to believe, and it will be seen from the figures in the Table of measurements, that the African femur is, as remarked by Cuvier, rather slenderer in proportion to its length than the Indian, though it does not seem that its transverse diameter across the head and trochanter is at all less. With respect to the rudimentary *trochanter minor*, noticed by Blainville, I believe it will be found usually considerably more developed, or, rather, more prominent, in the Indian than in the African femur, and that the digital fossa behind the trochanter is much deeper (and certainly more prolonged downwards) in the latter; whilst, as regards the condyles, there can be no doubt that they are far more unequal in *length*, if by that expression be meant the antero-posterior diameter, in the African than in the Indian species.

The general form and characters of the femur of Elephants are too well known to require remark; but for convenience of description in what I have to say respecting the comparison of that of *E. melitensis* with those of the existing species, it is as well to observe that, notwithstanding its great compression in the upper part, and comparative rotundity below, the shaft is more or less quadrangular. It consequently presents four surfaces (anterior, posterior, internal, and external), separated by four corresponding angles. Taking these surfaces and angles in the same order, it will be found that in the Indian Elephant the anterior aspect is nearly straight in the vertical direction, whilst in the African it is slightly concave. The principal other difference in this aspect is that,

* *Op. cit.* i. p. 571.

† Ostéographie des Mammifères, iii. p. 42.

in the lower part, the shaft is more rounded or convex, as may be gathered from the circumstance that at the line of the lower epiphysial suture the antero-posterior diameter is to the transverse, in the Indian Elephant, as about 603 to 1000; whilst in the African it is about 661. Besides which the anterior outline of the section at that part is more angular in the Indian femur. The difference in question is roughly shown in the accompanying figures, of which fig. 9 represents the transverse section at the lower epiphysial suture of *E. africanus*, and fig. 10 that of *E. indicus* of about the same age



2. On the posterior aspect the difference is considerably greater. In the African femur the bone throughout is flatter, and it is also much straighter in the vertical direction. In the Indian, commencing at about the termination of the upper third, the surface is much more rounded, and the shaft is convex in the vertical direction. The digital fossa is much deeper and prolonged further downwards in the African.

3. The internal surface or aspect in the Indian Elephant is less rectangular, owing to the comparatively greater rounding off of the anterior and internal angle, and the greater prominence inwards of the posterior and internal, more especially in the situation of the rudimentary *trochanter minor*, or adductor tuberosity, causing a prominence at that part, in the outline of the inner border, which is wanting in the African. The whole of the inner border is more rounded in the Indian, and also, in consequence of the greater projection inwards of the posterior and internal angle beyond the anterior and internal, more oblique in the upper part.

4. The chief difference observable in the outer border of the shaft arises from the circumstance that the anterior and posterior surfaces, in the upper part, are less parallel to each other in the Indian than in the African femur, in consequence of which the outer surface is narrower in the former than in the latter, in which, owing to the parallelism of those two surfaces of the bone, both borders are of about the same width.

5. Of the four angles, the anterior and internal is much more rounded off in the Indian than in the African, in which species, moreover, it is marked with a far deeper vascular groove. The anterior and outer angle also, in the upper part of the bone, is more pronounced in the African. The greater prominence of the posterior and internal angle in the Indian femur has already been noticed, to which may be added

that the inner condyloid ridge, which is a continuation of the angle in question, is more acute in that species. The posterior and external angle in the Indian Elephant runs in a nearly straight direction from the *trochanter major* to the outer condyle, and rises a little below the middle of the shaft into a considerable prominence or rudimentary third trochanter, below which it is continued into an acute external condyloid ridge. In the African, on the other hand, this angle forms a considerable curve inwards in the upper part of the bone, and presents scarcely any projection in the site of the third trochanter, presenting instead a rather broad rough surface, which is moreover placed lower down on the shaft; and below this the bone is rounded and with scarcely any distinct condyloid ridge.

It may also be remarked that in the Indian femur the surface is hollowed behind the third trochanteric tuberosity, whilst in the African it is not at all so.

6. With respect to the condyles, as has already been said, they are more unequal in length in the African than in the Indian species, as will be seen from the measurements given in the Table.

7. Another distinction which will probably be found constant, arises from the situation of the nutrient foramen, which in the Indian Elephant is placed on the inner surface, sometimes near the anterior, and sometimes near the posterior angle, but always high up on the shaft or in the upper third; whilst in the African it would seem to be situated below the middle, though on the same aspect.

8. The patellar sulcus is wider in the African.

With these observations we may proceed to consider the distinctive characteristics of the femur of *E. melitensis.*

1. It differs from the African, and agrees with the Indian, in the convexity in the vertical direction of the posterior surface, which is greater than it is even in the latter species.

2. It resembles the Indian, and differs from the African, in the slight degree of hollowness behind the rudimentary third trochanter.

3. It agrees with the Indian, and differs from the African, in the prominence of the rudimentary third trochanter, and the development of the external condyloid ridge. But it differs from the Indian, and agrees with the African, in the curvature of the upper part of the posterior and external angle.

4. It resembles the African in the depth of the vascular groove on the anterior and internal angle, and in the rotundity of the anterior surface of the shaft at the lower part.

5. It resembles the Indian in the high position of the nutrient foramen.

6. It differs very considerably from both, but more especially from the African, in the want of parallelism between the anterior and posterior surfaces in the upper or compressed part of the shaft, and the consequent great disparity in width of the internal and external surfaces. Other minute differences are perceptible when the different bones are placed side by side; but the above will suffice, perhaps, to show that the

femur of *E. melitensis* presents certain distinctive specific characters in some respects intermediate between those of the two existing species. With regard to the points of difference between it and that of *E. falconeri*, I will reserve what I have to say until I come to that bone.

§ IV. Elephas falconeri.

Of the remains referred to this second diminutive species, the following have been selected for the purpose of conveying some notion of the characteristics of the mature animal.

1. Portions of an atlas.
2. Portions of several vertebræ.
3. A portion of the second rib.
4. A portion of the scapula.
5. The greater part of the right humerus.
6. The lower extremity of the left humerus.
7, 8. The upper part of the right and left ulna.
9. The entire proximal phalanx of the 3rd manual digit.
10. A portion of the pelvis, including the entire acetabulum.
11. A small portion of the upper part of the shaft of the left femur.
12. The entire shaft, without the epiphyses, of the left femur of a younger animal.
13. Astragalus.
14. The 4th left metatarsal bone.

Besides these, the collection contains numerous fragments of bone clearly referrible to an animal of the same size; but those above enumerated are sufficient for the present purpose.

1. *Atlas.*

Of this important bone, figures of two fragments are given in Pl. LI. (figs. 32 & 33), which at first sight appear to belong to animals of the same size; and until I came to examine them very closely, I thought that they both belonged to *E. falconeri*. But upon due examination it will be found that one only, represented in fig. 32, really appertains to that species, and that the other is a portion of a very young atlas, belonging, as I believe, to *E. melitensis*.

The fragment shown in fig. 32 is the greater part of the left half of the atlas of apparently a perfectly mature animal, as shown by the strongly developed muscular and other impressions, the general density and aspect of the bone, and the complete ossification of the terminal epiphyses of the transverse processes. From its various dimensions the height of the animal to which it belonged, supposing its proportions to be like those of Cuvier's *E. indicus*, may be computed at about 41″, or, if we take the presumed height of the African Elephant in the British Museum as the standard, at about 40 inches. This would be a height rather greater than that which I have assigned to *E. falconeri*, computed from the dimensions of the femur and humerus; but as in the latter, at any rate, the upper epiphysis was not united, the height deduced from those bones whose growth was not completed may be regarded as somewhat below the mature stature. And it will afterwards be seen, when I come to speak of the pelvis of *E. falconeri*, or what I deem to be such, that that bone also indicates larger proportions than those which may be deduced from the humerus and femur, and agreeing very closely with those derived from the atlas. I consider therefore that the discrepancy, which after all is by no means more than might be looked for in any species of Elephant, may be explained upon the supposition that the Zebbug collection contains remains of a fully mature *E. falconeri*, and of one of younger age and somewhat lower stature, or, it may be, of individuals of different sexes,—a supposition for which some support may be found in the circumstance that we have in the collection a tusk which from its size may be deemed that of a male, whilst at the same time it contains numerous bones of extremely young or, perhaps, in some cases, of fetal animals, which must have been in immediate dependence upon the mother.

The present fragment, as I have said, is remarkably perfect, and from it all the information that can be wished for with respect to the atlas is readily obtainable. And it is a fortunate circumstance that we are also in possession of a considerable portion of the opposite half of the atlas of the larger form, to which I have restricted the name of *E. melitensis*, and which has been already described, although the contrast between the two has been reserved to the present place.

The fragment, from the middle of the inferior tubercle of the ring (which fortunately exists) to the point of the transverse process, measures about 2″·5, so that the entire breadth of the vertebra was 5″·0. The distance between the outer margins of the two anterior articular facets, or what may be termed the transverse diameter of the condyloid cup, may be estimated at about 3″·3, which of course will be about the transverse width at the base of the occipital condyles of *E. falconeri*, should they ever be met with.

The anterior articular facet presents a very shallow and very small sinus on its inner border, whilst the outer margin is quite entire and with very little sinuosity. The radius of its longest curve is 0″·85, and that of the surface for articulation with the odontoid process 0″·6, whence it may be concluded that that process was rather more than an inch in width at the base. It may be observed that the relative proportions of the long and short diameters of the anterior facet are exactly the same as in a young Indian atlas (No. 2678, R. C. S.), the latter being to the former as 75 to 100; whilst in the atlas of *E. melitensis* the proportion is as 67 to 100, which, curiously enough, is precisely the proportion the facet presents in the African Elephant in the British Museum,—and that a similar difference in the same direction, though apparently to a considerably greater amount, is seen in the measurements taken from M. de Blainville's figure of the same species. And this is a coincidence of perhaps some moment when it is regarded in relation with the difference already pointed out between the ischial border of the obturator foramen in the two small Maltese Elephants—a difference which also indicates an approach toward the African type in *E. melitensis*, and a corresponding resemblance to the Indian in *E. falconeri*.

2. *Other Vertebræ.*

Several fragments of the spines of dorsal vertebræ are contained in the collection, of which two are represented in Pl. LI. figs. 34 and 36 (the largest and most instructive of which is shown in fig. 34). It consists of the base of the neural spine, and a small portion of the arch. On the under surface the two posterior articular facets are left quite entire, and on the dorsal aspect a great part of the left anterior articular facet also remains. The perfect facet measures about $0''{\cdot}6 \times 0''{\cdot}4$. As well as can be judged from such an imperfect fragment, the vertebra to which it belonged was probably the 8th or 9th, or 10th; and the specimen consequently admits of easy comparison with the 7th or 8th dorsal vertebra of *E. melitensis* before described, and which is figured in Pl. XLVI. The corresponding facets in that vertebra measure $0''{\cdot}7 \times 0''{\cdot}5$; whilst the transverse width across from the outer edges of the facets, at the widest part, is, in the one case, $1''{\cdot}1$, and in the other $1''{\cdot}55$, proportions corresponding with those of the other bones. The other fragments agree in all respects so closely with the one described that there can be little doubt of their belonging in all probability to the same individual.

3. *Ribs.*

The only portion of the ribs distinctly recognizable from its dimensions is a fragment (nearly three inches in length) of the second right rib (fig. 37). The fragment is a good deal worn, and the surface is much eroded, as if by weathering. It is consequently not in nearly so advantageous a condition for comparison as the corresponding portion of the second left rib of *E. melitensis*, described in page 241, and figured in Pl. XLV. fig. 8. It nevertheless affords several distinctive characters beyond its mere size, which is at once obvious.

1. In the rib of *E. melitensis* the upperside of the neck is excavated into a large and deep fossa; whilst in that of *E. falconeri* it is rounded and without any excavation whatever. 2. In *E. melitensis* the anterior surface of the bone in the expanded portion is very concave, and in *E. falconeri* nearly level *. 3. In *E. melitensis* a very acute and prominent ridge or angle descends for a considerable distance from the anterior part of

* In the Indian Elephant, both in the very young animal and in one nearly full-grown (Chuny), the anterior surface of the rib at the part indicated is, if any thing, rather convex, and quite unlike the condition presented in *E. melitensis*. As in that species, however, the anterior and inner border of the bone in the upper or curved part is acutely angular, whilst on the other hand the neck is compressed and evenly rounded on the upper aspect, and not thick and hollowed as it is in *E. melitensis*.

the head, which renders the inner or concave border of the rib, for the distance of about 3 inches below the head, acutely angular; whilst in *E. falconeri* this part is rounded. On the posterior aspect there is no marked difference, nor is there any on the outer or dorsal aspect.

4. *Scapula.*

The only representative of this bone, apparently belonging to the smaller of the two dwarf Elephants, is a small portion of the right (Pl. XLVII. figs. 14^a, 14^b). It presents the entire glenoid cavity, with the neck, together with the commencement and about two inches behind it of the spine; the remaining portions of the supra- and infraspinous fossæ are very small. The glenoid fossa is narrow, elongated, and pyriform in shape. It measures about $1''\cdot7 \times 1''$, and the border slightly overhangs at the upper end. The radius of the longitudinal curve is $1''\cdot1$, and of the transverse $1''$,—curves that would seem to correspond pretty closely with the computed size of the head of the humerus of *E. falconeri*. The remaining portion of the spine (which shows no sign of an epiphysial surface on its edge) rises to a height of about $1''\cdot25$; and it commences about $1''\cdot5$ behind the margin of the glenoid fossa, at first gradually and then abruptly, the anterior edge being smooth and sharp. The dorsal edge is much expanded; and at the end of the fragment, or at a distance of fully $3''\cdot5$ behind the edge of the glenoid fossa, there is no indication whatever of a descending apophysis, which would therefore seem to have been situated further back than it is even in the Indian Elephant, in which it springs at a distance of not more than about twice the length of the glenoid fossa behind its posterior border, whilst in *E. africanus* it is placed not more than one length behind the glenoid fossa. In this respect therefore *E. falconeri* would seem to approach the Asiatic rather than the African type, if indeed it may not have differed from both in the entire absence of the descending apophysis. The subscapular surface is smooth and evenly convex, in a line parallel with, but rather below, the level of the spine. The glenoid fossa is narrower below than above; and the bone at that part is narrow and wholly without any of the coracoid protuberance on the dorsal aspect, which is so strongly developed in the scapula of *E. melitensis* and all other known species. The bone is obviously that of a young animal, as shown by the pitted surface of the articular fossa; and to this circumstance the narrowness of the glenoid fossa below, and the slenderness of the neck at the lower border may perhaps be in part assigned *.

* The fragment of scapula above described was regarded by Dr. Falconer as belonging to the dwarf Elephant, and it would be very difficult to assign it to any other known animal. But repeated consideration of it since the above was written makes me more and more uncertain on the matter. The differences between it and the scapula of any known species of Elephant are so considerable as to be in appearance almost insurmountable. Amongst the most marked of these are:—1, the absence of any descending apophysis within the usual distance from the glenoid fossa, as above noticed; 2, the form of the glenoid fossa itself, though this varies perhaps a good deal in the Elephant; 3, the entire absence of the least trace of a coracoid tube-

5, 6. *Humerus.*

Of this bone the collection affords several well-marked specimens, two of which are represented in Pl. XLIX. One of these (fig. 26) is amongst the most perfect and instructive of all the bones collected in the Zebbug Cavern. It is a nearly complete left humerus, wanting only the proximal epiphysis and great part of the internal condyle with the corresponding part of the shaft above it. The upper epiphysial surface, however, remains perfect and wholly uninjured; so that we may conclude that the capitular epiphysis was naturally detached. The fractured surface at the inner condyle appears to be recent; and the bone has been broken obliquely across the shaft, and through the condyloid extremity probably at the same time; but the fragments having been carefully united, the integrity of the bone is very satisfactorily restored, with the exceptions above indicated.

Although the upper epiphysis was not united, there is no trace whatever remaining of the line of junction of the lower epiphysis, not even on the exposed fractured surface. Nor is there a trace left of the non-ossification of the epiphysial cartilage on the supinator ridge, which is late in becoming completed in the Elephant; we may conclude, consequently, that the animal to which the bone belonged had nearly, if not quite, reached its full maturity and stature. And the maturity of its age, at any rate, may also be inferred from the deep and strong muscular impressions, and from the density and weight &c. of the bone generally. The specimen, as it is, measures 9 inches in length—that is to say, from the highest point of the upper epiphysial surface to the lowest point on the condyloid extremity. But from its various dimensions, which will be found in the Table, its length when entire may be estimated at about 12 inches, which would give a height of about 3 feet to the Elephant to which it belonged. According to the same data I estimate the antero-posterior diameter of the head at 2″·2, which is exactly proportionate also to the length of the head in *E. melitensis*, when that dimension is measured in relation to the antero-posterior diameter of the upper epiphysial surface. As the part which is wanting in the present specimen is precisely that of which we have so excellent an example in the upper extremity of the humerus of *E. melitensis* (fig. 22),

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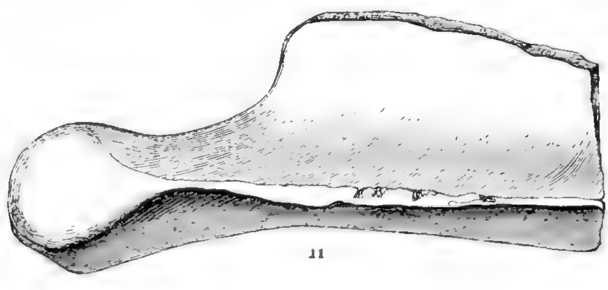
rosity; and, 4th, the form of the acromial end of the spine, which, so far as I know, is always hooked over, as it were. This peculiarity in the Maltese scapula is shown in the subjoined figure, in which the spine is represented in a vertical position.



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and we possess no other well-marked or recognizable portions of the humerus of that species, no means exist of instituting a direct comparison between the humerus of the two forms; but the present affords very abundant means of comparison with those of other species.

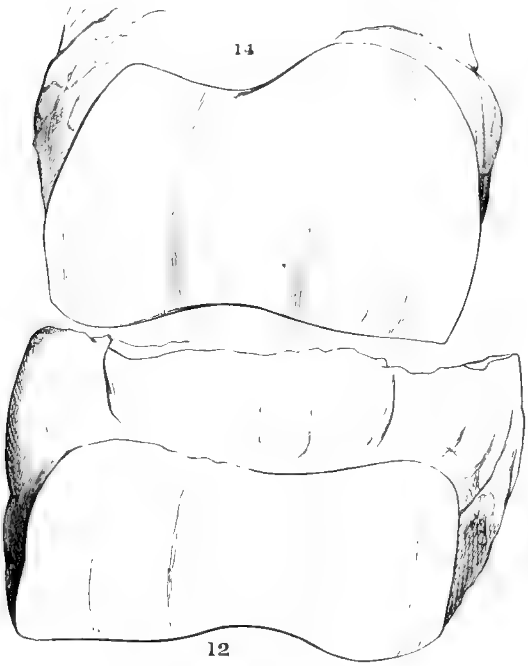
With regard to the differences between the humerus of the Indian and African Elephant but little information is to be found in osteological works. All that Cuvier remarks on the subject is, that in the African Elephant the bone is of slenderer proportions, that the deltoid crest descends lower, that the supinator or external condyloid ridge is *less* salient, and that the bicipital groove is wider.

M. de Blainville, on the other hand, as in the case of the femur, states that the African humerus is stouter and shorter, and the condyloid ridge *more* salient. These two writers concur, however, in describing the deltoid crest as descending lower, and the bicipital groove as being wider.

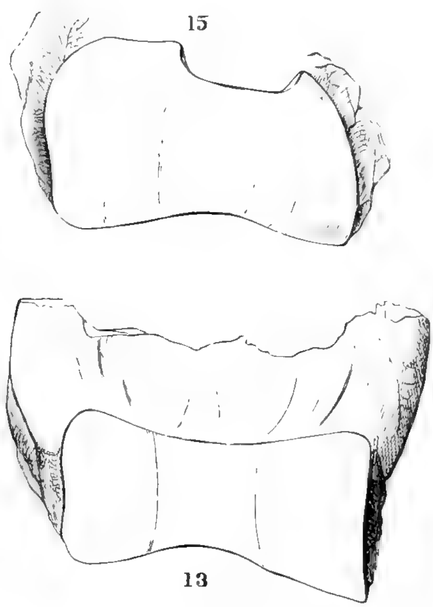
For the purpose of comparison of the fossil bones, I have contrasted the humerus of the African Elephant in the British Museum with those of the same length belonging to the Indian species to which I have had access—with the following results:—

As regards differences in the proportions, expressed numerically, it would seem (*a*) that the antero-posterior diameter of the head is about the same, (*b*) that the transverse diameter of the head in the Indian is as about 102 to 92 in the African, (*c*) that the antero-posterior diameter of the tuberosity, as well as that of the head and tuberosity together, are also nearly equal, (*d*) that the least transverse diameter of the shaft is about the same, but (*e*) that in the African the antero-posterior diameter at the same part is considerably less, or as 60 to 49, whilst (*f*) the circumference at the same part of the shaft is in the Indian as 16 to 13 in the African, (*g*) that the transverse width of the condyles, being 84 in the Indian, is 78 in the African, and (*h*) that the antero-posterior diameter of the inner condyle is 63 in the Indian against 56 in the African, and of the outer as 56 to 48, and (*i*) that the proportionate antero-posterior diameter of the inner to the outer condyle is, in the Indian as 100 to 88, and in the African as 100 to 85, whilst (*j*) the antero-posterior diameter of the middle of the trochlea between the condyles is the same in both. In either species the length of the supinator ridge is the same, and equal to about one-third of the entire length of the bone. It may be said therefore that the head and tuberosity together are rather more compressed in the African, and that the shaft is, as stated by Cuvier, more slender in proportion to its length, and that there is, as in the African femur, a greater difference in size or antero-posterior diameter in the condyles in the African than in the Indian species.

With respect to the extent to which the deltoid crest descends, I cannot perceive any material difference; nor do I find that there is any marked difference one way or another in the salience of the condyloid ridge. Other differences remain to be pointed out; amongst these is the much lower position of the nutrient foramen, which (as has been said before with regard to the femur) is placed much lower in the African than in the Indian, being usually considerably above the middle in the latter, and as low as the commencement of the lower third in the former. But, besides the difference in the proportionate size of the condyles to each other, they differ not inconsiderably in form in the two species. The contour of the outer condyle in the African humerus is more globose or rounded towards the outside; and, owing to this and to the circumstance that, whilst the middle part of the trochlea is of about the same diameter as in the Indian, and the condyles themselves are rather smaller, the transverse contour-line of the articular surface at the lowest part is widely different in the two cases, as may be seen in the subjoined reduced outlines.



12 & 14.—*Elephas africanus.*



13 & 15.—*Elephas indicus.*

And it is also to be remarked that another important difference exists in the transverse contour-line of the condyles, behind or across what may be called the intercondyloid sulcus, which line in the African humerus forms an easy sigmoid curve, whilst in the Indian the intercondyloid depression is bounded on either side by an abrupt border, as may be better seen in the accompanying figures.

In the African humerus the surface of the shaft above the olecranon-fossa is more concave than it is in the Indian, and the internal condyloid ridge more acute. And in the Indian humerus there is a considerable depression about the middle of the supinator ridge behind, which does not exist in the African specimen examined. A further important distinction also is seen on the posterior aspect of the bone in its upper half. In the Indian Elephant, of whatever age, an angular ridge is continued more or less distinctly from the supinator or external condyloid ridge to the middle of the back of the head (or, more properly speaking, of the shaft), up to the line of the epiphysial junction. In consequence of this the upper part of the shaft in the Indian humerus appears angular behind, or in some cases almost carinate, whilst at the same part the African humerus is rounded and even, the angle continued from the condyloid ridge usually not reaching beyond the middle of the shaft.

Now, with respect to the humerus of *E. falconeri*, as we have no means of actually measuring the head, we are unable to compare its proportions with those of the existing species. And as the upper epiphysis is wanting, we have no direct means of measuring the proportionate diameters of the head and tuberosity; but, to judge from the form of the epiphysial surface, it may be considered probable that the transverse diameter (in proportion to the antero-posterior) was less than in the Indian, or even African, and very much less than in *E. primigenius*. The subjoined figure gives the outline of this surface in *E. falconeri*, of the natural size.

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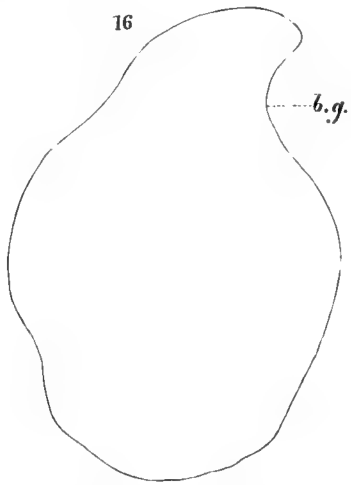

In the shaft the chief peculiarities consist:—(1) in the presence of a very deep elongated fossa on the outer aspect, immediately behind, and overlapped, as it were, by the upper part of the deltoid crest; (2) in the comparative shortness of the supinator ridge, which equals little more than one quarter of the entire length of the bone, instead of one-third, as it does in the Indian and African Elephants; in this respect the bone shows a resemblance to the humerus of *E. primigenius*; (3) in the great relative disparity in the size of the articular condyles, which is greater even than in the African humerus, as the antero-posterior diameter of the inner condyle stands to that of the outer in the ratio of 100 to 77. This of course gives the contour of the articular trochlea from below a distinctive character, as may be seen in the reduced figures adjoined, of which 17 represents the inferior contour of the trochlea as viewed in front, and 18 as seen from below, so as to exhibit the posterior intercondyloid fossa. As in the

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great disparity of the condyles, so also in the concavity of the surface above the olecranon-fossa and, apparently, in the accompanying elevation of the internal condyloid ridge, does the humerus of *E. falconeri* resemble that of *E. africanus*; but in it the concavity in question is even still greater. On the other hand, again, in the strongly marked angularity of the upper half of the shaft behind, the bone exactly resembles that of *E. indicus*. Scarcely enough of the bicipital groove remains to enable us to determine whether it was wide and shallow as in the African, or deep and narrow as in the Indian; but, so far as can be judged from the way in which the outer border of the groove arches over it, it may be concluded, perhaps, that in that respect it resembled the Indian humerus rather than the African, in which neither border ever arches over the groove. And in the same particular does the bicipital groove in *E. falconeri* differ from that in *E. melitensis*, in which, as before said, the groove in its shallowness and width fully equals, if it does not exceed, that of the African humerus. In other respects also, so far as can be judged from the small portion we possess of the humerus of *E. melitensis*, it appears to present several other important points of difference:—The lateral compression of the upper epiphysial surface is much more marked in *E. melitensis*, the extreme tr. d. of the surface in the specimen standing in the ratio of not more than 63 to 100, whilst in *E. falconeri* it is 76 to 100; whence we may conclude that the upper epiphysis, including the head and tuberosity, was proportionally broader in the latter. It is to be observed, also, that the small remaining portion of the outer surface of the shaft below the epiphysial junction in *E. melitensis* shows no indication of the existence on that side of the shaft of the very peculiar deep and elongated fossa which is so striking a feature in the humerus of *E. falconeri*.

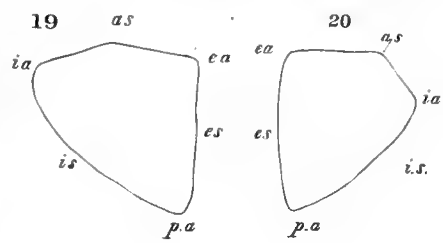
From all that has been stated, it appears to me that, besides its diminutive size, the remarkable humerus assigned to *E. falconeri* exhibits abundant evidence of specific distinction from either of the living species of Elephant, as well as from *E. melitensis* and *E. primigenius*.

The second portion of the humerus (represented in fig. 27, Pl. XLIX.) fortunately replaces what was wanting of the lower extremity of the specimen just described. It presents the entire condyloid articulation; and it is from it that the measurements and figures just cited, relating to this part, have been taken. It is of slightly larger proportions than the shaft; and it appears to have belonged to an older, or at any rate to a more robust animal than that whose humerus has been above described.

7, 8. *Ulna.*

Two well-marked portions of the ulna of *E. falconeri* are contained in the collection, one belonging apparently to a younger animal than the other, which from its colour and general aspect would appear to appertain to the same individual as the condyloid articular extremity represented in fig. 27; whilst the former specimen, fig. 28, in like manner agrees in colour and appearance, and probably also in age, with the shaft of the humerus represented in fig. 26. But, except in their colour and apparent disparity in age, the two specimens exactly resemble each other; and it is very satisfactory to find that the peculiar characters shown in them are not limited to a single individual, and consequently that those characters cannot be regarded as accidental. The specimens are portions of the upper end of the right and of the left ulna. The longer and more perfect fragment is that shown in figs. 28 and 28[a]. It is about 3″·7 long, from the summit of the olecranon, on which is observable a considerable part of the epiphysial surface. The shaft is broken irregularly across about 2″·8 below the level of the articular surface, above which the olecranon rises about 1″·2. The olecranon is about 1″·1 in transverse diameter at the base, and its greatest antero-posterior diameter is nearly the same. The transverse diameter of the head on the level of the articular surface is about 1″·2 or 1″·3, and the ap. d. at the same level 2″·2. The internal articular facet is 0″·95 in its widest transverse diameter, and the same in the antero-posterior, measured from the anterior border to a line drawn across it at right angles from the bottom of the radial sulcus. The radius of the curve of the articular facet in the antero-posterior direction is 0″·9, and that of the prominent part of the articular surface on the olecranon 0″·625.

The anterior surface of the bone is hollowed, as usual, immediately below the notch for the attachment of the head of the radius; but this hollow is very circumscribed, and immediately below it the surface is flat from side to side, and a little lower down convex. The outer surface is concave and quite smooth; the internal, except between the articular head and the olecranon, flat, or slightly convex. The internal angle is rounded and smooth, and without any fossa; the external very acute, but it does not project at all in front. The adjoining figures represent the outlines of a transverse section of the shaft, in fig. 19 at about 2″·1, and in fig. 20 at about 2″·7 below the level of the articular surface at the bottom of the radial notch; and the comparison of these with the outline of a transverse section of the shaft of *E. melitensis* at a rather lower point (p. 246) will serve to show how closely in form they all resemble each other. In other respects also the ulna of *E. falconeri*, save in size, appears to agree



very closely with that of *E. melitensis*, except in one very important particular, which alone, as it seems to me, would be amply sufficient to indicate a specific distinction between the two forms, even had we no other bones for comparison. Had we been in possession of only a single specimen of the ulna of *E. falconeri*, its remarkable character in the respect alluded to might well have been deemed perhaps an accidental or individual deviation; but when we are furnished with two well-marked instances in bones belonging to animals of different ages, and also find that the deviation from the ordinary elephantine type is connected with a special characteristic of the humerus referred to the same species, it is impossible not to regard the character in question as normal, and therefore distinctive.

One of the great peculiarities amongst the many others of the elephantine ulna, as is well-known, is the mode in which its articulation with the radius, more especially at the upper end, is effected, the comparatively diminutive head of that bone being, as it were, embraced between two arms or lobes of the head of the ulna, whose articular surface, as remarked by Blainville, thence acquires a trefoil form, the two lateral folioles or facets corresponding with the respective condyles of the humerus; whilst the central one ascends on the front of the olecranon and fits on the middle part of the humeral trochlea. The two lateral facets will therefore naturally differ somewhat in their relative dimensions, according to the size of the corresponding condyle. We consequently find that in the African ulna the outer facet is, as compared with the inner, of somewhat smaller size than in the Indian; and it has already been pointed out that in the ulna of *E. melitensis* the disparity is still greater in the same direction. In *E. falconeri* it is carried to the extreme, and it may almost be said that the outer foliole of the trefoil is wholly aborted, as may be seen in the figure (fig. 28 *a*). It is true that a small splinter has been broken off the external angle in front, just below the articulation, and also that the extreme anterior angle of the facet itself is abraded; but it does not appear that either the fracture or abrasion encroaches much, if at all, upon the actual articular surface itself. At any rate in *E. falconeri* the outer facet is reduced to a minimum; and it is interesting to observe with relation to this diminution that the outer humeral condyle, also, as compared with the inner, is smaller in that species than in any other with which it was compared. This abortion of the outer facet, and the attenuation of the corresponding part of the bone upon which it would be supported, give the ulna of *E. falconeri* so peculiar a character as, even when compared with that of *E. melitensis*, at once to strike the attention and to distinguish it from the corresponding bone in any other known species or form of Elephant, either recent or fossil *. But it is nevertheless interesting to institute some comparison between it and that of the Indian and African species in other particulars. Unfortunately, owing to the want of any other part of the bone except the upper extremity, and especially to the absence of the lower articular surface, which seems to afford excellent

* The subjoined figures will convey an idea of the difference in form of the upper articular surface in

distinctive characters, little can be said on this subject. It may be pointed out, however, that the bone, on the anterior aspect, differs very widely from the African in the com-

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E. africanus, *E. indicus*, *E. melitensis*, and *E. falconeri*. The two latter are of the natural size, and the others enlarged to the same width from the figures in the 'Ossemens Fossiles.'

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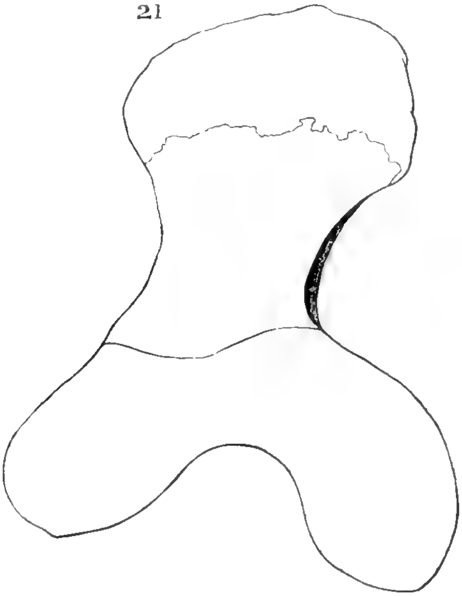
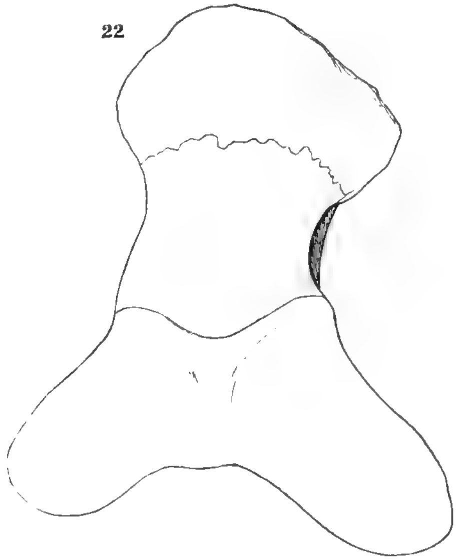


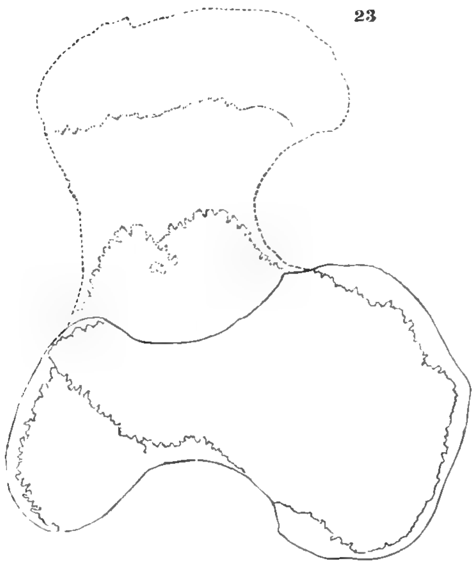
E. indicus.

22



E. africanus.

23



E. melitensis.

24

E. falconeri.

parative flatness or rather convexity of the surface below the radial fossa, and in the consequent want of elevation of the outer and inner angles which constitute the borders of a deep concavity in *E. africanus*. From the same species it also differs in the rotundity of the inner angle, in which it in the same degree resembles the Indian. It also differs from the African in the absence of any flattening on the inner face of the inner head, and from both the Indian and the African in the want of any pit or depression in front of the inner head (for the insertion, as I suppose, of the *brachialis anticus*). But in the apparent arching inwards of the olecranon it presents a decidedly African character.

As regards the dimensions of the bone when entire, if we take the comparative length of the humerus and ulna in the Indian Elephant, as exemplified in the skeleton of Chuny in the Royal College of Surgeons, the length of the ulna in *E. falconeri* would be about 10″·3; according to the skeleton of the Ceylon Elephant in the British Museum, 9″·9; according to Cuvier's measurements of the Indian Elephant, 9″·8; and according to the African Elephant in the British Museum, 9″·2. We may conclude therefore that the probable length was about 10 inches. Assuming this as the length, it would seem that the transverse width of the upper articular head, allowing the utmost for loss by abrasion &c. is at least 0″·5 less than it ought to be, had it stood in anything like the same proportion to the length of the bone that that dimension does in the four instances cited, in which the diameter in question would seem to equal about one quarter of the entire length of the bone.

9. *Bones of the Fore Foot.*

The only other bone belonging to the anterior extremity that admits of satisfactory identification is the proximal phalanx of the third digit of the left side (Pl. LI. fig. 41). The bone, which appears to be that of a mature animal, as the epiphysis is perfectly united, without any trace of the junction, is quite entire, and presents no trace of weathering or wear. It is exactly 1″ long, and the same in tr. d. at the upper end, which is 0″·9 in ap. d., whilst the lower end has a tr. d. of 0″·9, and an ap. d. of 0″·55. In form and proportions it differs in no respect from the corresponding bone in *E. indicus* (Chuny), which has a length of 3″·0. Assuming the proportionate lengths of the bones to be similar to those in *E. indicus*, as shown in the specimen above named, this proximal phalanx would give for the humerus of *E. falconeri* a length of between 11″ and 12″, or about the same as that which I have deduced from the other data which have been already discussed.

10. *Pelvis.*

The pelvis of *E. falconeri* is represented by a considerable portion of the left *os innominatum*, which is shown in Pl. L. fig. 31. The fragment includes the entire acetabulum, with a small portion of the body of the ischium, and a still smaller portion of the body of the pubis,—very important parts of the bone, inasmuch as they form the boundaries of the upper or anterior part of the *foramen ovale*, the value of which as affording a distinctive character between the pelvis of the Indian and African Elephants has been already fully referred to (p. 242). Above the acetabulum is a large portion of the ilium with its anterior curved margin, extending to a height of more than three inches above the upper border of the acetabulum. The general character of the bone is that of a fully mature animal; and, from its brown colour, condition, and comparatively large size, it corresponds very exactly with the larger and older portions of the humerus and ulna already described and referred to an individual of larger size and more mature age than that to which the shaft of the humerus and the more perfect portion of the ulna probably belonged.

The dimensions of the bone, so far as they are afforded in the specimen, are as under :—Width of acetabulum (inside) 2″·1, length 2″·3; radius of concavity about 1″·1. The cotyloid notch is about 0″·5 in width; and the channel continued from it on the anterior surface of the body of the ischium ceases immediately beyond the cotyloid border. The width of the contracted part of the ilium, above the acetabulum is 1″·8. The body of the ischium is unfortunately broken off obliquely on the outer side; but about 1″·25 of the obturator border remains. This border is acute, and presents about 0″·5 below the summit of the obturator foramen a slight elevation representing what I have termed in a previous part of this paper the ischial obturator spine, which is so strongly developed usually in the Indian Elephant, as well as in the Mammoth. The length remaining of the pubic border of the foramen is too short to exhibit any trace of the corresponding pubic obturator projection; but sufficient is left of the ischial border to show the important difference in form between that part and the corresponding part in *E. melitensis*, which in that respect, as before pointed out, more resembles the African than the Indian species. Another particular in which the present specimen approaches the Indian and differs from the African type is in the comparatively great width of the cotyloid notch, which, as is well known, is much narrower in the African acetabulum. The internal or pelvic surface of the ilium is smooth and equably concave, and the outer is also smooth and evenly convex. Posteriorly the triangular surface of bone forming the back of the acetabulum is much less concave from side to side than in either the Indian or African species; and the two borders consequently are indistinct and rounded. And, corresponding with this general flatness of the surface in this part, the excavation continued upwards from the obturator foramen is extremely shallow.

11, 12. *Femur*.

The collection contains at least three well-recognizable portions of the femur of *E. falconeri*, belonging to individuals of widely differing ages. Two of these specimens are shown in Pl. L. figs. 29, 29 *a*, & 30. The latter of these is the upper portion of the shaft of a left femur, to all appearance of at least tolerably mature age; and it corresponds in all respects as regards colour and condition with the shaft of the humerus (fig. 26). The fragment measures 3″·4 in length; and it is broken irregularly across at the upper end, just above the inferior termination of the posttrochanteric fossa. At the lower end it has been sawn across, I believe by Dr. Falconer; and this part is probably, to judge from analogy, not very far above the point of least circumference of the shaft. No indication of the nutrient foramen is to be perceived in the fragment; and its situation, therefore, was in all probability lower down the shaft than is usually the case in the Indian femur. The various dimensions afforded by the specimen are:—tr. d. at upper end 2″·4., ap. d. about 0″·95; tr. d. at lower end 1″·25, ap. d. 0″·85; circumference 3″·4; whilst the outline of the transverse section at that point, which, as before said, cannot be very much, if at all, above the point of least circumference of the shaft, is shown in the accompanying figures, contrasted with that of the femur of *E. melitensis*, taken, as nearly as can be judged, at the same part of the shaft. The anterior surface of the

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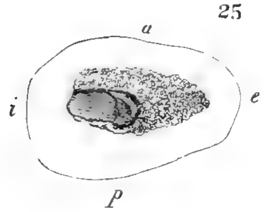
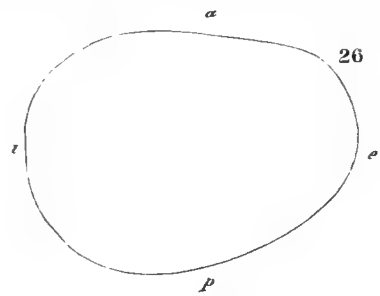


E. falconeri.

26



E. melitensis.

bone presents a slight elevation in the middle, with a very shallow depression internally, and a much deeper and larger one (a pretrochanteric fossa, as it may be termed) externally, the outer boundary of which is formed by a well-pronounced, rough, elongated tuberosity. On the posterior aspect, at the upper end and outer angle, is seen the strongly projecting base of the *trochanter major*, within which is the lower part of a deep digital or posttrochanteric fossa. The inner and outer surfaces are of very nearly the same width from before backwards; and they both have the rectangular form, peculiar more especially to the African femur.

This fragment, compared with the corresponding part of the femur of *E. melitensis*, exhibits such marked differences, in almost all respects, as to afford, perhaps as strongly as any other of the remains, as striking a proof as can be desired of the, at any rate, specific difference between the two dwarf Elephants. In the first place the transverse section of the shaft, shown in the two figures given above, is widely different at corresponding points. On the anterior aspect the surface is totally different in the two cases. In *E. melitensis* it slopes obliquely backwards and outwards, from the anterior and internal angle, with an even, slightly convex curve; whilst in *E. falconeri* (owing to the anterior and posterior surfaces in the upper part, and till very near the lower end of the fragment, being parallel to each other, and the outer and inner faces consequently of equal width) the anterior surface is not oblique. But a still greater peculiarity in this respect, consists in the presence of the remarkable pre- or, more properly, infratrochanteric fossa, the existence of which, so far as I am aware, is peculiar to *E. falconeri*. On the posterior aspect the base of the *trochanter major*, or rather the posterior and external angle of the shaft going to it, is very much more elevated, as is also the surface of the bone on the inner side of this face. The central part, consequently, just below the level of the lowest point of the digital fossa, is much more concave in *E. falconeri*. In fact, the most cursory inspection of these two portions of the femur is sufficient to demonstrate the extreme difference between them. It will have been observed that in some particulars the femur of *E. falconeri* exhibits African tendencies, which is a curious circumstance when we remember the numerous instances, in other parts of the skeleton, in which the contrary tendency would seem to be manifested.

With respect to the dimensions of the entire femur, as deduced from those of the fragment, and from the length of what I regard as the corresponding humerus, its length may probably be taken at about 13″ or 14″, and the diameter of the head in the fully mature animal at about 1″·8, or 2″. The latter dimension is less than would accord with the size of the acetabulum in the portion of pelvis here referred to the same species, which demands a head of about 2″ in diameter at least; and I am able to explain the apparent discrepancy only on the ground, either that the proportion of the size of the head to that of the shaft was rather greater than usual in *E. falconeri*, or, as is perhaps more probable, that the pelvis in question belonged to an older and larger individual of the same species. But the fact that the comparative size of the head in proportion to the length of the shaft varies very greatly, not altogether in accordance with age, is apparent in the circumstance that, if we deduce the size of the head in *E. falconeri* from the proportions exhibited in the femur of Chuny, it would be about 1″·9; whilst if we take the proportions in a somewhat younger, but very much smaller, Sumatran Elephant in the British Museum, it would be only 1″·5, and, from those of a Ceylon Elephant also in the British Museum, 1″·7, and, from those of the African, 1″·6. And these examples have been selected as being, I believe, those of animals as nearly as possible (except the Sumatran) of the same age, or with the dentition in nearly the same stage—that is to say, with the three molars in wear. In all of them the femoral and many of the other epiphyses are still not united. Upon full consideration, therefore, I think it not unsafe to conclude that the apparent discrepancy between the size of the acetabulum and the computed size of the head of the femur represented in fig. 30 is not greater than may be looked for within the limits of one and the same species.

A second instance of the femur of *E. falconeri* is that represented in figs. 29 & 29 *a*. It consists of the entire shaft of the left femur with both epiphyses detached; and it is also, from its taper form and all its other characters, manifestly that of a very young animal. On the anterior aspect the great concavity on the outer side, immediately below the base of the trochanter, at once marks the peculiarity of the bone and its resemblance to the older femur last described. On the same aspect is seen the nutrient foramen in an unusual situation for an Elephant—that is to say, in the middle of the anterior surface, about 3″·5 below the summit of the shaft. Since in the former instance there is no trace of this foramen in the more usual situation, which is on the inner aspect and (as in the case of the Indian Elephant) at, or but little below, the upper third of the entire length of the bone, it is interesting to find its situation indicated in the present specimen; and this situation, if it be not a mere individual variation, will further indicate an important distinctive character in the femur of *E. falconeri* *. At the lower end the form of the anterior surface is subtriangular, and in that respect more like the corresponding surface in the young Indian than in the African femur, in which, as before remarked, the anterior aspect of the bone is more rounded. On the posterior aspect the chief peculiarity consists in the great projection backwards of the postero-external angle above, by which the surface is rendered concave. At the lower end may be noticed a rather deep groove on the internal condyloid ridge.

In order to give as complete an idea as I can of the distinctive peculiarities of the femur of *E. falconeri*, and of the manifest relation the present specimen bears to that last described, I have added the subjoined outlines of the transverse section in a line immediately below the base of the *trochanter major*, and as nearly as possible at the corresponding level in all three instances. From the more imperfect condition, however,

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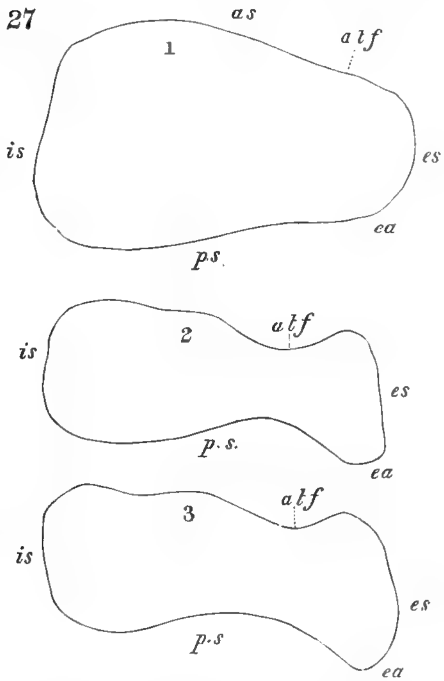


1. Transverse section of femur of *E. melitensis* (Pl. XLV. fig. 6).
2. Transverse section of femur of *E. falconeri* (Pl. L. fig. 29).
3. Transverse section of femur of *E. falconeri* (Pl. L. fig. 30).

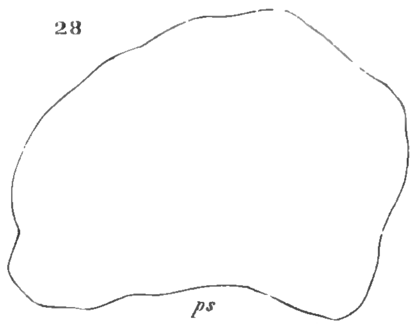
a s. Anterior surface.
p s. Posterior surface.
i s. Internal surface.
e s. External surface.
e a. External angle.
a t f. Pretrochanteric fossa.

* It may be remarked that, in this instance, the nutrient foramen occupies the same situation that it does in the greater number of Ruminants.

of the femur of *E. melitensis*, the section in that case is taken at a rather lower level, for which some allowance must be made.

In these figures will again be seen the very different form of the femur in the two dwarf Elephants, and at the same time the great peculiarity of the anterior surface in *E. falconeri*, especially in the presence of the pretrochanteric fossa (indicated by the letters *a t f*), and of the posterior, in the great elevation of the postero-external angle *e a*.

The accompanying cut represents the outline of the lower epiphysial surface.



The various dimensions of the bone are given in Table V.; and, taking these data in comparison with the corresponding measurements of the femur of a young Indian Elephant of probably about the same age, in the British Museum, it would seem that the proportions are pretty nearly the same in both cases. The actual length of the shaft, without the epiphysis, in the specimen is 9″·5; and by computation from the dimensions of the shaft of the femur of the young Elephant above referred to, which measures 21″ in length, it would be 9″·6, the utmost deviation in any direction not being more than 0″·4. This coincidence perhaps affords some ground for believing that the general proportions of the length of the limbs of *E. falconeri* to its height, at any rate when young, were not widely different from those of the Indian Elephant.

13, 14. *Bones of the Hind Foot.*

(1) *Astragalus.*

The only specimen of the Astragalus, contained in the Zebbug collection, is that whose upper surface is shown in Pl. XLVII. fig. 14.

The bone is that of an immature animal; and a portion is broken off on the outer side, so that the greater part of the peroneal facet is removed. The true characters, therefore, of the mature bone are not fully displayed in the specimen.

The immature condition of the astragalus is shown by its generally light and porous condition, the thinness of the cortical layer, and by the remains of an epiphysial surface, marking the site of the unossified internal tuberosity, which, in the Elephant's astragalus, it would seem, is developed from a distinct point of ossification, or remains much longer in the condition of cartilage than in most other animals. It is also further evidenced in the condition of the internal calcaneal facet, which is not yet formed into a single articular surface, but consists of two small ones, separated by a shallow depression—exhibiting in fact exactly the same condition as that shown in M. de Blainville's figure of the under surface of the astragalus of *E. africanus*, and regarded, apparently, by that author as a distinctive character between the Indian and African astragalus. In truth, however, it only indicates an immature condition, since in the mature African astragalus no trace of such a division of the facets exists, any more than it does, I believe, in any other species. It is not improbable, nevertheless, that the completion of this articular surface may be effected later in the African than in the Indian Elephant; for in a very young astragalus of the latter the surface in question is quite entire. And as this, from other circumstances, seems to be an astragalus of about the same age as the Maltese specimen, it may be supposed that the latter may have resembled the African in the comparatively late completion of the internal calcaneal facet.

In its general form the astragalus strongly resembles that of a young Indian Elephant in which the internal tuberosity is still unossified. The chief peculiarity observable in it, irrespective of the proportionate dimensions of the different parts, is in the existence of a large and deep pit towards the anterior part of the sulcus for the interosseous or calcaneo-astragaloid ligament: no such pit exists in any other astragalus that has come under my notice. But it may, of course, be merely an individual peculiarity. In the comparative length of the neck the bone resembles the Indian rather than the African astragalus, the upper edge of the scaphoid facet projecting in front of the middle of the anterior border of the tibial facet exactly one-half of the median antero-posterior diameter of that facet.

With regard to the proportionate dimensions of the bone in its various diameters, and of the different facets as compared with the same measurements in the existing species, in most particulars no marked difference is observable, as will be seen from the measurements in Table IV., from which it will also be perceived that with respect to its somewhat greater proportionate breadth, again, the astragalus of *E. falconeri* shows a resemblance to the Indian rather than the African type. But in the proportionate dimensions of the various facets rather more important differences are observable. For instance, whilst in the Indian astragali, measured by me, the mean vertical diameter or height of the scaphoid facet, as compared with its length across, was about as 626, and in *E. africanus* as 602 to 1000, in *E. falconeri* this dimension is not more than 500. And, again, whilst in the Indian Elephant the antero-posterior diameter of the tibial facet stands in relation to its transverse diameter as about 758 to 1000, and in *E. africanus* as 900, in the mature *E. falconeri* it is 941, showing a rather remarkable difference, more especially from the Indian species. But of all these differences the most striking appears to be in the transverse or longest diameter of the scaphoid facet, which, in the Indian and

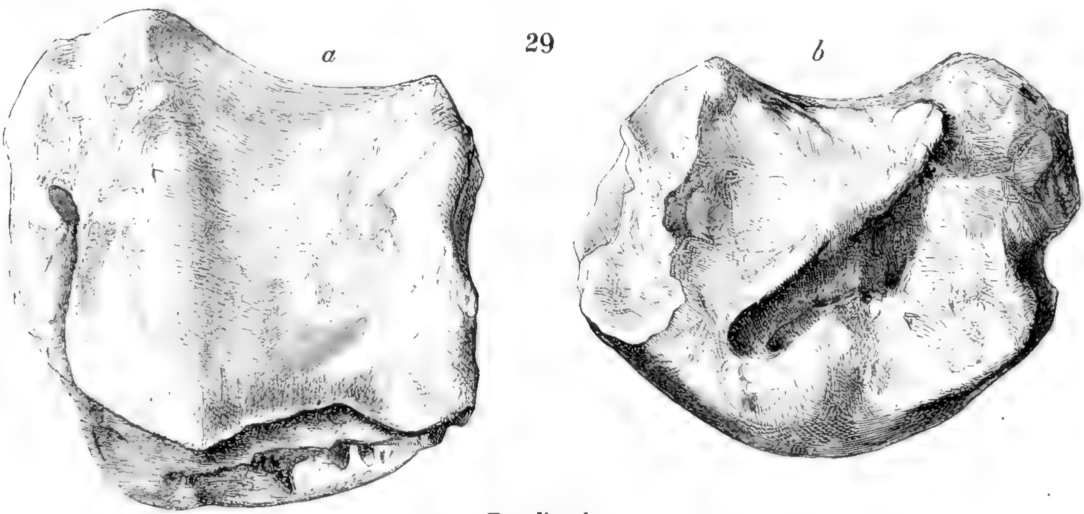
African Elephants, as compared with the total width of the astragalus, stands in the ratio of about 758 to 1000; whilst in *E. falconeri* it is about 900 *.

If we proceed to compare the size of the astragalus with the computed and actual dimensions of the humerus and femur referred to *E. falconeri*, the result would, at first sight, seem to indicate an animal of rather greater stature than was assigned to that species from other considerations. For instance, in the Sumatran Elephant in the British Museum, which may be taken to represent the type of a somewhat diminutive variety of *E. indicus*, the width of the astragalus is about 4″, and the length of the humerus 28″, and of the femur 33″·5, in accordance with which the humerus of *E. falconeri* should be about 14″, and the femur between 16″ and 17″. Again, in *E.*

* The subjoined figures, taken from specimens in Dr. Leith Adams's collection, which has come into my hands since this paper was read and the above account of the astragalus drawn up, represent what I regard as the astragali of *E. melitensis* and *E. falconeri*. They have belonged to fully mature animals, and are drawn of the natural size:—

29

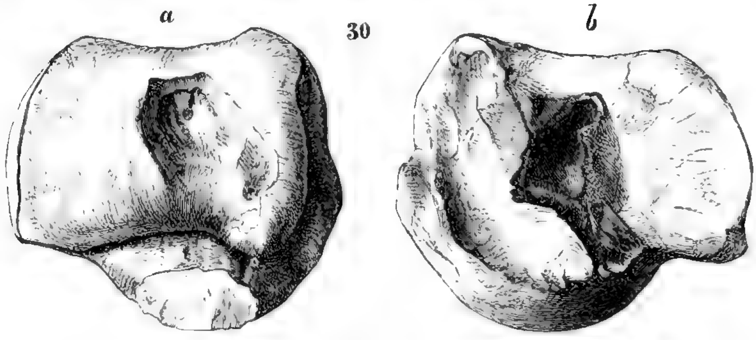
a *b*



E. melitensis.

30

a *b*



E. falconeri.

africanus the breadth of the astragalus is 5″·2, and the length of the humerus and femur respectively 36″ and 42″, according to which, in *E. falconeri* these bones should measure 14″·5 and 16″·9, or nearly the same as above. But if we take the proportions presented in the skeleton of Chuny, the result is different. In that instance the astragalus measures about 6″ across, the humerus has a length of 35″, and the femur one of 42″, proportions which would make the lengths of those bones in *E. falconeri* respectively 12″·2, and 14″·7; and these dimensions do not differ very widely from those already derived from other data. And even this difference, such as it is, may perhaps be in some measure explained, as regards the Sumatran Elephant, and still more as regards the African, by the circumstance that the Maltese astragalus is comparatively wider in proportion to its size than it is in either of those forms, and very nearly corresponds with that of Chuny.

(2) *Fourth Metatarsal.*

A second bone which I refer to the hind foot of *E. falconeri* is the fourth left metatarsal (Pl. LI. figs. 40, 40 *a*, 40 *b*). The bone is quite entire, and only slightly chipped on some of the prominent edges. It is of a dark-brown colour and obviously that of a fully mature and, as I should judge from its proportionate size as compared, for instance, with the proximal phalanx (fig. 41) which has been already described (page 263), rather large animal. As it entirely corresponds in its somewhat peculiar colour, comparative size, and other characters of age &c. with the condyloid end of the humerus represented in fig. 27 (which, as has been already stated, is of robuster proportions than most of the other bones referred to *E. falconeri*), and also with the portion of the pelvis, fig. 31 (likewise distinguished by its comparatively large dimensions), we might perhaps venture to surmise that the metatarsal may have belonged either to the same individual or to one of similar size. The corresponding metatarsal in *E. indicus* (Chuny) is 4″·8 long, corresponding with a length of 42″ for the femur, and of 35″ for the humerus. From these numbers we obtain, for the humerus of *E. falconeri* to which the metatarsal belonged, a length of about 13″, and for the femur one of 15″·7—figures probably not far from representing the extreme size of those bones in that species. But any computation of the lengths of the long bones from those of the metatarsals may be regarded as liable to error, when we consider the remarkable difference in the proportionate size of the scaphoid facet of the astragalus in *E. falconeri* and *E. indicus*, which can hardly be unaccompanied by corresponding differences in the other bones of the tarsus and metatarsus. It is possible therefore that the metatarsal bones in *E. falconeri* may have been proportionally longer than in *E. indicus*, and consequently from their sizes those of the humerus and femur computed somewhat above the reality.

§ V. Very young or Immature Bones.

Having adduced the evidence afforded by the mature or nearly mature bones in

Capt. Spratt's collection, as to the presence in it of the remains of three distinct species of Elephant, I will proceed to inquire what confirmation of the plurality of species is added from the study of the remains of the very young (or, perhaps, in some cases, of absolutely fœtal) animals.

The number of these immature bones is very remarkable; and many (although necessarily of very fragile texture) are in excellent preservation, though the majority are more or less worn or otherwise injured.

In noticing the largest species of the Maltese Elephants, I have already described a very young exoccipital bone (figs. 3 & 4), and a portion of the shaft of a femur, obviously that of a very young animal, and which may have belonged to the same individual. Besides these juvenile remains of the large Elephant, there are several other fragments apparently referrible to the same species, though of much younger age. As the mere size of these specimens is sufficient to distinguish them from the remains of either of the dwarf species, it will be unnecessary perhaps to enter into further particulars concerning them, beyond what have already been given.

With respect to the immature bones of the two smaller Elephants, however, it will be requisite to go into some detail, in order to point out what I conceive to be distinctive specific characters in them, although I do not pretend at present to be able to assign the different forms to the respective species with any approach to certainty.

1. *Bones of the Cranium and Face.*

Of the cranial bones the only ones sufficiently perfect to be of much use in the inquiry are three or four exoccipitals, two of which are represented in Pl. LII. figs. 42′, 42′ *a*, and 44, 44 *a*. These two bones are of the same size, and, to all appearance, of exactly the same age. Each is also broken precisely to the same extent, having lost the posterior angle, including the whole of the thickened border which joins the supra-occipital *. In all other respects the bones are entire and but very little worn, especially that shown in fig. 42′. One belongs to the right, and the other to the left side; but they are obviously not a pair; and it is curious that the collection also affords a third exoccipital belonging to the left side, not so perfect as either of those which have been figured, but sufficiently so to prove that it has exactly the same characters as fig. 42′. We have thus, from these bones alone, evidence of the presence in the ossiferous cave of Zebbug of three very young Pigmy Elephants. In general dimensions, as has been said, the two exoccipitals very closely agree, the principal difference remarkable between them being that fig. 42′ † is rather higher, as it may be termed, in proportion to its antero-posterior diameter than fig. 44. The exact antero-posterior width cannot be positively given, owing to the imperfect condition of the bones; but as the posterior part of each

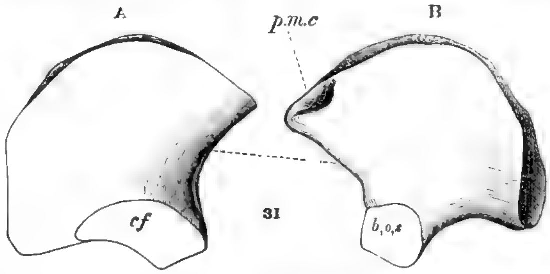
* The fact is, that both are broken across the weakest part of the bone.

† To save words, as I am unwilling to employ a specific name, I use the Nos. of the figures to designate the two bones.

is broken off immediately behind the condyle, their respective breadths across the constricted part admit of fair comparison. Compared in this way, fig. 42′ measures in extreme height 1″·95, and at the constricted part above the condyle 0″·9; whilst fig. 44 in the corresponding directions measures 1″·85, and 1″·1. It is true that the latter is a little more worn on the upper edge; but, making every allowance for this, it is undoubtedly the wider of the two in the antero-posterior direction. Again, in fig. 42′ the condyloid articular facet measures 1″ × 0″·5, and in No. 44 1″·1 × 0″·5. And in No. 42′ the surface of the exo-basioccipital synchondrosis is 0″·6 × 0″·3, and in No. 44 0″·6 × 0″·4. But, besides these differences in measurements, which in such small dimensions are not so inconsiderable as they may seem, the two bones present others, as it appears to me, of even greater importance. In the first place, on the inner aspect of No. 42′ (42′ *a*) the cerebellar fossa is much more concave, and the sulcus for the lateral sinus much more pronounced; whilst in 44 *a* the cerebellar fossa is but slightly concave, and no discernible trace of the lateral sulcus can be perceived. In consequence of this difference in the internal aspect, the opening of the paramastoid cells (*p c*), in fig. 42′ *a*, is separated, as it were, from the cerebellar fossa, or rather from the lateral sulcus, by a steep or abrupt wall, which is wholly wanting in 44 *a*. On the outer aspect the chief thing remarkable is the greater flatness of the surface. The anterior margin immediately above the exo-basioccipital synchondrosis, or at the part where it forms the posterior boundary of the jugular foramen (*j f*) (the jugular sulcus, as it is termed in human anatomy), is very acute in both specimens; but the bone itself, immediately beyond the border, is very much thicker in 44. And this difference is so great upon viewing the bones edgeways, though not readily described in words, as of itself to give a different character to the two bones when viewed in this aspect. I am moreover particularly desirous of directing attention to this part of the bone, inasmuch as it is here that a very important difference exists between the exoccipital of the Indian and that of the African Elephant at the same age as the Maltese specimens. And it fortunately happens that we have the materials for comparison in the British Museum and Royal College of Surgeons, the former affording the cranial bones of an African, and the latter that of an Indian Elephant, of apparently the same age as the Maltese bones we are discussing. Comparison of these shows that, whilst at first sight they more closely correspond than might have been anticipated, in many respects they differ to about the same extent as the two Maltese specimens. Amongst these differences the most striking is the form of the anterior border at the jugular sulcus: in the African this border is very thick and rounded, whilst in the Indian it is thin and acute. And, as might be supposed, there is to some extent a corresponding difference in the depth of the lateral sulcus, and the general concavity of the cerebellar fossa, both of which are considerably greater in the Indian than in the African, though perhaps not to the same extent as in the two Maltese exoccipitals. On the same aspect also there may be observed in No. 44 two ridges close behind the edge of the jugular sulcus, where in No. 42′ the surface is perfectly even. In No. 42′ the exo-basioccipital synchondrosis projects more in front than in No. 44, as it does in the African as compared with the Indian.

On the whole it would seem that the distinction between the two dwarf Maltese forms is pretty nearly, though certainly not quite, as well marked as is that between the two existing species, and that in some respects the form represented in fig. 44 exhibits rather a tendency towards the African type.

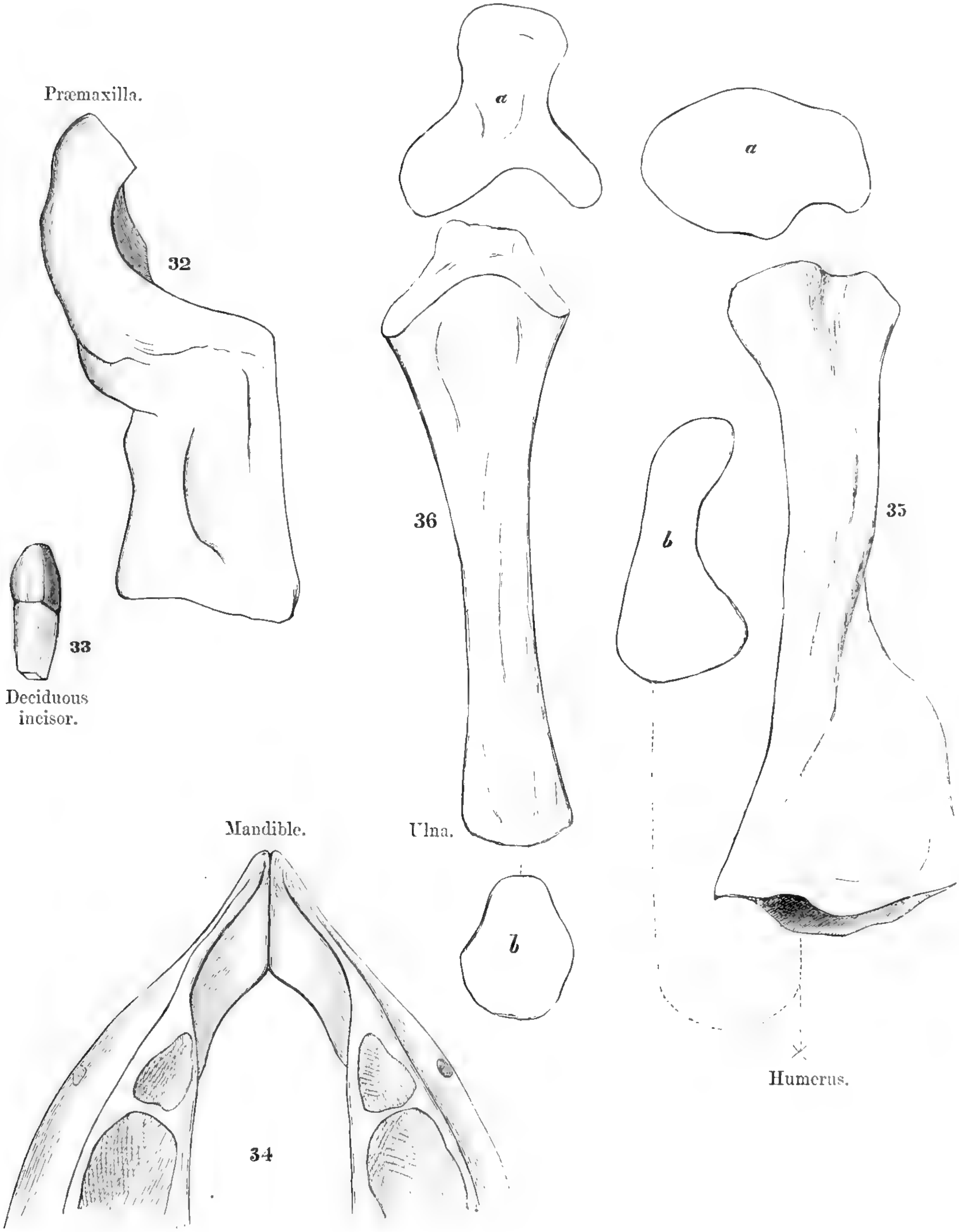
As it may perhaps occur to some that the two small exoccipitals represented in Pl. LII. might possibly have belonged to extremely young fœtuses of a larger Elephant, the characters which go to disprove such a supposition may be briefly pointed out. The subjoined woodcut represents the outlines of the inner and outer aspects of the exocci-



31

pital of a very young uterine fœtus of *E. africanus* in the British Museum. The bone itself, as will be observed, is on the whole of pretty nearly the same dimensions as those of the Maltese pigmy Elephants, whilst the condyloid facet (*c f*) and the exo-basioccipital synchondrosis (*b o s*) are both considerably smaller. It will also be seen that, although the expanded portion of the bone is at least as wide as in the Pigmy exoccipitals, it exhibits scarcely a trace, or merely a rudimentary commencement, of the paramastoid cells (*p m c*) which are so largely developed in the others. The outlines also of the symphysis and adjoining part of the mandible belonging to the same fœtus will suffice to show that, even at a very much earlier stage of development, those bones are very much larger than the corresponding part in either of the pigmy Elephants, in which there is reason to believe the second milk-molar had been well used. Besides this difference in the degree of development of the peripheral part of the African fœtal exoccipital, the condition of the bone itself is very different. When received at the Museum the bones were preserved in spirit; and when in the moist state they were quite soft and almost cartilaginous, and now when dry are exceedingly light and fragile; whilst in the Maltese specimen the bone is firm and solid, and evidently much further advanced in ossification.

For the purpose of comparison, as to size, with other bones of the pigmy Elephants, I have thought it might also be useful to give the subjoined outlines of various other bones of the same African uterine fœtus.



Various bones of uterine fœtus of *E. africanus.*

2. *Upper Jaw.*

The collection affords two fragments of the premaxillary bone, and none apparently of any other part of the upper jaw.

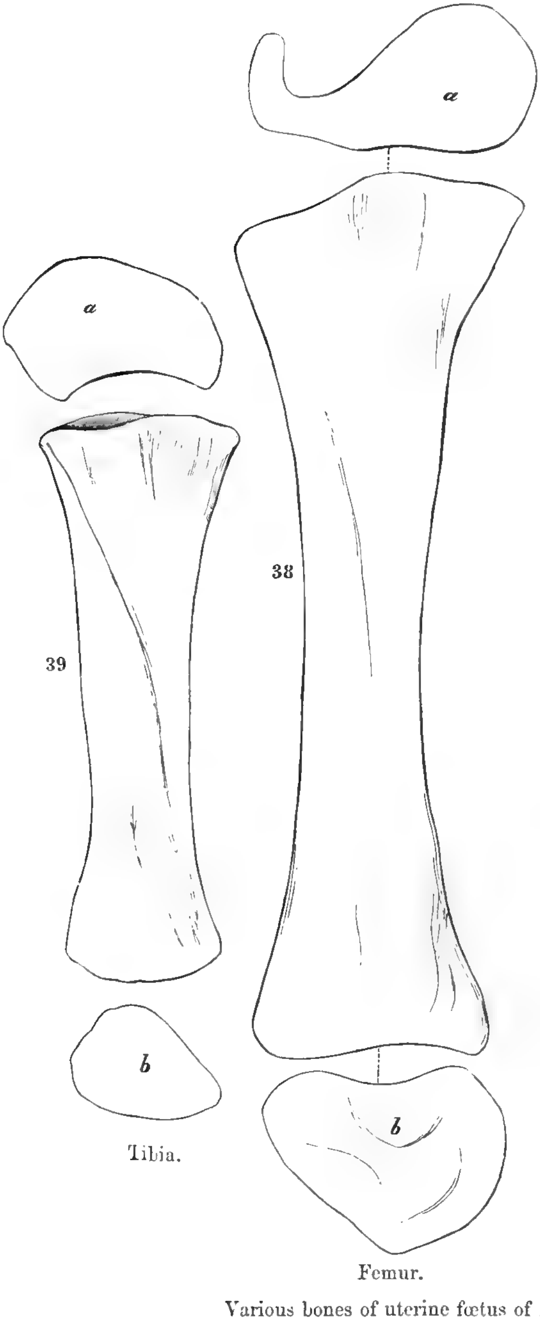
1. One of these is a fragment rather more than 3 inches long, and about $1\frac{1}{4}$ wide at the lower end, evidently (from the texture of the bone) of a young animal, and from its dimensions not improbably belonging to the same individual, or to one of the same age and size, as that whose exoccipital is represented in Pl. XLIV. fig. 4. It is a portion of the right premaxillary; and on the inner side the socket of the permanent tusk is exposed, in the form of a sulcus about 2 inches long, and about $0''{\cdot}5$ in diameter.

2. The second specimen of the same bone is represented in Pl. LII. fig. 46, with what appears to be the point of a very young permanent tusk *in situ*. It should be observed, however, that there is no reason, so far as I know, to believe that the tooth and bone were actually found in conjunction. The former seems to have been fitted and cemented into its place by Dr. Falconer; it is therefore impossible to say whether it really belonged to the bone or not. The fragment which belongs to the left side is of dense and close texture; and the bone, to all appearance, is not that of a young animal, although undoubtedly one of very small size. I should be inclined to refer it to *E. falconeri*; and in colour and condition it exactly accords with some of the other bones already referred to that species.

The portion of the tusk attached to it is nearly 2 inches long, and about $0''{\cdot}4$ in diameter. Its surface is marked by well-pronounced parallel ridges; and the exposed part is partially coated with a thin layer of very hard semitransparent substance of ferruginous colour, and apparently of the nature of enamel. At one part of the circumference this enamel crust, if such it be, terminates naturally in a very thin edge. The greater part has been scaled off, and at the apex it, as well as the ivory below it, has been worn away by attrition; but whether during life or not is uncertain, though, from the obliquity and smoothness of the worn apex, the former is by far the more probable. I am not aware that the existence of enamel on the permanent incisor of the Elephant has ever before been noticed, although, as is well known, the deciduous tusk always has a tolerably thick cap of that substance; so that its occurrence upon what is undoubtedly the permanent incisor, in the present case, is worthy of note.

3. *Lower Jaw.*

1. The collection contains seven or eight fragments of the lower jaw. One of these, consisting of the entire symphysis, has been already described as belonging to a mature animal of considerable size. A second fragment, apparently belonging to the same species, though of younger age, is a portion (about 5 inches long) of the anterior part of the right ramus. The whole of the outer table is broken away, and the exposed surface is somewhat worn; but on it may be perceived the very shallow remains of the alveolus of the 2nd milk-molar, and further back a smooth depression, probably an indication of



Various bones of uterine fœtus of *E. africanus*.

the socket of the 3rd milk-molar. From the size of the bone, it undoubtedly belongs to the largest of the Maltese Elephants.

2. A second fragment of the mandible is represented in Pl. LII. fig. 43. It is also a portion of the anterior part of the right ramus, which is broken across very obliquely from before backwards and downwards, in such a way that the two fractured surfaces are parallel with each other, and portions of the upper and of the lower border of the ramus are left of about the same length. The upper or, rather, anterior border is very acute, and represents a portion of the diasteme immediately anterior to the alveolus of the 2nd milk-molar. Close to the edge, on the external aspect, are three openings, of which the anterior and largest is the mental foramen, and the others also vascular or nervous channels leading into the dental canal, the open orifice of which is seen at the hinder end of the fragment, and is about 0″·25 in diameter.

The alveolus of the 2nd milk-molar is widely exposed by the fracture, and, as usual, consists of sockets for two fangs. The anterior fang must have been about 0″·6 in diameter at the base, and larger than the posterior. Both sockets curve backwards; but the hinder is much more oblique in its direction than the anterior. In size and form the alveolus would seem to correspond very exactly with such a tooth as is represented in fig. 4, Plate LIII., the penultimate milk-molar, as I should presume it to be, of *E. melitensis*; but I am by no means certain of this. The thickness of the ramus, opposite to the point of the posterior fang of the penultimate milk-molar cannot be very satisfactorily determined, but may be estimated at rather more than 1″, whilst its height at about the same part was probably 2″·5 to 2″·75.

3. The three remaining portions of the mandible are of much smaller size, and all apparently of uniform character. The most perfect of these is shown in fig. 45, and consists of the entire symphysis with the diasteme; on each side the entire alveolus of the 1st milk-molar remains, and on the right an indication of that of the 2nd milk-molar, sufficient to show that the anterior fang of that tooth must have been of about the same diameter (0″·6) as that in fig. 43; so that there may be reason to presume that the jaw shown in fig. 45 may represent a younger state of the one shown in fig. 43.

The portions of the two rami were not, I believe, found in connexion; but there can be little doubt of their belonging to the same individual; at any rate they correspond very exactly. The distance from the anterior alveolus to the extremity of the beak, or what remains of it, is about 1″·7, and the height of the ramus in a vertical line immediately in front of the socket is 1″·25, and its thickness about 0″·7. The small mental foramen is quite upon the border of the diasteme; and on the right side there is only a single secondary foramen behind it, whilst on the left there are two.

4. The remaining two fragments of the mandible are of particular interest, as showing what appears to me to be a distinction, apparently of specific importance, in that bone, even at a very early period of life, between the two dwarf species. In those specimens referrible to one or other of these smaller forms, which have been already described, I

have been unable to perceive any greater distinction than can be accounted for by difference of age; but in the two specimens I am now about to refer to, and which appear as nearly as possible in the same stage of development, there is a difference in proportionate thickness which cannot be so accounted for. One of the two specimens is figured in Pl. LII. figs. 42 and 42 *a*; the other has not been figured. At first sight these two fragments might be supposed to be the right and left sides of the same symphysis, each being about 2 inches long, and broken off, as would seem to be usual, at the part where the ramus is necessarily weakened by the presence of the alveolus of the 3rd milk-molar. Closer inspection, however, of the fragments shows that they do not correspond as the opposite portions of the same jaw would.

The left fragment is thicker than the right, measuring at the smallest part behind the symphysis 0″·5, and the other 0″·4; and the distance between the mental foramen and the accessory foramen behind it (single in either case) is, in the left, 0″·35, and, in the right, 0″·45, though this is perhaps not a very important particular. The symphysial facet in the left portion is 1″ × 0″·5, and in the left 1″ × 0″·1.

The general antero-posterior curve, including that of the diastemic edge, is more rounded in the left fragment. And in consequence of this difference, and from the greater incurvation also, as it were, of the diastemic border, the left fragment, when viewed from above, appears much more rounded on the outer face.

The differences, in fact, between the two fragments are amply sufficient to show not only that they cannot have belonged to the same individual, but, in my opinion, to indicate an important and, perhaps, a specific distinction, when it is considered that the bones are both in the same stage of development.

4. *Bones of the Extremities.*

I have been unable to detect in the collection any bones belonging to the trunk of very young animals; but numerous specimens of various bones belonging to the fore and hinder extremities occur, amongst some of which, as it seems to me, significant indications of two distinct forms may be perceived.

(1) *Anterior Extremity.*

Of very young humeri we are in possession of three specimens, sufficiently entire to afford some diagnostic characters; two of these are figured in Pl. LII. figs. 49 & 50. The former is the almost entire shaft of the left humerus; it is apparently slightly rolled at each end, and an angular fragment has been recently broken off obliquely at the upper end in front. No part of either epiphysial surface is left; but it is nevertheless clear that the specimen represents very nearly the entire length of the interepiphysial shaft. With due allowance for the great difference in age, the general characters of this specimen correspond so closely with those of the humerus figured in Pl. XLIX. fig. 26, that little doubt can be entertained with respect to their belonging to the same species. One character, the value of which has been already adverted to in speaking of the larger humerus, appears to me of great importance in this comparison, viz. the angularity on the posterior aspect of the upper part of the shaft, and the well-marked depression on the inner side of the posterior angle, both of which are also well marked in the larger humerus, fig. 26. The nutrient foramen, in this little bone, is situated on the inner border, about 0″·75 above the inner condyle. As the corresponding part in the larger humerus is broken away, the site of the foramen cannot be positively determined; but as it does not exist in any other part of the bone, it could not have been placed very far from the same spot as in the fœtal bone. I have little hesitation, therefore, in referring this humerus, fig. 49, to a very young *E. falconeri*. The young humerus shown in fig. 50 is less entire at the upper end; but at the lower a considerable part of the epiphysial surface remains. What is left of the shaft is sufficient to show that in the upper part it is more rounded, as in the African Elephant, and that the supinator, or external condyloid ridge, is not continued upwards, as it were, into a posterior angle as it is usually in the Indian Elephant. So far as can be judged from the imperfect condition of the humerus fig. 49 at that part, the inner condyloid ridge is much thicker in the antero-posterior direction, and the inner border of the bone consequently more rounded, in fig. 50. In front also the anterior surface of the deltoid crest is much more oblique than it is in the humerus fig. 26, in which a well-marked angle, prolonged downwards from the anterior or external border of the bicipital groove, bounds internally a perfectly flat surface in front of the deltoid crest. The same angularity, it should be stated, is visible, though of course less marked, in the young humerus of *E. falconeri* (fig. 49). The nutrient foramen is in the same situation as in the former specimen. The humerus fig. 50 shows slight marks of gnawing, as by a small rodent, on the hinder surface.

Another fragment of a much older but still young animal, is a fragment of the lower end of the right humerus, broken obliquely through the shaft about 4″·5 above the middle of the lower epiphysial surface, a portion of which remains. So far as it admits of comparison, its characters accord with those of the humerus of *E. falconeri*; and it is not unreasonable to suppose that the bone may have formed part of the skeleton of the same animal as the femur fig. 29. In it the want of roundness in the internal condyloid ridge behind is well marked.

The only other young bone belonging to the anterior extremity of which there is any specimen is the *radius*, of which bone there are two examples. They are figured in Pl. XLVII. figs. 18 & 19, both belonging to the same side. One is of larger proportions than the other, and not improbably, though by no means certainly, of rather more advanced age. Both bones are broken across at the corresponding point, which is the slenderest part of the shaft, or about three transverse diameters of the lower epiphysial surface above that end. At this point the contours of the transverse sections differ a good deal, and show that the shaft of the larger radius (fig. 18) is much more compressed than the other, and particularly that the outer or, rather, anterior edge is very much more acute, leading to the supposition that at the upper end the bone might have presented the acute angle which is exhibited in the African and not in the Indian radius. The lower epiphysial surfaces again exhibit different contours, as may be seen in the Plate, where however, unfortunately, one of the bones is represented on the anterior, and the other on the posterior aspect. I have therefore subjoined the outlines of this surface taken in corresponding positions of the bones, so as to show at a glance the not inconsiderable difference they present.

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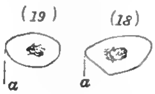

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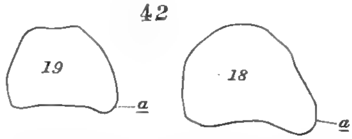

41. Transverse sections of shaft of radius.

42. Outline of distal epiphysial surfaces.

From what has been said, it cannot be denied that the same distinction exists between the very young dwarf radii as I have attempted to point out in the exoccipital bones and humerus. And considering the large size, at what would seem not very different ages, and the African tendency faintly exhibited in the radius fig. 18, I should be inclined to refer that to the young of *E. melitensis.* That neither of the small radii just described is a fœtal bone of a larger form of Elephant, is abundantly shown by their dense texture and aspect of greater age, as compared with the far larger radius of the uterine fœtus of *E. africanus*, of which an outline woodcut (No. 37) is given in p. 277.

(2) *Hinder Extremity.*

A portion of the shaft of a very young femur of the largest Maltese Elephant has been already described and figured; and I have already noticed the almost entire inter-epiphysial shaft of *E. falconeri.* No specimens of that bone of younger age, corresponding with the very young humeri, radii, &c. above noticed, occur in the collection; but of the tibia numerous specimens, of various ages, and some very young, exist. Of these, however, all it will be worth while here to notice more particularly are those represented in Pl. XLVII. figs. 15, 16, 17, 20, and 21. Of these I regard figs. 16 and 17 as belonging to a different type from that represented in figs. 20 and 21.

Figs. 16 and 21, each having both epiphysial surfaces almost entire, are pretty nearly of the same length, and to all appearance, so far as can be judged from the condition of the surface, of about the same age. They admit therefore of tolerably fair comparison. In the first place, as the figures will show, the bones differ a good deal in proportionate thickness; stated in numbers the differences in the various dimensions are as under:—

	Length.	Upper end.	Lower end.	Least circumference.
Fig. 16....	2·5	1·0×·7	·9×·7	1·6
Fig. 21....	2·4	·9×·6	·7×·6	1·4

The anterior angle of the shaft is more acute in fig. 21, and it is continued down towards the inner malleolus in a more pronounced manner. On the posterior aspect fig. 21 is much more concave at the upper part; and the outer posterior angle is continued, tolerably distinctly, quite to the lower end, whilst in fig. 16 it is not continued below the middle of the shaft. The posterior surface of the bone, consequently, in fig. 16 is more evenly rounded on the outer side than it is in the other, as shown in fig. 16 *b*. The difference in the contours of both the upper and lower epiphysial surfaces is shown in the subjoined outlines, and is, as it appears to me, much greater than can be attributed

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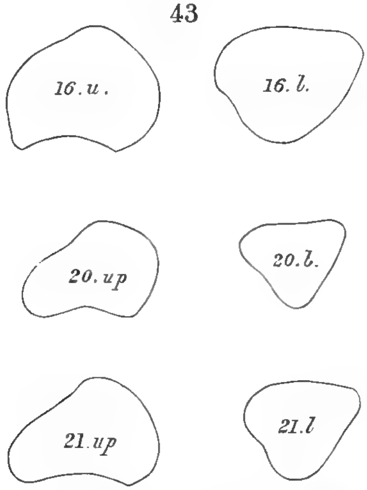


to mere individual variety or to difference of age. It may in addition be remarked that the nutrient foramen is placed much higher up in figs. 20 and 21 than in the other. In all the respects above referred to, except in size, the bone represented in fig. 17 agrees with fig. 16, and fig. 20 in like manner with fig. 21.

If, upon such imperfect data, one might speculate as to the species to which these two forms of tibia should be assigned, it would seem most likely that the type shown in figs. 16 and 17, from its greater robustness, belongs to *E. melitensis*, and the other to *E. falconeri*; but upon this I refrain from expressing any positive opinion. But, besides the five specimens thus disposed of, the collection contains three other equally young, if not younger, tibiæ, of a totally different type.

Two of these tibiæ are shown in Pl. LI. figs. 38, 38 *a*, and 39, 39 *a*; and their peculiar character as distinguished from the others will be at once obvious. The one represented in fig. 39 appears to have had a sort of spongy exostosis springing from the inner side of the head, which gives it a very bizarre appearance in the back view, fig. 39 *a**; the smaller specimen, therefore, shown in fig. 38, affords better materials for

* The artist has inadvertently drawn the inner face of the bone in fig. 39 instead of the proper anterior view.

comparison. Both bones are so much worn at either end, apparently by water-rolling, that no portion of either epiphysial surface remains; but the portions removed at either extremity cannot be very great, so that the length of the epiphysial shaft in fig. 38 may be estimated perhaps at about 3″·2; on comparing which with its other dimensions it will be seen that the bone is proportionally much more robust than that provisionally referred to *E. melitensis*. In other respects also it differs so remarkably, not only from that bone, but from all other *tibiæ* of any age belonging to the Elephant that have come under my notice, that I think it impossible to refer these bones to that genus at all. Had the means existed, which unfortunately they do not in this country, it would have been interesting to compare these immature tibiæ with those of the *Hippopotamus*, to which. at a guess, one might be inclined to assign them*.

§ VI. Dentition. (Plate LIII.)

The only part of the Zebbug Collection respecting which the late Dr. Falconer has left any written observations, beyond a few brief and scattered notes, is that which comprises the teeth.

It is well known that that distinguished palæontologist had devoted very great attention to the odontography of the Proboscidia, and that he assigned paramount importance to the study of the teeth in the discrimination of species. It is with the greatest satisfaction therefore that, with respect to the dentition of the Maltese fossil forms, I find myself in possession of his copious and careful notes, and am thus, on this subject. enabled to rely upon his great and undoubted authority.

Although in some points I have been led to form an opinion apparently differing from his, yet, as I feel that all palæontologists must desire to have the actual opinions and verbal descriptions, as he left them, of my lamented friend, I propose to give all that I can find of what he has written concerning the Zebbug fossil teeth in his own words, and to reserve to the end, or to notes, the few remarks I may have to offer myself. I would also add that the figures in Pl. LIII. have all been lithographed from Mr. Dinkel's drawings, which, as they were made under Dr. Falconer's immediate supervision, may be taken to convey what he deemed the more important characteristics of the various specimens in the Collection.

"Among the most interesting of the Zebbug fossils is a series of molar teeth and fragments of tusks. The molars comprise specimens ranging from the first milk-molar of very young animals up to what appear to be adult teeth; and they are at once characterized, besides other differential marks, by the singularly small size of the species which yielded them. Warned by the great blunders committed by Nesti, Fischer de Waldheim, and other palæontologists, who have been misled by the characters of milk-teeth to identify them as the remains of pigmy species of Elephant, I have been chary in

* With reference to this, it should be remembered that a diminutive species of *Hippopotamus* still exists.

admitting the convictions which the specimens forwarded by Captain Spratt forced upon me when I first examined them.

"1. *Milk-incisors.*—The series fortunately includes a very perfect milk-incisor, which confirms the line of specific affinities indicated by the molars. The specimen is represented of the natural size by figs. 1 & 1 *a*, 1 *b*. It differs from the permanent tusk in having the crown and fang portions distinctly defined. The crown forms an obtuse, flattened, rounded, and irregularly indented body, invested with a thick shell of enamel, supported in a long cylindro-conical fang, part of which is broken off near the end. From the diameter of the broken end and of the central canal, it is manifest that at least a third of the entire length of the fang is wanting. The specimen was compared with the corresponding tooth of a fœtal African Elephant, belonging to a skull transmitted to the British Museum by Dr. Livingstone, in which the milk-molars are quite unworn. The two agree very closely in the dilated blunt form of the crown, investing shell of enamel, and defined fang. The chief difference detected between them was in the form of the latter, which in the young African Elephant forms a rather short and compressed cone, terminating in a sharp and slender point, while in the Zebbug fossil the fang is stouter, more cylindrical, and much more elongated. The dimensions of the specimen are:—

Entire length........................	1″·4
Length of crown	0″·6
Width of crown	0″·4
Thickness of crown	0″·3
Diameter at the collar	0″·3
Diameter at broken end	0″·25

"These minutiæ are given, and in such detail, in order to mark the affinity which the Malta fossil bears throughout in its dentition to the African Elephant. A shell of enamel has not yet, so far as I am aware, been detected on the milk-incisors of any species of the subgenus *Euelephas*. It occurs on those of the African species; and I have detected it forming a sheath upon the young permanent tusks of *E. insignis*, belonging to the group *Stegodon**.

* In the British Museum, besides the fœtal African Elephant referred to by Dr. Falconer, there are numerous bones of another, very much smaller and obviously a very young uterine fœtus: outline figures of some of the bones belonging to this specimen have been given in a preceding part of this paper. Among its remains is the milk-incisor in the germ state; that is to say, the fang is still incomplete, and the enamel cap probably very thin. The milk-incisor of the older fœtus alluded to by Dr. Falconer is completely formed, and presents a different appearance, owing to the increased thickness of the cap, which appears to be formed of two layers, an external (probably of osteine), and an interior (the enamel). The fang comes to a fine point; and when the upper portion of the cap (which is quite loose) is removed, the ivory nucleus of the crown, of nearly the same size and form as the crown of the uterine tooth, is exposed. The entire length of the tooth is 1″·8, and the greatest diameter of the crown about 0″·45, and its length about 0″·6. The tooth, therefore, would seem to correspond

"2. *Permanent Incisors.*—The collection contains numerous fragments of Elephants' tusks, for the most part amorphous pieces or splinters of the outer layers, many of them bearing distinct marks of having been gnawed, but indicating tusks of very considerable diameter and out of all proportion to the small Zebbug molars. These fragments, which appear to indicate another and larger species of fossil Elephant, will be noticed in the sequel.

"There is only one determinable specimen which will admit of being referred to the smaller form, and that only conjecturally. It consists of a portion of the distal end of a slightly curved tusk, about 5 inches in length. The greater part of the outer layer, which is weathered of a greyish tint, has disappeared by dislamination. The but-end yields a round section slightly compressed at the sides. The outer layer is smooth, and throughout a line of thickness shows no appearance of engine-turning. Beneath it the ivory surface is very distinctly channelled longitudinally and regularly; and thus the section inwards to the cone exhibits very distinct engine-turning, more pronounced even than is commonly seen in proboscidian tusks, the inequalities being nearly as marked as in a tailor's thimble. The specimen tapers to a conical point. The dimensions are:—

Length	$5''{\cdot}0$
But-end	$1''{\cdot}15 \times 1''{\cdot}1$

This tusk would correspond in size with the true molars of the Malta form*.

very closely, both in size and proportion, with the Maltese fossil. This circumstance may perhaps render it doubtful whether the latter really belongs to either of the dwarf Elephants, and may not rather belong to the largest extinct form.

* It is a rather curious circumstance that the specimen above described by Dr. Falconer, and which, from some words which I have omitted, he seems either to have had or to have intended to have figured, was not to be found in Captain Spratt's collection when it came into my hands; nor is there any figure of it to be found. But, strangely enough, another permanent tusk of precisely corresponding dimensions, and with a ticket upon it in Dr. Falconer's handwriting, "*Elephas melitensis*, tusk, Zebbug Cave," is in the collection; it is the one figured in Pl. LII. fig. 48. The specimen, as will be seen, is far more perfect than that described by Dr. Falconer; but in dimensions and all other characters (excepting colour, which is mottled with brown and black instead of being "grey") the two so fully accord that we might almost suppose that the missing specimen and the one extant in the collection may have belonged to the same individual. It is true that the specimen figured in Pl. LII. has been broken across; but the fracture, instead of five, is more than seven inches from the truncated extremity, and probably fully eight inches from the entire conical point, which is stated to have existed in the missing specimen. And it should be noted that the fractured surface at the apex is not a recent one; so that the specimen cannot be the one described by Dr. Falconer with the point subsequently broken off. In the presence, therefore, of this more complete specimen of an obviously similar tusk, the loss of the one described by Dr. Falconer will be the less felt. In the existing specimen the outer layers, as will be seen in the figure, are detached towards the point, exposing a subjacent surface very strongly sulcate; and at the fractured end the coarse engine-turning described by Dr. Falconer is plainly visible. The diameters of the tusk, at the distance of 5 inches from the estimated real point, are $1''{\cdot}1 \times 1''$, or very nearly the same as those given by Dr. Falconer, whilst an inch or so lower down they exactly correspond, viz. $1''{\cdot}15 \times 1''{\cdot}1$; and this is the greatest diameter down to the alveolar end, the maximum circumference being $3''{\cdot}5$. The extreme length of the specimen measured along the outside curve is about $10''{\cdot}5$, to which may be added, to complete the point in its natural state, about another

"3. *Lower Milk-molars.*—Fig. 2 and fig. 2 *a*, represent, of the natural size, the antepenultimate milk-molar (m.-m. 2) of a very young animal, and, I believe, the smallest Elephantine molar, fossil or recent, that has hitherto been met with, figured, or described. The outline of the crown is broad oval, being narrow in front and wide behind. It is composed of three collines, with a posterior talon. It is clear that the tooth did not belong to a fœtal individual, as the crown exhibits the most distinct proof of having been in use, and worn against an opposed tooth. Further, the posterior talon bears a well-marked disk of pressure, from the contact of an advancing tooth behind it. The disks of wear of the crown surface are broad, but not much advanced in wear. One large elongated and conical fang only remains, connected with the anterior and middle portions; but the base of the tooth shows a doubtful appearance of there having been a small fang below the posterior talon. The dimensions are:—

	in.
Extreme length	0·40
Width of crown in front	0·23
Greatest width	0·32
Greatest height of crown	0·40 *.

inch, making the entire length of the tusk between 10″·5 and 12″, whilst the depth of the pulp-cavity is not more than 2″·7 in the present state of the specimen; and as this is remarkably perfect even at the thin alveolar edge, it probably could not have exceeded 2″·9, or 3″. As this is rather less, I believe, than the usual proportion of the depth of the pulp-cavity to the length of the tusk as ivory is brought to the market ($\frac{1}{3}$), it probably indicates that the tooth was of considerable age and consequently belonged to a mature animal. Dr. Falconer further states that the specimen described by him was the only instance of the permanent tusk in the collection; but in this, besides that I have just noticed, I find two other fragments of what I conceive to be very young permanent incisors. One of these, or rather a portion of one of these, is seen attached to the premaxillary bone represented in fig. 46, to which reference has been already made. The other is the basal portion of another young tusk, of exactly the same diameter, about 2 inches long; the outer end is broken obliquely off a short way beyond that part of the tooth which, to judge from the colour, was lodged in the alveolus, whilst the other was exposed to some reagent which has given it a brown colour. The remaining depth of the pulp-cavity is 0″·9; and when the tooth was perfect it was probably 1″ or rather less; so that the entire original length of the tusk may be estimated at about 3 inches. Its circumference is 1″·3, and greatest diameter 0″·4. At first sight it does not appear altogether impossible that the two fragments of the small tusk may be parts of one and the same; but, in the first place, the fractured surfaces do not fit, nor is the colour of the interior the same in both fragments; and if the two were placed together even without any intermediate missing portion, the tusk would be too long in proportion, as it seems to me, for the premaxillary bone, and would project from the alveolus much more, in proportion to its thickness, than the young tusk of an elephant does. Though no appearance of engine-turned marking can be discerned in either fragment, the external longitudinal striation, where dislamination of the outer layer has taken place, is as coarse as it is in the larger tusk. I have already mentioned that Dr. Falconer had cemented one of these small tusks into what remains of the alveolar cavity in the premaxillary bone; but on close examination I find that the basal portion fits much more closely; and I have therefore substituted it in the specimen for the other.

* The dimensions above given are not quite half those of the corresponding tooth in *E. africanus*, and as nearly as possible half those of the second milk-molar in *E. indicus, E. primigenius, and E. antiquus*; so that, admitting it to be really the second and not the true first milk-molar, it is obvious that the Maltese specimen must have

"De Blainville ('Ostéographie,' Eléphans, pl. ix. fig. 1) has given a figure of a lower jaw of a very young African Elephant, in which a pre-antepenultimate or theoretical first milk-molar was developed on one side of the lower jaw; and in the 'Fauna Antiqua Sivalensis' another example of the same kind is also figured*. The milk-tooth in both these cases was very rudimentary; and it is possible that the Zebbug specimen might be conjectured to be an equivalent tooth. But it appears to me that this view is distinctly negatived by the fact that the Zebbug milk-molar was supported upon a large fang, and that its crown is well worn, proving that it had served an alimentary function, and that it was not a case of unusual or monstrous development of a theoretical tooth which is commonly suppressed. In the instances of the African Elephant above referred to, the pre-antepenultimate milk-molar was restricted to one side of the lower jaw, and was not developed in the upper jaw. It is difficult to say of the Malta tooth whether it belonged to the upper or lower jaw.

"Fig. 3 of the same plate represents the portion of the crown borne upon the large anterior fang of a milk-molar. It is composed of three distinct disks of wear, which are very open, resembling in this respect the characters yielded by fig. 2; indeed they are as much expanded as in the existing African Elephant. The crown is narrow in front, and widens very rapidly backwards, the dimensions being:—

	in.
Width in front (of anterior ridge)	0·3
Greatest width behind	0·5
Length of crown-fragment (of three front disks)	0·54

"The anterior end of the fragment bears halfway up a distinct smooth pit, being the disk of pressure against an anterior tooth that had been in contact with it. The enamel plates surrounding the worn disks show no marks of crimping. It is not possible to say what was the precise number of ridges entering into the composition of the crown of this tooth; but judging from a germ specimen, to be described in the sequel, it con-

belonged to a diminutive species. It is a curious circumstance, however, and one well worthy of note with respect to this tooth, that its fangs must have differed widely from those of the second milk-molar in all other known instances, in which they are subequal in size and strongly divergent. Dr. Falconer states that there is some indication of the existence of a distinct small anterior fang—though I am myself by no means satisfied of this, but on the contrary conceive that the existing fang, as shown in the figure, is in fact composed of two connate ones. In any case it is obvious that, even had an anterior fang existed, it must have been very much smaller than the posterior; and it is equally clear, from the direction of the remaining fang, that they were not divergent. Another circumstance, however, goes strongly to show that the existing fang is really a double one. In the fœtal mandible, represented in fig. 45, the alveoli of a small tooth immediately in front of the third milk-molar remain; and of one of these I have taken a wax cast of the interior, which shows that the fangs of the tooth occupying it were also connate and non-divergent. From this circumstance, if confirmed by further instances, it would seem probable, either that the true second milk-molar, in at least one of the pigmy Elephants, had connate, non-divergent fangs, or (what is perhaps equally probable) that that tooth was normally suppressed and replaced by a functionally developed first milk-molar.

* Pl. xiv. fig. 4, left side, *a*.

sisted of five ridges with front and back talons. From the very narrow width in front, and the rapid increase backwards, it is inferred that it was a lower milk-molar, and probably the penultimate ($\overline{\text{m.-m. 3}}$).

"Fig. 4 represents the crown and side aspects of a beautifully preserved specimen, comprising nearly the entire length of the crown, of an inferior milk-molar, left side. The crown presents the disks, well worn, of five ridges with a small posterior talon. The disks are wide and open in the antero-posterior direction, and somewhat rhomboidal in outline, as in the African Elephant, and they bear a close general resemblance to those of figs. 2 and 3. A large fang supporting the last three ridges and talon is present, nearly entire; but the front fang is broken off, together with a small portion of the anterior talon. The fractured surface from which the fang had been broken off is distinctly marked below, and shows that the crown is all but complete in length. The anterior part of the crown appears to have been worn down close to the level of the fang. The grinding-plane is slightly concave in the antero-posterior direction, proving it to have been an inferior molar; and I infer that it is the equivalent tooth of the specimen last described, *i. e.* the left lower penultimate milk-molar ($\overline{\text{m.-m. 3}}$), and that when entire it was composed of five ridges with front and back talons. The dimensions are:—

	in.
Extreme length of fragment	1·30
Width of crown at front ridge	0·57
Greatest width of front ridge	0·70

"The enamel plates in this, as in the two other specimens above described, are very thin, with no tendency to crimping, the appearance which looks like this being simply the vertical grooves in contact with the cement. It is important to add that there is a broad and well-defined smooth depression upon the posterior end, indicating the pressure of a contiguous tooth bearing against it from behind.

"Fig. 5 represents, of the natural size, the top and side aspects of a finely preserved milk-molar of the same series, inferred to be the last of the lower jaw, right side ($\overline{\text{m.-m. 4}}$). Its crown surface is concave from back to front, proving it to be lower; and the oblique direction of the disks of wear determines the side. With the exception of a little damage to the anterior end, which has removed a portion of the front talon, the crown is quite perfect; and the whole of the fangs are also present, more or less fractured. The crown was composed of eight ridges, all of which have been affected by wear. The disks bear the closest resemblance in form to those of fig. 4; and it will be seen by a comparison of the figures, that they were in a nearly corresponding condition of wear. In three of the intermediate disks (viz. 4, 5, and 6) there is a slight tendency to an angular rhomboidal expansion in the middle; but, as in the teeth above described, the enamel plates are very thin, and the edges in contact with the ivory-depressions are straight and perfectly free from any tendency to plication or crimping.

There is a small talon process appended to the last ridge, enveloped by cement. The crown is worn low in front, and differs from those of the preceding teeth in maintaining nearly a uniform width throughout, the others being narrow in front, and widening suddenly backwards. The front fang is thick and massive, supporting two or three ridges; between it and the large back fang there are the remains of a series of smaller fangs, more or less confluent with the latter, presenting characters widely different (in the greater amount of complexity) from those yielded by fig. 4, and indicating, in harmony with other points, that they were not teeth of equivalent age. A part only of the anterior talon remains. The dimensions are:—

	in.
Length of crown	2·2
Width in front	0·7
Width in the middle	0·7
Width at eighth ridge	0·7
Height of crown at the last ridge	0·8

"So far as I am aware, no milk-molar of an Elephant, fossil or recent, has hitherto been observed with so complex a crown, conjoined with such small dimensions.

"4. *Upper Milk-molars.*—Of upper milk-molars the series is less complete than of lower. Of the antepenultimate (m.-m. 2) or, as commonly called, first milk-molar, there is no determinable specimen. But of the penultimate (m.-m. 3) a very beautifully preserved germ is represented by fig. 6 of the same Plate, top and side aspects. It consists of the entire shell, before the ivory nuclei had become ossified, and without fangs; the layer of cement had not been completely formed, and is denuded from the sides. The crown is of an oblong form, a little wider behind than in front, and is composed of five principal ridges, with a distinct talon in front and behind. The tips of the digitations of the first ridge and talon are alone affected by wear, and that only to a slight degree. Taking into account the difference of upper and lower teeth in form, and the difference in the stage of wear, it agrees closely in size and proportions with the inferior penultimate shown in fig. 4 and already described. The ridges are seen to be separated by rather wide intervals, and they are high relatively to the other proportions. The digital terminations of the ridges speedily become confluent below the apex, this constituting the principal cause of the absence of crimping in the enamel plates, noticed in the description of the lower milk-molars. The dimensions are:—

	in.
Length of crown	1·4
Width in front	0·6
Greatest width behind	0·8
Height (greatest) of ridge plates	0·95

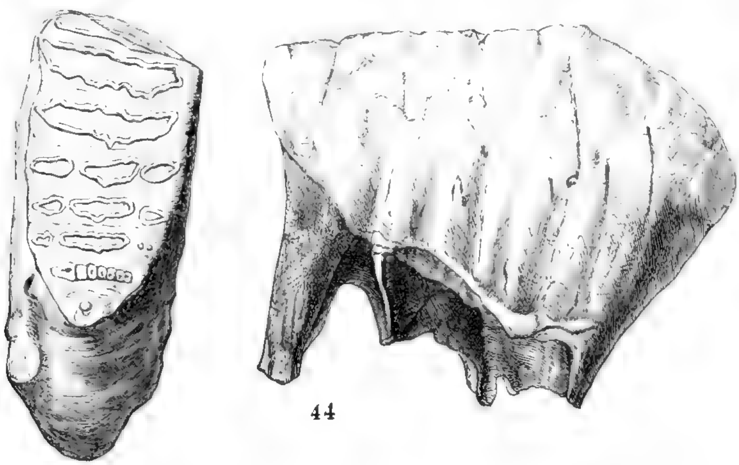
The tooth is of the left side. There are in the collection a number of detached plates of an unconsolidated germ tooth of the same age.

"Of the last upper milk-molar (m.-m. 4) there are numerous fragments, but unluckily no entire tooth, in the collection. The most perfect of the series is the specimen represented by figs. 8 and 8 *a*, which consists of the intermediate portion, comprising six ridges, but mutilated both in front and behind. It is evident that of the hind portion only one or two collines are wanting, these being the last ridge and posterior talon; and as regards the anterior end, the fractured section is seen to pass vertically through the middle of the large front fang, indicating that the front ridge and talon alone are there wanting. The tooth, when entire, must have been nearly in a germ-state, as the tips alone of the front remaining ridge are affected by wear. The height falls off very rapidly from the front backwards; and the ridges are high in proportion to the width. This tooth is inferred to have been the upper milk-molar corresponding in age with fig. 5 of the lower jaw. The dimensions are:—

	in.
Length of fragment of crown	1·4
Width in front	0·95
Width behind	0·85
Extreme height of crown-ridges	2·3

There are no means of determining with certainty what was the precise number of ridges that entered into the composition of this tooth*; but assuming from the data

* Besides the teeth noticed by Dr. Falconer, the collection contains an entire upper molar which appears to correspond so closely in dimensions with the fragment above described, and represented in fig. 8, as to leave no doubt in my mind of its being a corresponding tooth in the series, whatever its place may be. So far, also, as can be judged from the little-worn condition of the *machærides*, and from the thickness of the plates, it would seem to belong to the same type as fig. 9, from which tooth, however, it differs most remarkably in the height of the crown, though nearly corresponding in all other dimensions. As the specimen is one of great interest, and in nearly perfect condition, I have thought it might be useful to add figures showing its main characteristics.



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The tooth is clearly an upper molar of the right side; but whether it is to be regarded as a milk- or as a true molar, opinions may be divided.

given above that only a single ridge and talon have been broken off at either end, the perfect tooth would have presented eight ridges, besides talons.

"Figs. 7 and 7 *a* represent, of the natural size, another fragment of a germ of the same tooth, comprising four of the middle and posterior ridges. It was proportionally smaller than fig. 8; but the form and size are irreconcilable with fig. 6; it is therefore inferred to be a part of m.-m. 4; it presents no special characters for a description.

"5. *True Molars.*—The evidence above adduced from various instances of milk-molars jointly goes to prove the former existence in Malta of a small form of Elephant: this inference is fully corroborated by the remains of true molars; and first, as regards those of the lower jaw:—

"*Lower True Molars.*—Fig. 12 represents, of the natural size, a specimen comprising the greater part of a lower molar of the right side. The anterior part of the crown,

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The crown part is entire, excepting a small portion of the anterior talon, which has been recently chipped off; it measures 2″·9 in length by 1″·1 in extreme width, which is at the second plate; the greatest height (at the 7th plate) is 1″·85. The length of the grinding-surface is about 2″; and on it are exposed the *machærides* of part of the front talon and of six plates, together with the extreme point of a single median cusp of the seventh. Only two of the plates, however, are worn into complete rings; and the sixth presents no less than seven minute annuli crowded into a space of 0″·5. The tooth is composed of eight plates and an anterior and posterior talon, *i. e.* of ten elements. The hinder end is hollowed and flattened below the talon; but there is not the slightest indication of pressure by a succeeding tooth, either in this tooth, or in that shown in fig. 9. The average thickness of the plates is about 0″·27; and, as far as can be seen in the few spots where the cementum has been removed (apparently by attrition), the surface of the enamel is finely and irregularly fluted, and in some places, though very rarely, an extremely faint indication of transverse wrinkling is exhibited, but by no means so clearly as in the teeth shown in figs. 7, 8, 9.

With respect to the position of this tooth in the series it is not very easy to arrive at any satisfactory decision. As I have said, it seems to resemble so closely in all respects that represented in fig. 8, that the two may, I think, be safely regarded as corresponding teeth, differing only in the degree of wear they have undergone. The latter tooth is regarded by Dr. Falconer as the fourth upper milk-molar, and as representing an upper tooth corresponding to the lower milk-molar, fig. 5. From its general characters, as regards its form and the thickness of the plates, as shown more clearly in the entire tooth than in the fragment figured by Dr. Falconer, it will also be seen to bear a strong resemblance to fig. 9, which tooth Dr. Falconer appears to have been inclined to regard as the second true molar, though not certain that it might not be the first, which I think is equally (if not more) likely.

We have to consider therefore whether the tooth described in this note, is m-m. 4, or m. 1.

First, with respect to its being m-m. 4 of the same species as m. 1, or m. 2, fig. 9.

If we compare the relative lengths of the m-m. 4 and m. 1 in *E. indicus*, they will be found on the average, as regards length, to measure about 5″·1 and 6″·6 respectively, or to stand in relation to each other as ·772 to 1·000; in *E. primigenius*, 3″·6 and 5″·2, or as ·692 to 1·000; in *E. antiquus* 5″·3 and 6″·7, or as ·791 to 1·000; and in *E. meridionalis* 4″·6 and 6″·2, or as ·741 to 1·000; whilst the relative lengths of the tooth we are discussing and that shown in fig. 9 are 2″·9 and 3″·0, or nearly identical; and in fact, when it is remarked that fig. 9 has an additional plate (*g*), the other is actually quite as long, if not the longer. Again, if we take as the term of comparison the thickness of the plates, it will be found to be nearly identical in the two teeth; whilst if we take the relative thickness of the plates in m-m. 4 and m. 1 in the above-named species of Elephant, a very considerable difference will be found to exist. For instance in *E. indicus*, the last milk-molar plates are about supported upon the large front fang, has been ground down, and removed by advanced wear: the remaining portion is complete back to the hind talon. The fragment presents all the characters of the residuary part of a last true molar, more especially in the very significant circumstance that the last ridges become gradually less and less vertical, and diverge in a fan-shaped fashion until the hindmost become nearly horizontal. This portion of the tooth is completely enveloped in well-preserved cement, and there is not the slightest indication of a disk of pressure caused by a hinder tooth pushing it forwards. This is the typical form which the last true molar ($\overline{\text{m. 3}}$) commonly assumes in the existing Indian Elephant and in fossil species of the same subgenus *Euelephas*. It is irreconcilable with that of a last milk-molar, or of either of the intermediate true molars, as it would necessarily imply the absence of any other

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0″·44, and those of the first true molar 0″·54 in thickness,—in *E. antiquus* 0″·52 and 0″·6, in *E. primigenius* 0″·33 and 0″·43, and in a single instance of *E. meridionalis* 0″·56 and 0″·68,—showing that, as a rule, the plates of the first molar are considerably thicker than they are in the last milk-molar. I have no direct measurement of the relative thickness of the plates in these teeth of *E. africanus*, but should estimate the difference as much greater even than in any of the species above mentioned, or as about 0″·65 and 0″·85. In both these particulars, therefore, of the length of the tooth and the thickness of the plates, the tooth under discussion, were it the $\underline{\text{m-m. 4}}$ of the same species as No. 9, would have proportions widely different from those which that tooth possesses in all other known species of Elephant.

In the same way, if we assume with Dr. Falconer that the tooth represents an upper m-m. 4 corresponding with such a $\overline{\text{m-m. 4}}$ as fig. 5, we are met with similar objections. For upon comparing the relative dimensions of the upper and lower m-m. 4 in other species of Elephant, the latter will, I believe, in all, or at any rate in most cases, be found to be the longer and generally the narrower, though the difference in the latter respect is never anything like as great as it is between the subject of this note and the tooth shown in fig. 5, the one being 1″·1, the other only 0″·7, in width. The former, again, is 2″·9 long and the latter 2″·2, showing an equally great difference, but in a direction exactly opposite to what it should be did the teeth stand to each other in the relation of upper and lower. But as the tooth fig. 5 is clearly a $\overline{\text{m-m. 4}}$, it follows that the other cannot be an $\underline{\text{m-m. 4}}$.

Of course, if the tooth fig. 9 be regarded as $\underline{\text{m. 2}}$, the above arguments against the smaller one being $\underline{\text{m-m. 4}}$, are very much strengthened.

The second question to be discussed is whether, supposing fig. 9 to represent an $\underline{\text{m-m. 2}}$, the tooth figured in this note represents the $\underline{\text{m. 1}}$ of the same species, or of one of the same size. This point I think may be briefly decided by a reference to the comparative dimensions of $\underline{\text{m. 1}}$ and $\underline{\text{m. 2}}$ in other species of Elephant.

In *E. indicus* the average length of these teeth may be stated as about 6″·8 and 8″·8, in *E. africanus* as 6″·4 and 7″·3, in *E. antiquus* as 6″·7 and 8″·3, in *E. primigenius* as about 5″·3 and 8″·2, and in *E. meridionalis* as 6″·5 and 8″·8,—showing that in round numbers the second molar, as regards length, stands in relation to the first pretty nearly as 63 to 83.

But the tooth I am describing and that shown in fig. 9 are of nearly the same length; so that here again, unless we assume the existence of entirely different proportions between the length of the teeth in the dwarf Elephant and that of those of all other species, we are compelled to the conclusion that the teeth in question both occupy the same place in the series—that is, are both either the $\underline{\text{m. 1}}$, or $\underline{\text{m. 2}}$; but which, it is not very easy to say; and on the supposition that they are so, the very great difference between them in the height of the crown is very remarkable.

successional tooth advancing behind it. The outline is bowed very considerably sideways, being convex upon the inner side, and concave on the outer, to a greater degree even than is indicated by the figures. The residuary worn surface of the crown exhibits seven abraded ridges, of which the four anterior disks show rather wide and open depressions, with a defined angular expansion in the middle. The plates of enamel are rather thick and uniformly straight, presenting not the slightest degree of crimping or plicature, with the exception of the sharply angular, little, mesial expansion. The three next hinder ridges are but slightly abraded. The anterior disks are very oblique in their direction, which runs from the inside outwards and backwards. The unworn hind portion is so completely enveloped by cement, and the plates so nearly horizontal, that it is hardly possible to reckon exactly the number of ridges composing this part of the crown. But approximately the fragment is estimated to have in all nine ridges, with a small posterior talon. There are no means of determining exactly how many ridges have disappeared in front, as all remains of the great front fang are wanting. The width of the crown gradually diminishes back to the talon, as normally occurs with the last true molar of the Elephants. The dimensions are:—

	in.
Extreme length of fragment	4·2
Width of crown at second ridge	1·3
Width of crown at seventh ridge	1·2
Width of crown behind	0·85
Space occupied by second, third, and fourth disks	1·1
Length of residuary grinding-surface, including seven ridges	2·3
Extreme height of crown near middle, where unworn	2·1

The fangs are broken off along the base near the roots; the contour of this part of the tooth when reversed is very much and nearly uniformly curved, like a bow on the stretch.

"The specimen next to be noticed confirms the inference drawn from fig. 12. It consists of the posterior half of a lower molar, right side, including six ridges and the greater part of the posterior talon. It is represented by fig. 13. Like fig. 12, what remains of the fragment is concave on the outside, and convex inwards in the longitudinal direction. The three anterior ridges are worn; but the grinding-surface is very distorted, descending nearly vertically in a spoon-shaped concavity from the outside inwards and downwards: this peculiarity had evidently been caused by the crown having been opposed to an abnormally developed or diseased upper molar. The distortion is attempted to be shown by the contrasted shades of fig. 13, the dark tint showing the higher side. But the amount is best expressed by measurements,—

	in.
The height of the crown at the outer side of the distorted portion being	2·9
And of the inner	1 95

making a difference of nearly an inch. A series of discoloured bands upon the surface of the cement of the outer side near the top, disposed concentrically, have been caused by this distorted wear. The three hindmost ridges are intact, and, instead of being vertical, they are in a certain measure retrofracted, the convexity being directed forwards—a character which is commonly presented by the hindmost of the true molars in the Elephants. The posterior talon appears to have consisted of a single flattened digitation, the back plate of which has been removed by a fracture. This circumstance has deprived us of any direct evidence as to the presence or absence of a disk of pressure behind; but the characters presented by the specimen, regarded in the aggregate, are consistent only with determining it to have been a penultimate or last true molar, probably the latter. The dimensions are:—

	in.
Extreme length of fragment	3·3
Width at anterior plate	1·35
Width behind	1·2
Extreme height of crown..............................	2·9

These dimensions are comparatively larger than those yielded by fig. 12; but the difference is not greater than may be fairly attributed to distinct individuals, or difference of sex. The distortion in the grinding-plane, noticed above, is rarely, if ever, seen in molars of the milk or adolescent stage, but is occasionally met with, variously modified, in teeth belonging to the period of old age.

"A still more perfect specimen is represented, top and side aspects, by figs. 11 and 11 *a*, which is inferred to be another example of a last lower molar of the left side, in a different stage of wear from the preceding two. What remains of the crown consists of ten ridges and a posterior talon. All of these are more or less affected by wear. The seven anterior ridges had been ground down into transverse disks, of which the two first are confluent into a uniform surface, from which all trace of enamel has disappeared; and they are confluent also by a narrow isthmus with the third disk. The disks correspond in form exactly with those of the teeth already described, being broad in the antero-posterior direction, with a slight tendency to sharply angular expansion in the middle, which is more or less developed upon the fourth, fifth, and sixth ridges. The enamel edges in contact with the ivory depressions of the disks are straight, and entirely free from any tendency to plication or crimping, this being clearly a distinctive character of the species. The ridges, besides their considerable breadth, are separated by rather wide intervals of cement: this is well shown on the side aspect of fig. 11 *a*. The posterior talon forms a prominent splent, consisting of about a couple of digitations. All the fangs have been removed by fracture close to the base. The crown surface in front has been ground down to the level of the fangs; and there is no trace remaining of the large anterior fang, or of the portion of the crown supported by it, which must have borne at least two additional ridges, which would give a total of twelve or thirteen to the entire length of crown. The crown surface bears a very considerable degree of resemblance to that of the existing African Elephant, and greater probably than that presented by any other species, except certain varieties of *Elephas antiquus*. The dimensions are:—

	in.
Length of crown	4·4
Width in front at fourth ridge	1·4
Greatest width of fourth ridge	1·45
Width at eighth ridge	1·2
Width at last ridge	1·1
Height of crown at seventh ridge	2·05

"There is a certain amount of retrofraction in the vertical direction of the last ridges, but less considerable than in fig. 13, and nothing approaching the fan-shaped divergence and horizontality of the hinder ridges of fig. 12. There is not the slightest indication of a disk of pressure anywhere upon the hind talon, the surface of which is perfectly preserved with its coating of cement from the fang upwards. This circumstance is of important significance in determining the tooth to have been the last true molar, as, considering its advanced stage of detrition, it is difficult to conceive that it could have been followed by an older tooth driving it forwards, without leaving the usual mark of pressure. It is further clear that the three specimens last described must have belonged to distinct individuals.

"*Upper true molars.*—The specimen represented in fig. 9 is a very finely preserved molar of the upper jaw, right side, complete in every respect, with the exception of the ends of the fangs, which are more or less broken. The crown is composed of nine principal ridges, together with a front and back talon. The anterior fang is distinctly present and supports the two front ridges and talon. The front talon, or what remains of it, appears to be composed of four minute digitations, the greater part of it having been ground away*. The three anterior disks are transverse; the next five are only slightly worn, showing the tips of the digitations abraded into annular detached islands, or in three divisions. The anterior disk is expanded in the middle, and narrows at either side, presenting only two or three flexures in the enamel plate, without any crimping. The second and third are of nearly similar form with uncrimped enamel and narrowing at the sides. The fourth, fifth, and sixth are each in three divisions; and the seventh and eighth only show the tips of the digitations worn across. The enamel plates are decidedly thick for the size of the tooth†, and the ridges are very high relatively to the length. The layer of cement at the anterior end has been removed, and with it all appearance of a disk of pressure. The hind talon forms a gibbous projection beyond

* The enamel cannot be said to be uncrimped, as it is decidedly crimped on the hinder edge of the anterior, and on both the anterior and posterior edges of the two succeeding *machærides*.

† They are not quite so thick as they are represented in the figure.

the vertical plane of the posterior fang. There is no distinct disk of pressure upon the crown portion of the talon; but there is an obscure depression at the basal part, near the fang, which may be of this nature*. The following are the dimensions:—

	in.
Extreme length of crown	2·9
Width in front	1·35 (2nd plate)
Width in the middle	1·3
Width behind	1·1
Length of surface occupied by the eight anterior disks in wear	2·2
Extreme height of crown at unworn portion, 9th ridge . . .	2·8

"From the above dimensions, the contraction of the crown posteriorly and the considerable height of the ridges relatively to its length are well shown.

"Had this specimen been discovered isolated, little or no hesitation would have been entertained by the palæontologist in referring it to the age of a milk-molar of some species of Elephant. But when regarded as part of a series in connexion with the undoubted milk-molars figs. 2–6 inclusive, and more especially with fig. 8, the whole of which are of such unusually small proportions, and when further compared with the adult molars of the lower jaw (figs. 11, 12, and 13) and an upper molar belonging to the Public Library at Malta, it is manifest that it maintains its place consistently as a true molar of the same series. I am at present unable to decide with confidence whether it had best be regarded as an antepenultimate or penultimate†.

"Of the *antepenultimate upper true molar* (m. 1) no perfect specimen is to be found in the collection. One fragment, inferred to be a part of this tooth from its size, form, and proportions, comprises the two anterior ridges, together with the large fang that supports them. The corresponding molar of the lower jaw is equally wanting as an entire specimen; but there are fragments referrible to it also."

With respect to the Maltese tooth in question Dr. Falconer remarks:—

"One of the most characteristic of the specimens is an upper molar of the left side bearing the following label:

"'Dente che si conserva nella pubblica Biblioteca di Malta e trovato in Novembre 1859 in Malta.'

"The tooth is a well-worn upper molar of the left side, perfect so far as the crown goes, with the exception of the front portion supported upon the large anterior fang, which portion had been worn away by continued grinding action. This is distinctly proved by the circumstance that the grinding-plane of the crown intersects the most anterior of the extant fangs. The rest of the fangs from this point backwards to the posterior talon are

* There can, I think, be no doubt that the deep hollow below the hind talon is due to the pressure of the succeeding capsule.

† There can be little doubt as to the true position of this tooth as m. 1. In form and general character it is the exact counterpart, except in size, of an m. 1 of *E. antiquus*—identified as such by Dr. Falconer.

all present, but more or less fractured or abraded. The molar is vertically fractured across through the middle, involving the loss of the greater part of one colline; but as the fragments fit at the base, this circumstance does not interfere with the precise appreciation of the crown-characters. What remains of the crown is composed of ten ridges, of which nine are more or less worn, the rest being intact. The posterior talon consists of a single flattened gibbous digitation appended to the last ridge, which is composed of three or four digitations. The most anterior disk of wear is vertically divided through the middle, so that its posterior half only is present. The seven anterior disks form oblong transverse depressions bounded by *parallel* bands of enamel, there not being the slightest tendency in any of them to digital subdivisions forming secondary undulations. These disks are of nearly uniform width across, parallel and without any indication of the retroflected cornua at the sides, such as are commonly seen in *Elephas antiquus.* Their most striking character is the nearly entire absence of anything approaching crimping (or primary undulations) upon the edges of the enamel plates, as they appear in relief on the surface of the crown. There is a slight appearance of vertical grooving upon the cement aspect in these enamel plates, but considerably less than is exhibited in the molars of any species of Elephant, fossil or recent, with which I am acquainted. The enamel of the plates is rather thick, quite as thick in proportion as in the existing Indian Elephant or *E. antiquus.* There is the slightest possible tendency to mesial angular expansion in some of the anterior disks, but it is barely appreciable, while in some other of the specimens this character is somewhat more pronounced. The talon consists of but a single flattened digitation; and there is this remarkable circumstance about it, that it nowhere bears the slightest indication of any disk of pressure upon it arising from the protrusion of another molar advancing from behind. The last or tenth ridge of the specimen I have reckoned as such, and not as a talon appendage, from the fact that it is continued vertically down into the large posterior fang and distinctly within its bearing. The crown, in proportion to the height of the plates, is narrow. The disks of wear, where much abraded in front, are in close contact, the enamel plates nearly touching each other; but they are well separated in the hinder part of the tooth, and the whole of the crown is enveloped by a coat of cement, which, at the sides, is seen to be of considerable thickness.

"I have reckoned that what remains of the crown is composed of ten ridges; and, taking into account that the most anterior portion, supported upon the large front fang, had disappeared by age, and that it was probably composed of at least two ridges, this would yield for the ridge-formula of the molar a total of twelve collines, exclusive of talons.

"What was the age of this molar in the dental series of the animal? At the first glance it might be supposed from its size to be a third or last milk-molar; but this inference is at once negatived by the fact already remarked on, that the posterior talon bears nowhere upon it, nor does the end of the tooth exhibit the slightest indication of, a depression arising from the pressure of a tooth advancing behind it. As the same result is yielded in a still more decided fashion by inferior molars noticed above*, I see no alternative to the inference that it was an adult tooth of a dwarf species of Elephant. The following are the dimensions:—

	in.
Extreme length of crown, measured from back talon to anterior edge, exactly	4·0
Width of ditto at second ridge	1·4
Width of ditto at third ridge	1·5
Width of ditto at sixth ridge	1·4
Greatest width of crown	1·55
Width at 9th ridge	1·2
Width at last ridge	1·0
Greatest height of crown, taken at reflection of 10th ridge	2·95
Length occupied by five disks, from second to sixth inclusive	1·8
Width at middle of third disk, taken between the enamel-edges	0·23

"With reference to the alimentary characters, the disks of ivory, and the cement-hollows between the enamel ridges are but slightly excavated; in fact the most anterior portion of the crown exhibits the flat and nearly uniformly smooth surface which is commonly presented by Elephants reared in the domestic state and fed upon potatoes and other soft food. The inference to be drawn from this is, that the food of the Maltese species was more herbaceous than woody.

6. "*Ridge-formula.*—It now remains to consider how the data furnished above by the molars bear upon the determination of the ridge-formula, which of all the characters is the most significant in pointing out the affinities of the species.

"(1) *Milk-molars.*—The antepenultimate milk-molar m.-m. 2 (fig. 2) is seen to have been composed of three collines, like the corresponding tooth of the African Elephant †, while in *E. primigenius*, *E. indicus*, and other species of the subgenus *Euelephas*, it presents four collines.

"The penultimate milk-molar m.-m. 3 is clearly proved by the upper germ-specimen, fig. 6, and by the lower, fig. 4, to have had five collines besides front and back talons. In the African Elephant it is composed commonly of five ridges in the upper jaw and of six in the lower; whilst in the species of *Euelephas* the number ranges from seven to eight, seven being the complement in *E. antiquus*, and eight that in the Indian Elephant and Mammoth.

"Of the last milk-molar, m.-m. 4, the specimen shown in fig. 5 fortunately presents the crown of an inferior tooth in perfect integrity, composed of eight ridges in addition to a front and hind talon; the African Elephant commonly yields the same number, while

* Those shown in figs. 11, 12, 13.

† In the only specimen to which I have had access of a fœtal African Elephant, in the British Museum, and which is the one referred to by Dr. Falconer (page 284) as having been brought by Dr. Livingstone, the m.-m. 2 in both upper and lower jaws have distinctly four collines and two talons (six elements).

in *E. antiquus* the number is ten, and in *E. primigenius* and *E. indicus* it amounts to twelve.

"(2) *True molars.*—Of the antepenultimate true molar (m. 1) there is no perfect specimen in the collection*. But as in all the species of Elephant and Mastodon this tooth invariably repeats the composition of the last milk-molar, we have no difficulty in fixing the normal number of its ridges at eight, besides talons. In *E. antiquus* the number is ten, and in the Mammoth and Indian Elephant twelve.

"Of the penultimate true molar (m. 2) there is no entire specimen of a lower tooth; but we have the upper beautifully preserved, as shown in fig. 9 (*vide* note p. 296). It exhibits a crown distinctly composed of nine ridges, besides a front and hind talon. In the African Elephant the same tooth is commonly made up of nine ridges. In *E. antiquus* the normal number is twelve, while in *E. primigenius* and *E. indicus* it amounts to sixteen.

"Of the last true molar (m. 3) there are fortunately specimens belonging to both the upper and lower jaws; and although the portion supported on the anterior fang is wanting in both, as that constantly corresponds in all the species of Elephant with what is borne upon the same fang of the penultimate, we have little difficulty in restoring the missing part of the teeth.

"The upper molar exhibits the remains of ten ridges; and adding two for the part corresponding with the anterior fang, we get a complement of twelve ridges for the crown of the last molar. In the African Elephant the same tooth in the upper jaw ranges with from nine to ten ridges, and in the lower from nine to twelve. In *E. antiquus* the number is sixteen; and in *E. primigenius* the number of plates reaches twenty-four †.

"From the above data the ridge-formula of the molar series is deduced to have been

$$\begin{array}{cc} \text{Milk-molars.} & \text{True molars.} \\ \dfrac{3+5+8}{3+5+8}, & \dfrac{8+9+12}{8+9+12}. \end{array}$$

This formula at once brings the small Zebbug species within the subgeneric group of the Elephants which I have called *Loxodon*, along with *E. africanus*. The affinity of the fossil to the existing species is further clearly indicated by the narrow crown and mesial expansion of the disks of wear, together with the point already alluded to of the milk-incisors being invested at the crown with a layer of enamel. But, though allied, the two forms are specifically very distinct. Besides the signal difference of size, the forms of the disks of wear, although belonging to a common pattern, present broad marks of distinction. In the African species the disks are angularly dilated into rhombs in the middle, and the angles terminate in a round loop caused by a single outlying digital element, which in the progress of abrasion becomes confluent with the disk of the ridge

* Unless, as I believe, we may regard fig. 9 as such.

† The numbers of plates were not filled in in Dr. Falconer's MS.

to which it is appended. In the Zebbug form there is never a trace of this outlying loop; and the disks, although open, exhibit only a very slight tendency to angular expansion. The character is most pronounced in the two milk-teeth, figs. 4 and 5, whilst it is entirely wanting in the penultimate upper molar, fig. 10. In fact this tooth differs more from the ordinary type of the African species than does the corresponding molar of *E. antiquus.* The amount of agreement and of difference in the molars of the two species is best appreciated by comparing the last lower molar (figs. 11–13) of the Zebbug form with the corresponding molar of the African species."

Having thus given Dr. Falconer's descriptions of the teeth, and his valuable observations concerning them, it only remains to inquire whether any evidence is afforded by these parts of the existence of more than one species of Elephant of dwarf size. This is a point to which Dr. Falconer has nowhere adverted; and it was therefore a matter of considerable interest to me, after I had been led from the study of the other bones to the conclusion that the Zebbug collection contained the remains of two small species, to ascertain whether similar evidence was afforded by the teeth. And it seems to me that they do indubitably present sufficient evidence to that effect.

When the teeth are placed side by side, it is at once quite obvious that they may be divided into two groups, at any rate so far as the true molars are concerned. These groups differ very markedly, more especially in the thickness of the plates, or in the number comprised within a given length, as well as in the form of the *machærides.* What the difference may be, if any, in the numerical formula, I am not prepared to say, as the materials are too scanty to allow of the solution of the question, which must wait to be decided by the very abundant materials since collected by Dr. Leith Adams. I shall content myself here simply with pointing out the striking differences exhibited between the teeth of the two species as they are represented in the Zebbug collection, and shown in the figures in Pl. LII.

If we compare, for instance, the $\overline{\text{m. 1}}$ represented in fig. 9 with either of those shown in figs. 11–13, but more especially with the first, of which a side view is also given, such a difference will at once be perceived in the form of the machærides or disks of wear, and in the thickness of the plates, as to stamp them as totally distinct forms. In the tooth fig. 9, nine ridges are comprised in a length of about 2″·5, which gives an average thickness of each plate of about 0″·27, whilst in fig. 11 seven plates occupy a length of 3″·0, equivalent to an average thickness of about 0″·43. Again, if we look at the form of the machærides in the two cases, the comparative narrowness of the disks and the disposition to true crimping of the enamel-edge, with the complete absence of any median angular expansion, in fig. 9 cannot fail to be at once perceived*. Again, in fig. 11 it will be seen that the hinder two or three plates, which are just coming into wear, exhibit

* The difference is perhaps more marked in the actual teeth, owing to the circumstance that the enamel-edges are represented rather too thick in fig. 9.

not more than two annuli, which are of large size and with thick enamel, whilst in fig. 9 the corresponding plates show five or six annuli, of small size, and a corresponding thin enamel. The above differences appear to me to be quite as important as those which exist between the true molars of the Indian and African species, and infinitely greater than those which distinguish the former species from *E. primigenius*.

In fig. 10 is shown the crown surface of a tooth from Maccagnone, which would seem in its size and characters to approach very nearly to the type of fig. 9; and I presume that Dr. Falconer may have introduced the figure with the view of showing some relation between the Sicilian and Maltese teeth. He has, however, left no observations on this point; and as the tooth itself is not now with the others, I am unable to say more about it than is shown in the figure.

With regard to the milk-teeth, we have not the same facility of judging of their relations from the thickness of the plates alone as we have in many cases in the true molars. In this respect little or no difference will be observed among the various milk-teeth of which figures have been given; and some might thence, under the circumstances, be led to conclude that these teeth must all belong to one only of the two species whose molars differ so widely in the thickness of the plates. But such a conclusion is by no means warranted by what we know of the milk-teeth in different species of Elephant, in which, notwithstanding very great differences in the thickness of the plates in the true molars, little or none will be found in that of the plates of the respective milk-teeth, whilst in some cases the difference in this regard will even be in an opposite direction to that in which it might be expected to show itself. For instance, the mean thickness of the true molar plates in *E. africanus* varies from 0″·85 to 1″ or more, and in *E. indicus* is about 0″·55, whilst the thickness of the plates in the $\overline{\text{m.-m. 3}}$ of the two is pretty nearly the same, or about 0″·32–·33; in *E. primigenius*, although the thickness of the plates in m. 1 is not more in most cases than about 0″·43–·45, those of the 3rd m.-m. average about 0″·34, or rather more than in *E. africanus*, though considerably less than in *E. antiquus*, in which the thickness may be taken at about 0″·41.

As we cannot, therefore, rely solely upon the thickness of the plates in the milk-molars as a diagnostic character in species so widely distinguished as *E. indicus* and *E. africanus*, it is impossible from that character to say whether or not all the milk-molars in the Zebbug collection belong to one or more species. Had they all been so worn as to afford a good view of the form of the machærides, the decision would probably have been easy enough; but it will be observed (leaving out of the question the $\overline{\text{m.-m. 2}}$, fig. 2) that only three of the specimens were worn sufficiently for this purpose; and as, from the form of the machærides in these instances, and the general condition and colour &c. of the teeth, it is not improbable that all belonged to one and the same individual, we must have recourse to other characters to determine the question of the true relations of the unworn specimens. I am not sure how far such a character may be depended upon; but, in the case more especially of milk-teeth uncovered with cementum, I think what may be termed the sculpturing of the surface may be regarded as of considerable value. Taking this, however, as a test, it will be found that whilst the surface of the plates in the m.-m. 3, fig. 6, is very coarsely and irregularly fluted in the vertical direction, and presents no trace of transverse wrinkling, that of the exposed plates in fig. 7 is very finely fluted, and at the same time very minutely wrinkled transversely*; and the same condition may be seen (though much less plainly, owing to a thick covering of cementum) in the fragment represented in fig. 8, or in the corresponding tooth described in the note in page 290. In the worn milk-teeth, figs. 3, 4, and 5, the surface is entirely covered with a thick cement. I am inclined therefore to assign fig. 6 to the same species as figs. 3, 4, and 5, whilst figs. 7, 8, and the corresponding tooth would belong to the same species as fig. 9, and perhaps as fig. 10.

How these teeth are related to the other bones of the two dwarf species, the present collection affords no certain means of positively deciding; but, from the more general tendency towards the African type which is exhibited in so many respects in *E. melitensis*, I should be inclined to assign the teeth represented in figs. 11, 12, and 13, with the corresponding milk-molars, to that species. This, again, however, is one of the questions which remain to be decided when we are furnished with more ample materials.

Among the teeth undoubtedly belonging to the Zebbug collection when it came into my hands, was one about whose source some obscurity exists. It was not marked as coming from Zebbug, nor is it entered in the rough list of the collection. Captain Spratt, however, though uncertain about its relation to Zebbug, is pretty confident that it was brought from Malta. I have therefore not included it in my account of the Zebbug collection, but think it should be noticed for future reference, as connected with the island.

The tooth is the m.-m. 3 of the right side, and it is tolerably entire, though considerably worn in front, so that the two anterior plates are worn down to the common base, and the third very nearly so; but the diminished base of the anterior fang, apparently much absorbed, still remains. There have been six plates, and probably two talons. The length is about 2′, and the extreme width (5th plate) 1″·3. The tooth, therefore, in general dimensions, differs but little in its size and proportions from the corresponding tooth in *E. indicus* and *E. primigenius*; whilst it is shorter in proportion than the 3rd m.-m. of *E. antiquus*, and proportionally a good deal wider than the same tooth in *E. africanus* and *E. meridionalis*. It almost exactly resembles, though rather more worn, a 3rd m.-m. from Long Hole, in Gower, and which is labelled by Dr. Falconer *E. antiquus*, though it seems to me to exhibit much more the characters of *E. primigenius*, to which species, I should, with the greatest deference to so high an authority, be inclined to assign both.

* The transverse wrinkling appears to me, from subsequent observation, to be a very uncertain character; but the large vertical markings afford, undoubtedly, characters of some importance.

DESCRIPTION OF THE PLATES.

PLATE XLIV.

Fig. 1. Symphysis of mandible of the largest Maltese Fossil Elephant (*Elephas* —— ?) (p. 231).

Fig. 2. Neural spine of the seventeenth or eighteenth dorsal vertebra of the same species (p. 233).

Figs. 3, 4. The outer and inner aspects of a very young exoccipital bone of the same (p. 233).

PLATE XLV.

Fig. 5. Fragment of shaft of femur (young) of the largest species, and not improbably belonging to the same individual as that which afforded the exoccipital (p. 235).

Fig. 6. Shaft of femur of mature *E. melitensis* (p. 247).

Fig. 7. Fragment of neural spine of dorsal vertebra of ditto (p. 241).

Fig. 8. Portion of second rib (right side) of ditto (p. 241).

PLATE XLVI.

Fig. 9. Seventh cervical vertebra of *E. melitensis* (p. 238).

Figs. 10, 10*a*. Sixth or seventh dorsal vertebra (p. 240).

Figs. 11, 11*a*. Second or third lumbar vertebra (p. 241).

PLATE XLVII.

Fig. 12. Portion of atlas of *E. melitensis* (p. 238).

Fig. 13. Portion of ascending ramus of mandible of ditto (p. 236).

Fig. 14. Upper surface of astragalus of *E. falconeri* (p. 268).

Fig. 14 (*bis*). Dorsal aspect of fragment of scapula referred doubtfully to *E. falconeri* (p. 254).

Fig. 14 (*bis*)[a]. View of the glenoid fossa.

Fig. 15. Posterior view of very young tibia, probably of *E. melitensis*.

Fig. 15*a*. Proximal articular surface.

Figs. 16, 16*a*. Anterior and posterior views of a fœtal tibia (p. 281)

Fig. 17. Anterior view of an older tibia (pp. 281, 282).

Figs. 18, 19. Two fœtal radii (p. 280).

Figs. 20, 21. Two fœtal tibiæ (pp. 281, 282).

PLATE XLVIII.

Fig. 22. Proximal end of humerus of *E. melitensis* (p. 244).
Fig. 23. Fragment of scapula of ditto (p. 243).
Fig. 23*a*. The glenoid fossa.
Fig. 24. Proximal end of ulna of *E. melitensis* (p. 245).
Fig. 24*a*. The proximal articular surface.
Fig. 25. An olecranon process of *E. melitensis* (p. 246).
Fig. 26. Fragment of ischium of ditto (p. 242).

PLATE XLIX.

Fig. 26 (*bis*). Anterior and posterior views of humerus of *E. falconeri* (p. 255).
Fig. 27. Distal articular surface of humerus of ditto (p. 259).
Fig. 28. Proximal end of ulna of ditto (p. 260).
Fig. 28*a*. Articular surface.

PLATE L.

Figs. 29, 29*a*. Anterior and posterior aspects of femur of *E. falconeri* (p. 266).
Fig. 30. Fragment of upper end of femur of ditto (p. 264).
Fig. 31. Portion of pelvis of ditto (p. 263).

PLATE LI.

Fig. 32. Posterior aspect of left half of atlas of *E. falconeri* (p. 251).
Fig. 32*a*. Anterior aspect.
Figs. 33, 33*a*. Similar aspects of another atlas of much younger age and doubtfully referred to *E. melitensis* (p. 251).
Figs. 34, 34*a*. Anterior and posterior views of a fragment of an eighth to tenth dorsal vertebra of *E. falconeri*.
Fig. 35. Fragment of atlas of *E. melitensis* (p. 238).
Figs. 36, 36*a*. Lateral and posterior aspects of neural spine of a dorsal vertebra of *E. falconeri*.
Fig. 37. Proximal end of second rib of ditto.
Figs. 38, 38*a*. Anterior and posterior views of a very young or fœtal tibia (? *Hippopotamus*).
Figs. 39, 39*a*. Lateral and posterior views of another tibia of apparently similar character.
Figs. 40, 40*a*, 40*b*. Fourth metatarsal of *E. falconeri* (p. 271).
Fig. 41. Proximal phalanx of third manual digit of ditto (p. 263).

PLATE LII.

Figs. 42, 42*a*. Fragment of right ramus of mandible of very young animal.

Figs. 42′, 42′*a*. External and internal aspects of a very young or fœtal oxoccipital (p. 272).

Fig. 43. Fragment of right side of mandible, rather older than that shown in Fig. 42 (p. 278).

Figs. 44, 44*a*. External and internal aspects of a very young or fœtal exoccipital apparently different from that shown in Fig. 42′ (p. 273).

Fig. 45. The entire symphysis of a very young or fœtal mandible, displaying the socket of the $\overline{\text{m.-m. 1}}$ and, on the right side, part of that of $\overline{\text{m.-m. 2}}$ (p. 278).

Fig. 46. Portion of the premaxillary with germ of permanent incisor (p. 276).

Figs. 47, 47*a*. Distal extremity of fibula? of *E. falconeri*?

Fig. 48. Tusk of *E. falconeri* (p. 285).

Fig. 49. Very young humerus of *E. falconeri* (p. 279).

Fig. 50. Another very young humerus (p. 279).

PLATE LIII.

Figs. 1, 1*a*, 1*b*. Deciduous incisor of *E. melitensis*? (p. 284).

Figs. 2, 2*a*. Antepenultimate lower milk-molar, $\overline{\text{m.-m. 2}}$ (p. 286).

Figs. 3, 3*a*. Fragment of (probably) the penultimate lower milk-molar, $\overline{\text{m.-m. 3}}$ (p. 287).

Figs. 4, 4*a*. Left lower penultimate milk-molar, $\overline{\text{m.-m. 3}}$ (p. 288).

Figs. 5, 5*a*. Last lower milk-molar of the left side, $\overline{\text{m.-m. 4}}$ (p. 288).

Figs. 6, 6*a*. Penultimate upper milk-molar in germ, $\underline{\text{m.-m. 3}}$ (p. 289).

Figs. 7, 7*a*. Fragment of germ of last upper milk-molar, $\underline{\text{m.-m. 4}}$?

Figs. 8, 8*a*. Portion of last upper milk-molar, $\underline{\text{m.-m. 4}}$? ($\underline{\text{m. 1}}$, *mihi*) (p. 290)?

Fig. 9. First upper true molar ($\underline{\text{m. 1}}$)? of *E. falconeri*? (p. 295).

Fig. 10. Crown surface of tooth from Maccagnone (p. 301).

Fig. 11. Last (?) lower molar of the left side, $\overline{\text{m. 3}}$ (p. 294). (*E. melitensis*?)

Fig. 12. Greater part of the last lower molar of the right side, $\overline{\text{m. 3}}$ (p. 291).

Fig. 13. Posterior half of last lower molar of the right side, $\overline{\text{m. 3}}$ (p. 293).

The following Tables give the principal measurements of some of the Bones and Teeth which have served as data for the comparison of the Maltese with other forms of Elephant.

TABLE III.—Atlas. Various measurements.

	Extreme width.	Extreme height or v.d.	Tr.d. outside anterior articular processes.	Tr.d. outside posterior articular processes.	A.p.d. of ring above.	A.p.d. of ring below.	A.p.d. of ring on side.	Tr.d. of condyloid cup.	Dimensions of condyloid facets.	Height and width of ring.	Radius of longer curve of condyloid facet.
E. indicus (Chuny)	16·0	..	..	..	..	..	..	..	....	....	..
,, (Sumatran)	10·5	6·4	7·3	5·2	2·4	1·9	3·4	6·5	3·3 × 2·4	3·2 × 2·4	1·7
,, (2678, R.C.S.)	12·5	7·0	7·8	6·5	2·7	2·1	3·8	7·6	4·0 × 3·0	3·5 × 3·0	2·0
,, (Cuvier)	13·5	..	..	..	..	..	..	..	....	....	..
,, (Blainville)	14·4	7·7	7·8	..		..	..	..	4·4 × 2·6	....	..
E. africanus, B.M.	13·5	8·5	9·5	8·8	3·6	2·5	4·1	8·3	4·5 × 3·0	4·3 × 3·2	2·4
,, (Blainville)	11·8	6·6	7·6	..	..		..	..	4·1 × 2·4	....	..
E. melitensis	....	3·5	..	..	..		..	..	2·5 × 1·7	....	1·5
E. falconeri	5·0	2·9	3·3	2·6	1·2	..	1·7	..	1·6 × 1·1	1·8	·85

TABLE IV.—Dimensions and Proportions of Astragalus.

	Length (a.p.d.).	Breadth (tr.d.).	Height (v.d.).	Tibial facet.	Scaphoid facet.	Peroneal facet.	Outer calcaneal facet.	Inner calcaneal facet.	Proportion of a.p.d. to tr.d. of bone.	Proportionate v.d.	Proportion of a.p.d. of tibial facet to its tr.d.	Proportion of v.d. of scaphoid facet to its tr.d.	Proportion of tr.d. of scaphoid facet to total tr.d. of bone.	Radii of curves of scaphoid facet.
E. indicus (Chuny)	5·1	6·0	..	......	4·0 ×	... ..	......	......	·850	..	..	..	·666	1·8 & 5·5
,, (Sumatran)	3·4	3·9	2·4	3·1 × 2·6	2·9 × 1·8	2·5 × 1·5	2·9 × 1·6	2·2 × 1·8	·871	·615	·733	·620	·743	1·8 & 5·5
,, (2707, R.C.S.)	4·3	4·9	2·8	3·7 × 3·3	3·4 × 2·1	2·6 × 1·3	3·5 × 2·2	2·7 × 1·4	·871	·573	·891	·610	·696	2·0 & 3·0
,, (young) B.M.	3·0	3·5	2·1	2·8 × 2·1	2·7 × 1·8	2·0 × 1·1	2·5 × 1·6	1·6 × ·75	·856	·600	·750	·648	·770	......
E. africanus, B.M.	4·6	5·2	3·1	4·0 × 3·7	4·2 × 2·5	3·5 × 1·8	3·0 × 2·5	3·0 × 2·7	·884	·596	·900	·602	·740	2·5 & 3·5
E. melitensis	2·7	3·1	2·0	2·4 × 2·2	3·0 × 1·9	1·9 × 1·1	1·8 × 1·4	2·1 × 1·0	·870	·645	·912	·633	·967	1·7 & 1·5
E. falconeri	1·9	2·2	1·4	1·7 × 1·6	2·1 × 1·0	1·4 × ·6	1·4 × ·8	1·5 × ·65	·863	·636	·941	·500	·954	1 0 & 1·5
E. ,, (?)	1·8	2·1	1·2	1·7 × 1·4	1·9 × ·95	......	......	1·4 × ·70	·857	·571	·874	·500	·904	1·0 & 2·3

TABLE V.—The Principal Measurements of the Humerus and Femur, as affording data for computing the Height and Proportion of Elephants.

To face page 306.

	Humerus.																Femur.														Height of Animal.						
																															According to Cuvier's data		According to Chuny R.C.S.		According to Ceylon Elephant, B.M.		
	Length	Length of head	Trd. of head and tuberosity	A.p.d. of tuberosity	A.p.d. of tuberosity and head	Least trd. of shaft	A.p.d. at the same point	Circumference at the same point	Trd. at the junction of distal epiphysis	Trd. of condyles	A.p.d. of inner condyle	A.p.d. of outer condyle	A.p.d. at middle of trochlea	Length of the supinator ridge	Radius of longitudinal arc of head	Radius of transverse arc	Length	Diameter of head	Least trd. of shaft	A.p.d. at the same point	Least circumference	Trd. of head with trochanter	Trd. at the line of lower epiphysis	Trd. of condyles	A.p.d. of inner condyle	A.p.d. of outer condyle	Length of shaft between epiphyses in young bone	A.p.d. at lower epiphysial surface	Trd. at the level of the lowest point of upper epiphysis	A.p.d. at the same level	From femur	From humerus	From femur	From humerus	From femur	From humerus	Absolute or mean computed height
E. indicus (Chuny)	35·0	8·0	10·1	8·6	12·0	3·0	6·0	15·0	11·0	8·2	6·3	5·5	4·0	12·0			42	6·1	4·7	3·1	12·1	13·0	9·0	8·1	8·6	7·8					•119	•115	103	103	•92	•96	103
,, 2744 E, R.C.S.	35·0	7·9	10·4	9·8	11·0	3·9	6·0	17·0	11·2	8·5	6·3	5·7		12·0	4·1	4·3	43	6·0	5·1	3·8	14·3	13·0	9·1	7·9	8·6	7·8					•120	•115	•105	•103	•95	•96	•105
,, ,, (Cuvier)	32·8	7·3			9·7	4·0				9·3							38·6	5·1	4·7												108	108	•95	•96	•85	•90	108
,, ,, Ceylon, B.M.	31·0	6·5	7·9		8·2	2·6	4·4	11·5	9·0	7·3				11·5			38·5	5·0	3·75	2·7	10·6	11·0	7·9	7·0	7·2	6·2					•107	•104	•94	•91	85	85	85
,, ,, Sumatran, B.M.	27·8	5·2	6·9	6·8		2·3	3·6	10·0	7·2	5·4				10·0	2·6	2·4	33·7	4·1	3·2	2·3	8·9	9·0	5·9	5·0	5·7	5·1					•94	•91	•81	•81	•74	•76	•83
,, ,, (young) 2723 C.S.	16·1	3·6	4·0	3·2		1·4	2·2	5·9	5·1	4·7	2·5	2·4			1·9	1·9																					•50?
,, ,, (young) B.M.	20·8	4·5	5·0			1·7	2·8	7·3	6·2	5·6	3·1	3·2		7·5					2·2	1·8	6·6		5·4				27·5	4·0	4·7	1·9	•56	•68	•55	•61		•57	•60
E. africanus, B.M.	35·5	7·9	9·2	9·3	11·0	3·3	4·9	13·1		7·8	5·6	4·8		12·0	4·0	4·4	42·5	6·0	4·2	3·1	11·9	13·1	8·3	8·0	8·4	6·9					•119	•116	•103	•103	•93	•97	•107
E. Malta (large)	•27														2·8	2·7	•33																				•80–85
E. melitensis, fig. 22	•16–17	3·5	3·4	3·7	4·5										1·8	1·5	•20														•56	•53	•49	•48	•44	•45	•50–55
,, ,, fig. 6	•15–16																•18–20		1·9	1·5	5·5										•56		•46		•44		•50–55
E. falconeri, figs. 26, 27	•10–12	•2·2															•13	•1·8													•36	•36	•32	•32	•29	•30	•30–36
,, ,, fig. 30	•10–12					1·0	1·5	4·1		2·5	1·8	1·4	1·2	3·2			•12–13	1·3	0·9	3·5	2·3						9·5	1·8	2·2	0·92							
E. primigenius, B.M.	32·0	7·3		9·6	10·3	4·3		13·6	9·5	8·1	5·9	5·2	3·9	12·0			•38																				•100–110

N.B. The numbers marked with an • are computed, the others taken from direct measurement. They indicate inches.

Size.	P.	T.	A pd.	Size.	P.	T.	A pd.	Size.	P.	T.	A pd.	Size.	P.	T.	A pd.	Size.	P.	T.	A pd.	Size.	P.	T.	A pd.	Size.	P.	T.
5·2×1·5	12	2	·40		13	1		6·3×2·1	12	2	·48	6·8×2·0	12	2	·52	8·5×		.	.	9·5×3·0	16	2	·55	13·5×3·2	24	
4·5×1·5	12	1	·48	4·4×1·3	12	1	·65	6·8×2·4	12	2	·52	7·8×	12	2	·60	7·5×3·0	16	2	·44	9·0×3·2	16	2	·52	12·0×3·0	22	
4·7×1·9	11	2	·40	5·3×1·7	12	2	·40	7·0×2·5	12	2	·53	7·5×2·4				8·8×3·0	16 17	1	·56	9·5×	16	2	·55			
				5·3×1·9	12	1	·41	6·8×2·5	12	2	·52									11·0×3·1	16		·66			
				5·2×1·6	13		·40	6·4×2·5	12	2	·49	6·4×2·1	14	1	·45	. .		..		8·4×2·9	13	1	·60			
				5·1×1·7	13	1	·40	6·0×2·0	14	1	·42	5·7×2·0	14		·48											
								5·4×2·15	13		·42	6·3×1·9	14	2	·47											
4·8×1·8	7	1	·75	5·2×1·7				5·7×2·0	9	1	·63	6·0×2·0	9	1	·71	6·3×2·9	6	1	1·0	7·0×2·1	7	1	1·0	8·5×2·9	9	
								6·7×2·5	9	1	·74	6·5×2·2	8	2	·71	7·2×2·3	8	1	1·0	5·8×2·8	7	1	·83	9·3×3·1	8	1
								6·6×2·2	9	1	·74	6·8×2·0	9	2	·75	8·0×2·9	8	2	1·04	7·5×2·7	9	1	·83	11·0×	10	1
								6·3×2·0	9	2	·75	6·4×2·0	9	1	·71	7·8×2·7	8	2	1·03	7·1×2·0	9	..	·78	3·4	..	
												6·8×2·8	7	2	·80									5·5×2·7	5	
5·0×2·0	9	2	[illegible]					6·7×2·5	11	1	·6[illegible]					8·3×2·4	12	2	·63	8·2×2·4	12	2	·63	10·8×3·0	16	1
4·7×1·8	10	2	·62													8·0×2·4	12	2	·61	9·3×2·6	13	1 2	·66			
5·3×2·1	[illegible]	2	·4[illegible]																							
[illegible]4×1·8	[illegible]	2	[illegible]	4·6×1·8	12	2	[illegible]	[illegible]×2·8	12	2	[illegible]	5·1×2·0	13		[illegible]	8·0×3·0	[illegible]	2	·47					12·0×4·0	26	
3·7×2·0	[illegible]	2	[illegible]	3·9×1·7	12		·42					5·3×2·3	12	2	[illegible]	8·0×3·2	16	2	·47							
3·3×1·8	11	1	[illegible]	3·7×1·5	12	2	[illegible]					5·2×2·4				6·7×3·3	16	2	·39							
4·0×2·0	11	2	[illegible]	4·2×2·0	11	2	[illegible]					5·1×2·3	12	2	[illegible]											
4·3×2·2	11	2	[illegible]	4·4×	13	1	[illegible]																			
[illegible]7×1·5	[illegible]	2	[illegible]																							
4·6×1·8	8	2	·51	[illegible]×1·0	8	2	·51	[illegible]2×2·4	9	2	·62	5·5×2·6	8	2	·62	9·0×4·6	9	2	·90	7·8×3·3	10	1	·80	11·0×4·3	13	2
4·7×[illegible]	8	2	·52	4·7×1·8	8	2	[illegible]	6·[illegible]	8	9	·72	6·4×2·4	8	2	·71	8·8×3·5	10	1	·88					9·6×3·6	12	1
	7	2		[illegible]×2·0	8		[illegible]					5·3×2·3	8	2	·61							..		6·6×3·5	12	1
												5·5×2·7	8	1	[illegible]											
				2·2×·75	8	2	·24	1·4×1	[illegible]		·27															
								2·9×1·1	8	2	·27															
								3·0×1·3	[illegible]	2	[illegible]															

Explanation of Letters &c.

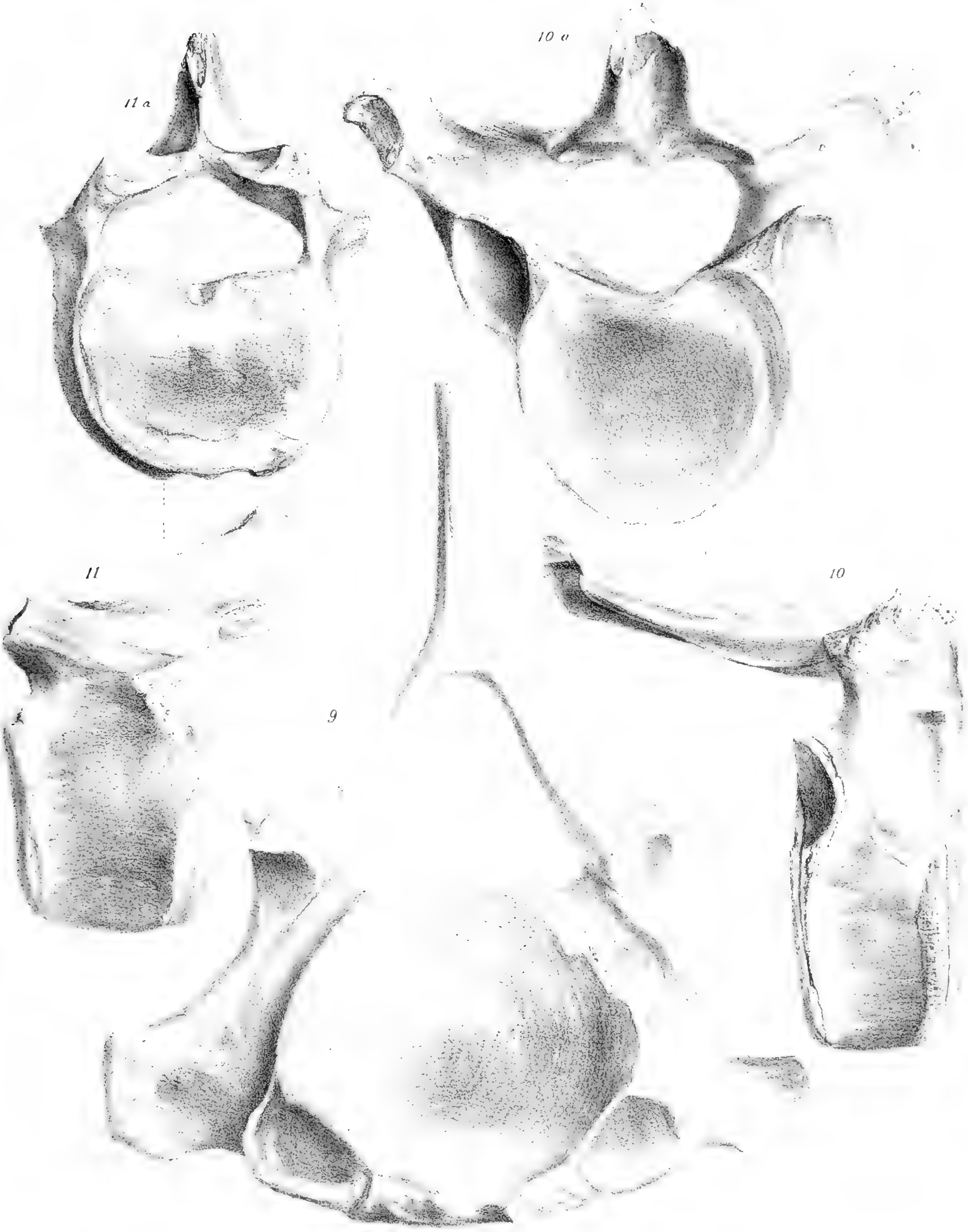
P. Pulps. A. [illegible] Upper jaw. Lower jaw. Right side. Left side. The numbers connected by bracket-lines refer to teeth belonging to the same individual.

J Erxleben. del et lith

M & N Hanhart imp

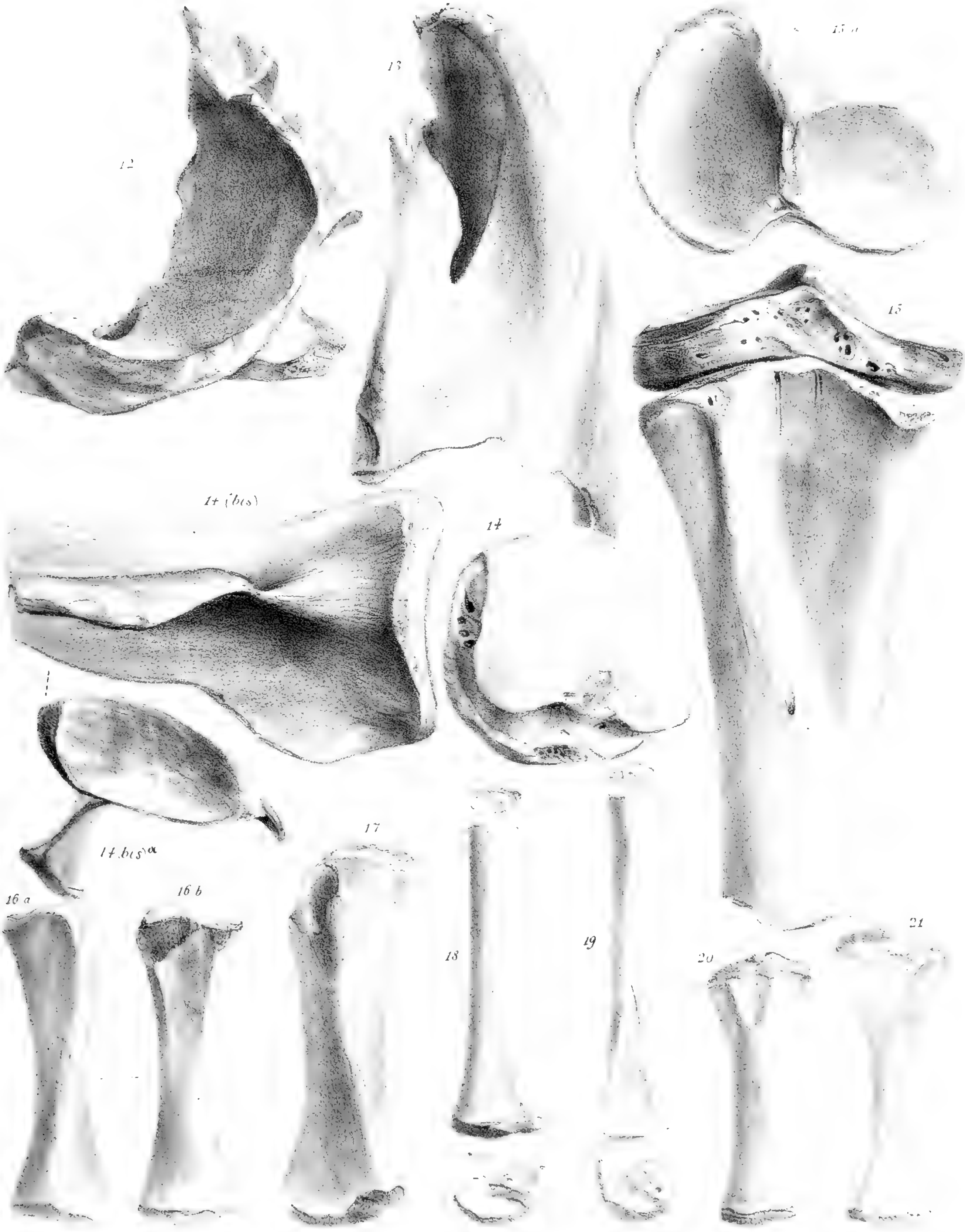
J. Erxleben del. et lith.

M & N Hanhart imp.



J Erxleben del et lith

M&N Hanhart imp



J. Erxleben del et lith

A. & N. Hanhart imp

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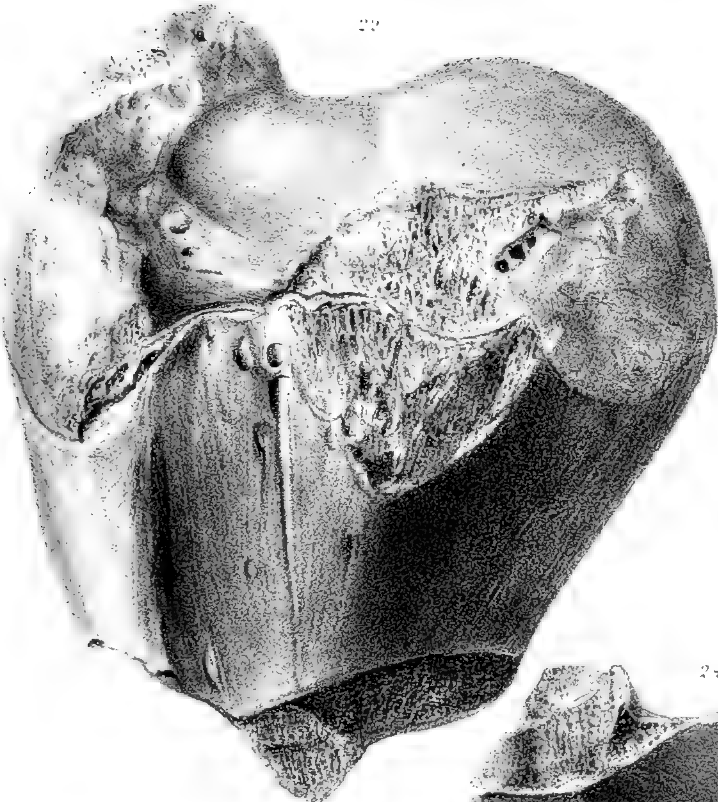

23

24 a

23 a

24

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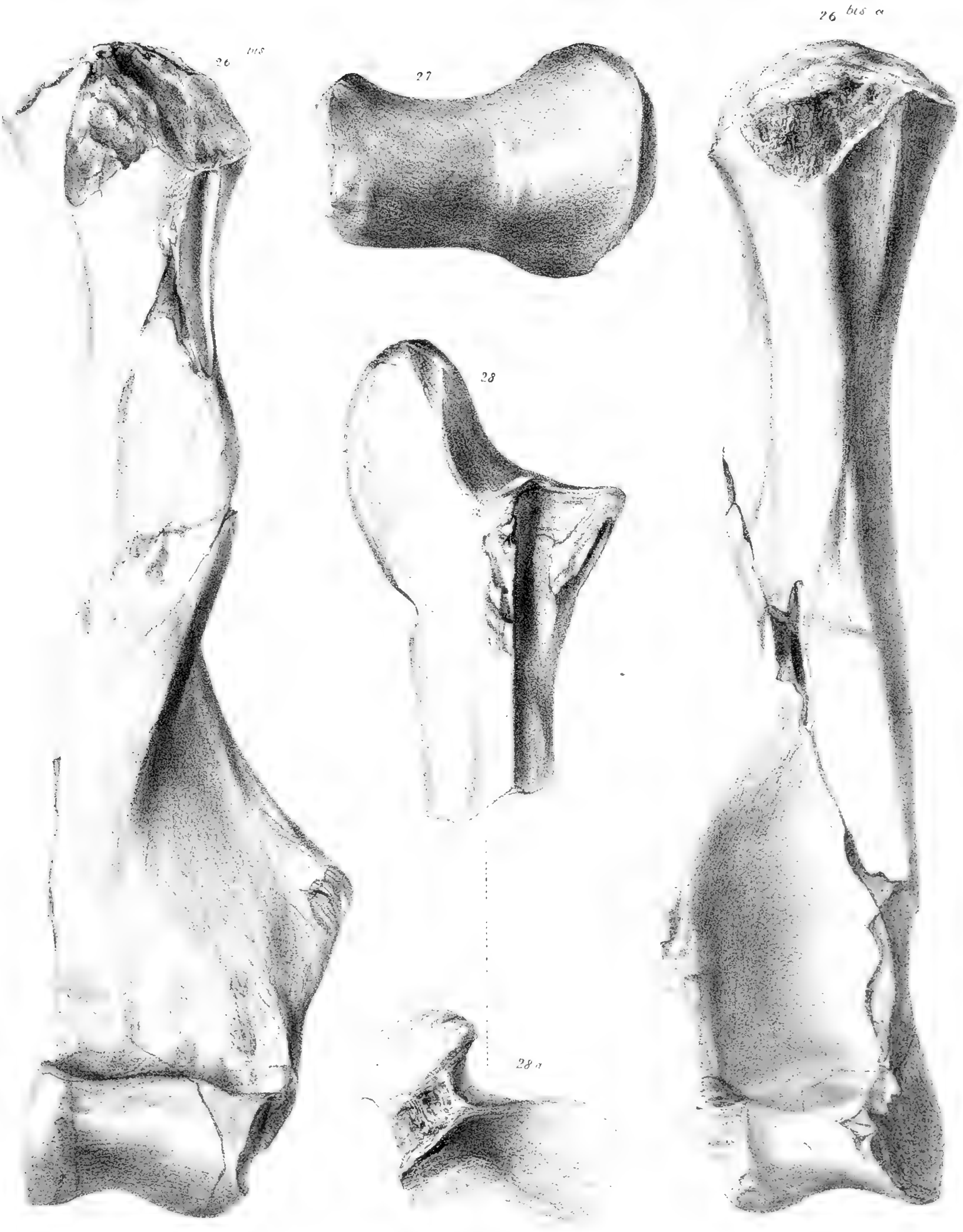
I. Erxleben del. et lith.

M & N

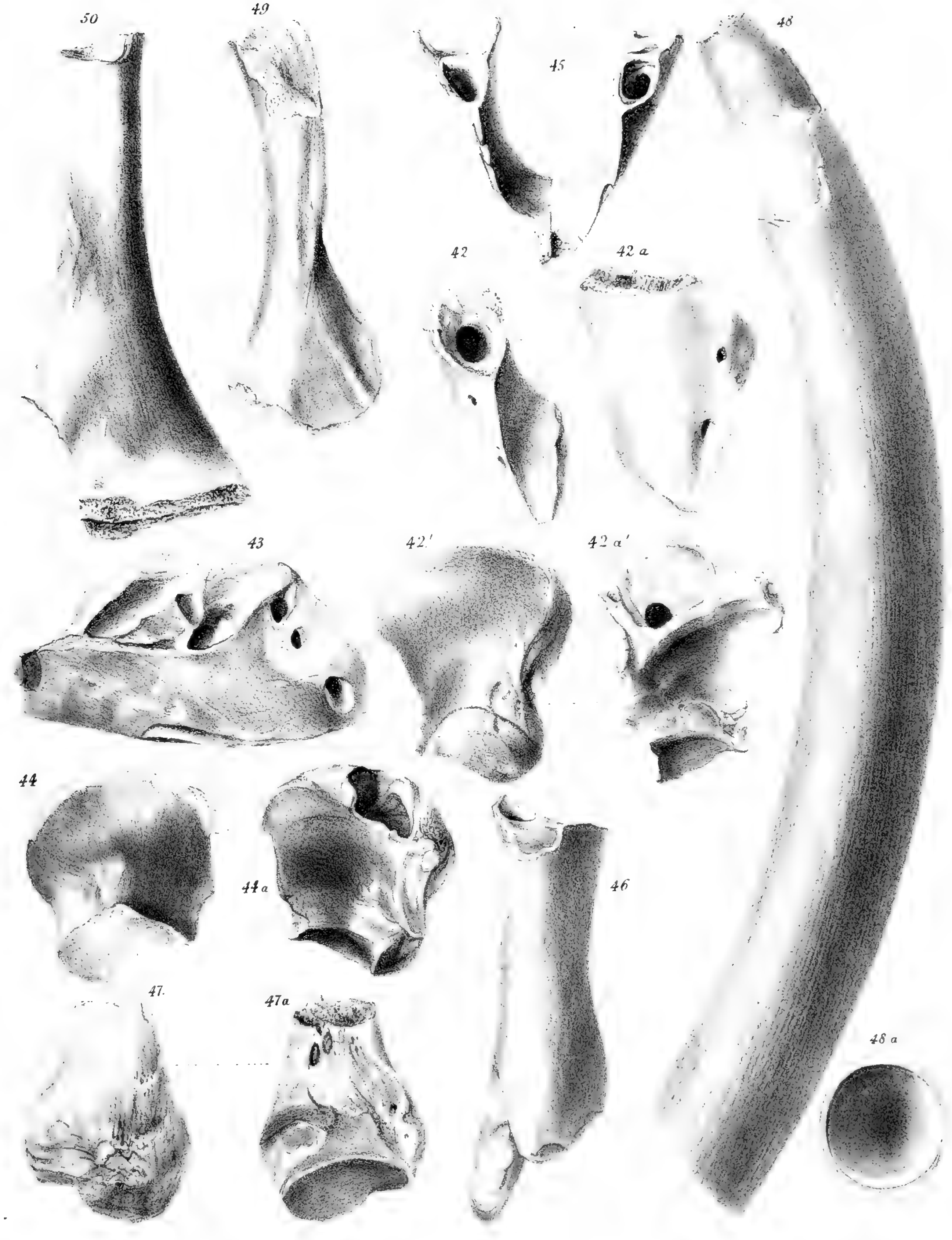


From nat. on Stone by J. Erxleben

M & N Hanhart imp.

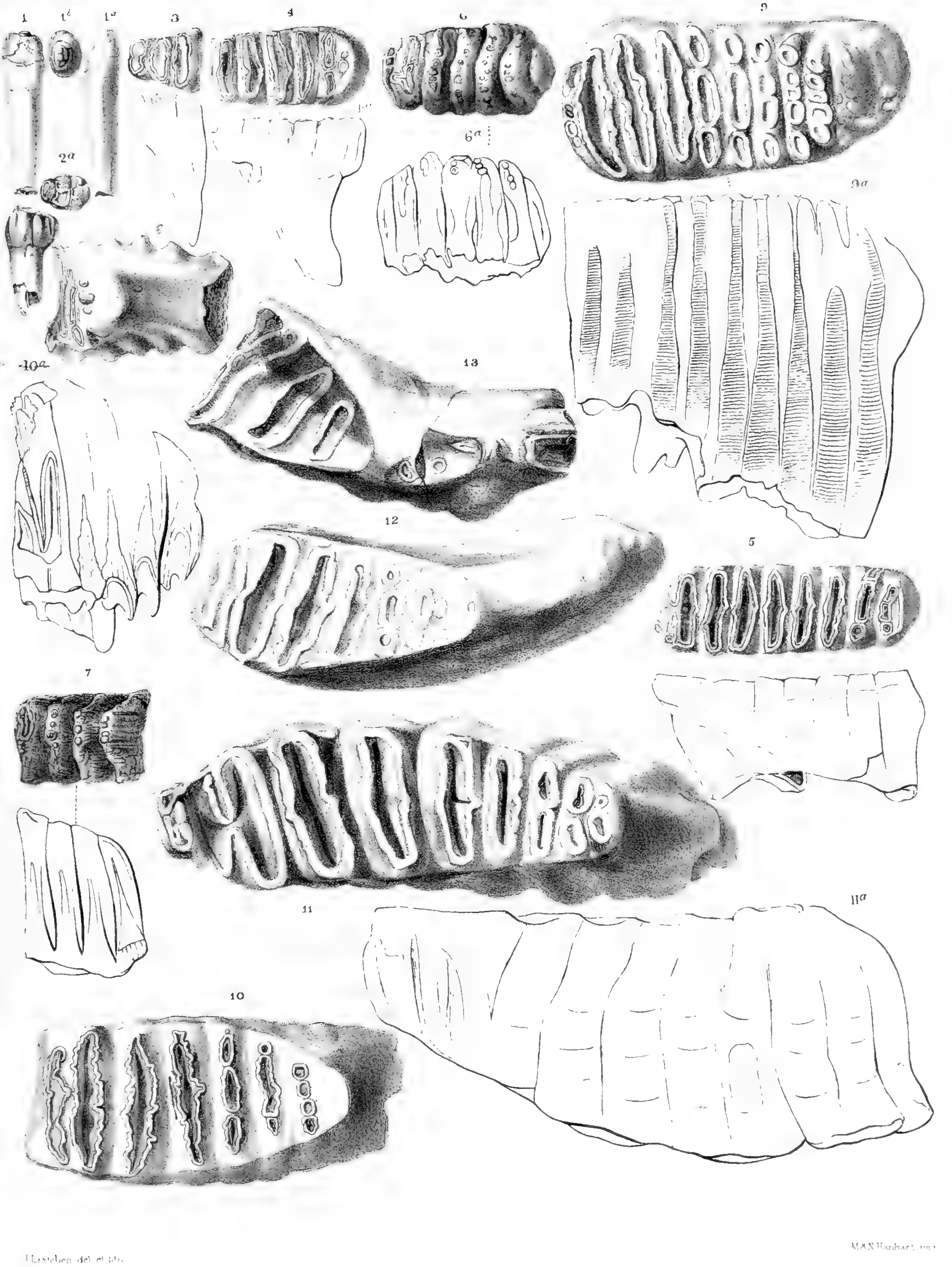
Erxleben del. et lit.

From life on Stone by J Erxleben



J. Erxleben del et lith

M & N Hanhart imp



J. Erxleben del. et lith.

M&N Hanhart imp.

XI. *On a Species of Dormouse* (Myoxus) *occurring in the Fossil state in Malta.*

By A. Leith Adams, *M.B.*, *F.G.S.*

Read May 9th, 1867.

[Plate LIV.]

In the 'Journal of the Royal Dublin Society' for November 1861, I figured the dental aspect of this Dormouse, which I have proposed to call *Myoxus melitensis*. But as the figures there given do not fully indicate the characters of the animal, I have deemed it requisite to furnish the following further illustrations, taken from the numerous specimens that have since come under my notice. The contour of the cranium, the relatively small size of the anterior and posterior molars compared with the intermediate ones (which are about as long as they are broad on the crowns, the bold *machærides* presenting well-defined, undulating ridges), and the absence of the small grinder in the upper jaw separate it from the *Sciurina*, and assimilate it to the subfamily *Myoxina*, whilst its large proportions represent a species distinct from any other known *Myoxus*, recent or fossil.

Among the abundant remains discovered by me in the caves, fissures, and alluvial deposits of Malta were several lower jaws comparatively more slender, and presenting a more marked concavity on the lower border, whilst they did not seem to differ in any other respect from the others (see *op. cit.* plate 2. fig. 11). To the form to which these belong I have given the name of *Myoxus cartei*; it may be doubtful, however, whether the above characters are really sufficient to create a distinct species from the other, which I have named *Myoxus melitensis*.

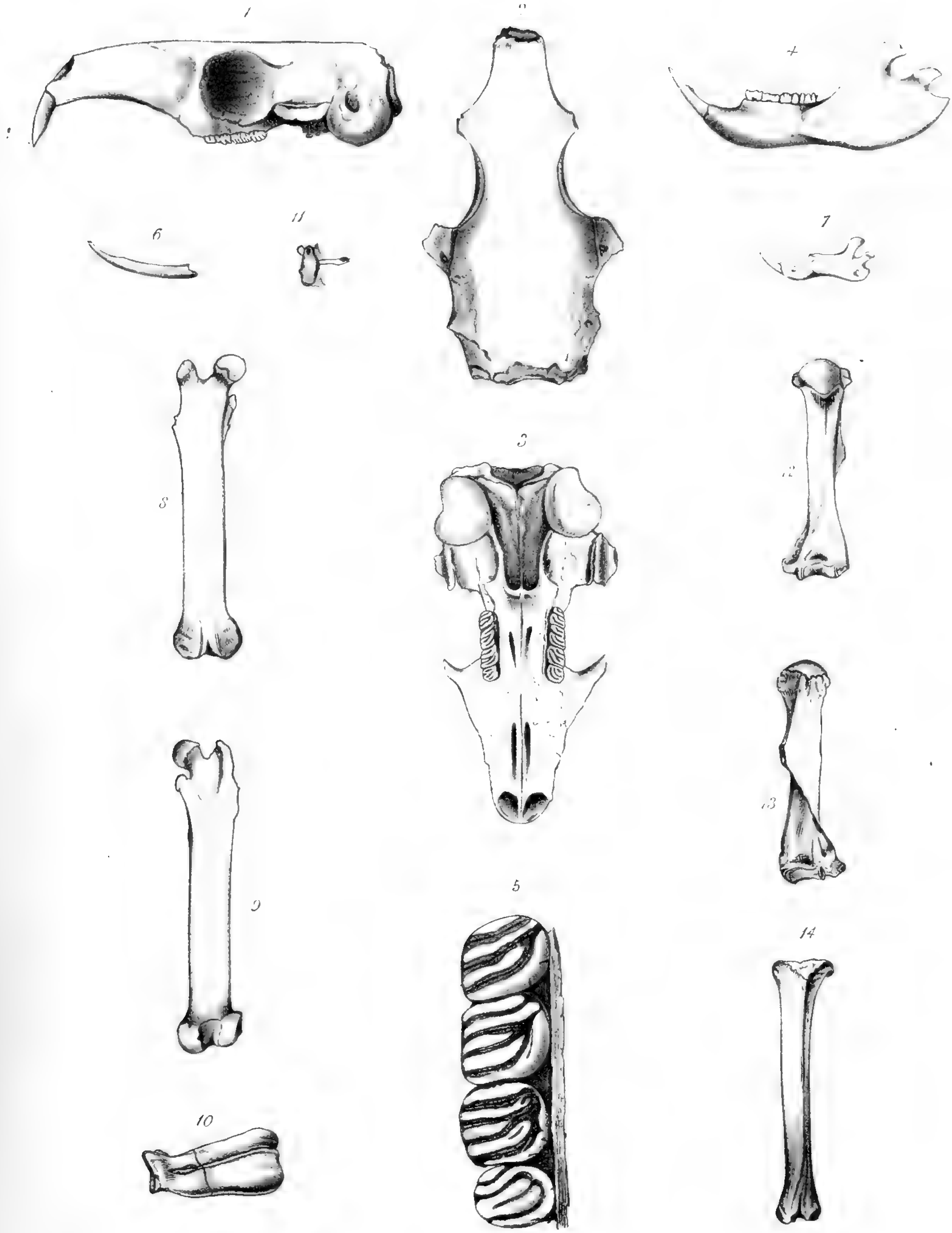
This Rodent seems to have existed in enormous numbers, inasmuch as its remains are met with in abundance throughout the cavern- and fissure-deposits, up even to the superficial alluvium now in course of formation, so as almost to indicate that the animal may have outlived many, if not all, of the other quadrupeds &c. with which its remains are so frequently associated.

The Reports on the Maltese Caves, read at the Meetings of the British Association in 1865 and 1866, together with my other communications on the fossil fauna of the Maltese fissures and alluvial deposits, give full particulars with reference to the localities and mode of occurrence of this and the other members of the fossil fauna. One point comes out clearly in the stratigraphical distribution of the remains of *Myoxus melitensis*, viz. that the animal lived and died in the caverns of Malta; whilst at the same time, from the exceedingly large numbers found strewing the lower portion of the fossiliferous deposit of the Mnaidra-gap, there is evidence of a wholesale destruction of this animal at all stages of its existence, from the unborn to the aged. And from the circumstance that the same conditions are found to obtain with the associated Elephantine remains, it may be concluded that the destruction of both was due to something more than the ordinary process of decay. Again, the very fragmentary condition of the bones found in the stalagmitic deposits of the Malak cave seems to indicate that they had been introduced into it by carnivorous mammals or birds.

EXPLANATION OF PLATE LIV.

Fig. 1. Side view of the skull of *Myoxus melitensis.*
Fig. 2. Coronal view of the skull of the same individual.
Fig. 3. Base of skull.
Fig. 4. Lower jaw of the same individual.
Fig. 5. Molars of upper jaw, magnified to four times the natural size.
Fig. 6. Incisor.
Fig. 7. Lower jaw of a young individual, the molars just appearing.
Figs. 8, 9. Humerus.
Fig. 10. Scapula.
Fig. 11. Articulating surface.
Figs. 12, 13. Femur.
Fig. 14. Tibia.

N.B. Except in fig. 5 all the parts are represented of the natural size.



L. A. ad nat. del

x 4 Diam

M & N Hanhart lith

MYOXUS MELITENSIS.

XII. *On the Osteology of the Cachalot or Sperm-Whale* (Physeter macrocephalus).

By WILLIAM HENRY FLOWER, *F.R.S., F.R.C.S., F.L.S., F.G.S., F.Z.S., Conservator of the Museum of the Royal College of Surgeons of England.*

Read November 14th, 1867.

[PLATES LV. to LXI.]

Introduction.

OUR present knowledge of the osteology of the Cachalots is derived from the following sources:—

1. Cuvier, in the 'Recherches sur les Ossemens Fossiles,' has given a description, clear and pointed, but brief, of an imperfect skeleton, bought by him in London in 1818, and still preserved in the Museum of the Jardin des Plantes. Figures on a very small scale are given of the cranium and lower jaw, of the scapula, humerus, radius and ulna, and of some of the vertebræ. The locality from which the animal was originally obtained is not stated. As will be presently shown, the skeleton presents certain peculiarities, especially in the number of the ribs and vertebræ, by which it differs from all others known.

In the same classical work, portions of the lower jaw of three other individuals contained in the Paris Museum are figured and described.

2. In the valuable posthumous work of Peter Camper, 'Observations Anatomiques sur la Structure intérieure et le Squelette de plusieurs espèces de Cétacés,' Paris, 1820, is a tolerably full description, and some very sketchy figures, of a mutilated cranium preserved in the church at Scheveningen, in Holland; and there are also some observations upon, and a figure of, another cranium, in the Paris Museum, taken from one of the individuals cast ashore near Audierne, in Brittany, in 1784. The tympanic and petrous bones, as well as the *ossicula auditûs*, are figured in considerable detail; and drawings are also given of the scapula and arm-bones, and of the atlas. The latter (from a specimen in the British Museum) is erroneously attributed to a *Balæna*, while the consolidated mass of cervical vertebræ of a whale of this genus is described as that of a Cachalot.

3. Lacépède ('Histoire Naturelle des Cétacés,' Paris, 1804) has given a figure of the skull of the Audierne Cachalot in the Paris Museum, also of one of the ribs and some vertebræ.

4. Beale ('Natural History of the Sperm-Whale,' London, 1839) has given a general description, unaccompanied by figures, of the skeleton of a full-grown Sperm-Whale, mounted in the Park at Burton Constable, near Hull. Certain errors in the articulation of the skeleton, particularly of the hyoid bones, sternum, pelvis, and carpus, not detected by Beale, necessarily introduced confusion into his description of these parts.

ERRATUM.

Vol. VI. p. 369, line 18, for "*rostro*" read "*cervice.*"

5. In a small octavo work, entitled "History and Description of the Skeleton of a New Sperm-Whale lately set up in the Australian Museum, by William S. Wall, Curator," &c., Sydney, 1851, the description, although defective in many respects, is on the whole the most complete yet published, as the skeleton which is the subject of it, although very young, was in a tolerably perfect state. The memoir is accompanied by a rudely executed drawing, on a small scale, of the entire skeleton, and also of the sternum, hyoid, and pelvic bones*.

6. In the 'Descriptive Catalogue of the Osteological Series of the Museum of the Royal College of Surgeons' (1853), Professor Owen has given a somewhat detailed account of the form and relations of the cranial bones in a very instructive skull of a fœtal Cachalot contained in that collection.

7. A woodcut figure of the same skull has been given by Professor Huxley in his 'Elements of Comparative Anatomy,' 1864.

8. The petrotympanic bones of a Cachalot from the same Museum are figured in Owen's 'British Fossil Mammals.'

9. Dr. Gray (Proc. Zool. Soc. 1864, p. 590, and 1865, p. 440) has given figures, taken from photographs, of the cervical vertebræ of two Cachalots in the Museum at Sydney, which he regards as belonging to distinct species.

Numerous as the above-noticed works may appear, the information contained in them is but fragmentary, and very much still remains to be done before our knowledge of the osteological characters of this huge and strangely modified Mammal can be said to be placed on the footing which its interest ought to secure for it.

In the present communication it is my intention,—

I. To give a description, accompanied by detailed drawings, of the nearly perfect skeleton of an adolescent male Cachalot, which was taken in the latter part of the year 1864 off the south-west coast of Tasmania, and the bones of which were prepared with great care and at considerable trouble and expense by W. L. Crowther, Esq., M.R.C.S.E., of Hobart Town, and by him presented to the Museum of the Royal College of Surgeons.

II. To compare this skeleton with other skeletons or parts of skeletons which are available for the purpose. As materials for this portion of the work I may especially mention:—

a. Various portions of the skeletons of Cachalots from the Tasmanian seas, also presented to the Museum of the College of Surgeons by Mr. Crowther, comprising the

* It is stated by Dr. G. Bennett (Gatherings of a Naturalist, 1860, p. 162) that the real author of this work was the late William Sharpe Macleay. But as there is no indication of this in the work itself, as Wall's name alone appears on the titlepage, and as he has been allowed by Macleay to identify himself with the author of the book, especially when speaking in the first person of acts connected with the preparation of the skeleton (see pp. 4, 5, &c.), which Dr. Bennett himself attributes to Wall, I shall always quote it under the latter name only. Some authors have, without any explanation, quoted this work as "Macleay's"—a practice which must necessarily introduce confusion into cetological literature.

complete skull of a very young animal, four lower jaws of adults, four perfect pectoral limbs, some caudal vertebræ, and several detached pelvic and petro-tympanic bones.

b. The nearly complete skeleton of an adult male Cachalot from the north of Scotland, now in the British Museum.

c. The skeleton of an adult male Cachalot preserved at Burton Constable, in Yorkshire.

d. The very imperfect skeleton at the Jardin des Plantes, Paris.

e. The fœtal skull in the Museum of the Royal College of Surgeons, which was purchased in 1844 of a dealer. Unfortunately the locality whence it was obtained is not recorded.

f. A disarticulated skull, about the same size as the last, in the Museum of St. Bartholomew's Hospital.

III. To compare the osteological characters of the Cachalots with those of other allied Cetaceans, in the hope of furnishing additional evidence as to their zoological position in the order.

IV. To endeavour to ascertain whether the osteological characters furnish indications of more than one species of Cachalot, and, if so, to establish diagnostic characters. Not to prejudge this question, I shall for the present avoid using any specific scientific designation, but speak of the different skeletons compared, according to the localities from which they were obtained.

A few notes upon the history, general characters, and condition of these skeletons will be useful before entering into details.

1. The Tasmanian specimen. As before stated, this was captured off the coast of Tasmania in the year 1864. The animal was considered a full-sized male, and said to have measured 60 feet in length. It was towed ashore, and the skeleton prepared under Mr. Crowther's directions. It is perfect, with the exception of one of the pelvic bones, four of the chevron bones, and a few of the terminal phalanges. The condition of ossification shows that it is not quite adult: the epiphyses are still loose on the upper end of the humerus, and on all the dorsal and lumbar, as well as the anterior eleven caudal vertebræ; beyond this they are united to the bodies. The vertebral formula is C. 7. D. 11. L. 8. C. 24=50, the vertebra which bears the anterior pair of chevron bones at its hinder end being reckoned as the first caudal. The length of the vertebral column when the vertebræ were placed close together, and in a straight line, was 30′ 4″. The cranium measures 16′ 9″ in length. The entire length of the skeleton as articulated is 50′ 1″, three feet having been allowed for the intervertebral spaces*. There are eleven

* Perhaps more should have been allowed; for by measuring the vertebral column of an adult Porpoise, in the recent state, and again after maceration, I find that the length of the whole of the vertebral bodies placed close together is to the recent column, with the intervertebral substances, as 100 to 115. Assuming that the relation is the same in the Cachalot, the recent vertebral column of the animal described above would be 34′ $10\frac{1}{2}$″, and the entire skeleton 51′ $7\frac{1}{2}$″.

pairs of ribs, the first ten fully developed, the eleventh rudimentary. The chevron bones are ten in number; but the articular surfaces on the vertebræ show that at least four are wanting. The teeth are complete, and very little worn.

2. The animal from which the next specimen was prepared was washed ashore in a much decomposed state, in July 1863, near Thurso, in the county of Caithness. The skeleton was presented by Captain Macdonald, upon whose property it was stranded, to the British Museum; and I am indebted to the kindness of the Keeper of the Zoological Department of that institution, Dr. Gray, for the opportunity of making a close examination of it while undergoing the process of preparation necessary to fit it for exhibition. This was also a male. The condition of the bones shows it to be quite aged: the epiphyses of all the vertebræ are firmly united to the bodies, and so is the head of the humerus to the shaft; the teeth are very much worn down. The skeleton is unfortunately far from being perfect. The cranium has been much injured, most of the teeth lost; several of the posterior caudal vertebræ, the hyoid bones, the pelvic bones, and many of the phalanges are missing. The vertebral formula is C. 7. D. 11. L. 8. C. 21+? The length of the column, the bones being placed close together, is 28′ 7″; the cranium is about 17′ 9″ (the ends of the præmaxillæ being broken, it cannot be measured exactly); so that, allowing for the terminal caudal vertebræ, the skeleton may be estimated at 47′ without the intervertebral spaces, or rather more than 50′ with them. The ribs, as in the former specimen, are ten well-developed pairs, and one rudimentary pair—that is, $13\frac{1}{2}''$ and $12\frac{1}{2}''$ long respectively, and nearly straight, having, apparently, been attached to the ends of the transverse processes of the eleventh dorsal vertebra. There are twelve chevron bones, the first ankylosed to its corresponding vertebra. I shall speak of this as the Caithness skeleton.

3. The Yorkshire skeleton, as it may be conveniently termed, was prepared from an animal stranded in 1825, at Tunstall, in the Holderness, and which fortunately, while still entire, came under the observation of Dr. Alderson, then residing in Hull, who has given a figure and description of its external characters, with some anatomical notes, in the 'Cambridge Philosophical Transactions' for the same year. No less fortunately for science, Sir Clifford Constable, Bart., in his capacity of "Lord Paramount of the Seigniories of Holderness," claimed the body of the animal, and had the skeleton prepared and mounted in his park at Burton Constable. With his kind permission I had the opportunity in June 1866 of making a careful examination, with measurements and drawings, of this specimen. Like the last, it is a perfectly adult male: the epiphyses of all the bodies of the vertebræ are united, only slight traces of the original separation still remaining in the anterior lumbar region; and there is only a slight indication of the original epiphysial condition of the head of the humerus. The vertebral formula is C. 7. D. 11. L. 8. C. 23=49. The total length of the skeleton is 48′ 4″, the vertebral bodies being placed close together; of this, the head occupies 18′ 11″. Ten pairs of ribs are present; but the vertebra which I have reckoned as the

eleventh dorsal, appears, from the condition of its transverse process, to have carried a rudimentary rib. The body of the hyoid bone, composed of three pieces, is present; but the basihyal is articulated to the posterior end of the sternum, and the two thyro-hyals, joined together, form a sort of pelvis. I mention these circumstances, as a knowledge of them will clear up some of the difficulties in Beale's description of this skeleton. The stylo-hyals are absent; but the bone which Beale took for an os penis was evidently one of them. The true pelvic bones are absent. There are ten chevron bones present. The carpus and phalanges are nearly complete on both sides, but incorrectly articulated. The teeth have all been removed and are replaced by wooden models. Notwithstanding these defects, it is a noble-looking specimen; and it would be a matter of great regret if it should become still further deteriorated by a long continuance of the exposure to all weathers to which it is now subjected. I cannot forbear mentioning as a curious incident connected with it, that at the time of my visit a Starling had formed her nest and was rearing her young brood in the cavity (certainly now most convenient for her purpose, but) which once contained the brain of this monster of the deep.

4. In the courtyard of the Anatomical Museum at the Jardin des Plantes, at Paris, is the decayed wreck of the Cachalot's skeleton mentioned by Cuvier as having been bought in London in 1818 *, and which furnished what for many years was the standard and, indeed, only description of the osteology of the animal extant. Yet this skeleton presents peculiarities in the number of the ribs and vertebræ, which separate it at once from all the preceding. While they, as well as the skeleton in the Sydney Museum described by Wall, all agree in having but ten pairs of well-developed ribs, the Paris specimen has fourteen, besides indications of a rudimentary fifteenth; and while in none of the others does the total number of vertebræ exceed fifty, this one has sixty, and still wants the terminal portion of the tail. Notwithstanding these differences, greater than are to be found in many animals generically separated, in general character the cranium, vertebræ, ribs, and other bones closely resemble those of the three former skeletons—so much so that one cannot avoid the suspicion that the specimen has been made up of the bones of more than one individual. On account of this circumstance, as well as its very imperfect condition (the hyoids, sternum, hands, pelvic bones, and terminal caudal vertebræ being absent), I have not made so much use of it in the comparisons as of the three skeletons at present in this country. It should be mentioned that the animal was adolescent: the teeth are slightly worn, the epiphyses not united to the head of the humerus, or to the majority of the vertebræ. The entire length of the skeleton as it now stands is 56′, the head being about 16′; but the tips of the premaxillaries are made of wood, and many of the epiphyses are lost from the vertebral

* This is probably the skeleton exhibited in Rackstrow's Museum, Fleet-street, described in the Catalogue (1794) as "The Astonishing and Complete SKELETON of a full-grown SPERMA-CETI WHALE, being the real bones joined together; near 70 feet in length. The Head, or Skull alone, measures 16 feet." I am indebted to Mr. Gore, of Bath, for this reference.

column, and insufficient spaces left between the bones; so that even these measurements afford but an approximative comparison.

Cranium.

In no known mammal does the cranium depart from the ordinary type to such an extent as in the Cachalot. The expansion, elongation, flattening, and distortion of many of the cranial and facial bones, met with in a certain degree in all Cetaceans, is here carried so far as to render it by no means easy, at least in the adult animal, to recognize their homologies. Comparison with the skulls of young individuals and of less-modified cetacean forms, however, clear up most of the apparent difficulties.

The size of the skull in the adult animal is larger in proportion to the remainder of the body than in any other known mammal *. As in all animals in which the great bulk of the skull is made up of the face and jaws and not of the brain-case, the relative size of the entire head increases with age, at all events up to maturity; and it is probable that the jaws continue to augment in size and weight after the growth of most other osseous structures has ceased. The relative length of the cranium to the vertebral column (the vertebræ being placed in contact) in the Sydney skeleton (according to Wall) is as 46 to 100, in the Tasmanian as 57, in the Caithness as 60, and in the Yorkshire as 67 to 100. The first is scarcely more than half-grown, the second adolescent, the last two adult.

As seen in the section, Pl. LVI. fig. 1, the cerebral cavity is of comparatively limited dimensions, being of a somewhat spherical form, with an average diameter of about 10″, and a capacity of 900 cubic inches. In front of this stretch out horizontally the enormously developed bones of the upper jaw, to which the great size of the entire skull is mainly due; while rising above it is the high, compressed, vertical, transverse wall of bone forming the great occipital crest, the posterior boundary of the enormous supracranial basin, so remarkable a feature in this singular skull.

The general form of the cranium may be compared to that of a huge pointed slipper, with a high heel-piece, and the front part trodden down. The lower surface is remarkably straight and flat, though sloping upwards at the sides. The outline, seen from above, is long and narrow, rounded behind, maintaining a tolerably uniform breadth for the posterior two-thirds of its length, and acutely pointed at the anterior extremity. The upper surface is, except quite in front, concave, the vast hollow in which the so-called "head-matter" of the whalers (composed of nearly pure spermaceti) lies being limited behind by the occipital crest, continued laterally into the elevated edges of the broadly expanded maxillæ, which rise from the median line towards the margin of the skull, instead of falling away as in most Cetaceans. The great breadth of these bones in front of the antorbital notch takes away the appearance of a distinct rostrum or beak, generally characteristic of the long-snouted dolphins.

* The skull of *Balæna mysticetus* is rather longer in proportion to the vertebral column, but it is less massive.

The absence of bilateral symmetry so generally met with in the skulls of toothed whales, is carried to its extreme in the Cachalot. It is chiefly manifested in the parts around the nasal passages. One of these orifices, the left, is immensely developed, the other reduced in a corresponding degree. But the distortion thus occasioned is not confined to the bones immediately concerned in the formation of these apertures, it affects the entire wall of the great supracranial basin, as seen in the upper view of the young skull (Pl. LVII. fig. 1).

As the individual bones of the fœtal Cachalot's skull have been described by Professor Owen *, I will confine my present account chiefly to the structure of the different regions of the cranium of the adult Tasmanian specimen, using the young skull from the same locality for illustration in cases where the ankylosed state of the former renders it impossible to make out the nature of the parts. I will also add some comparisons with the Hyperoodon, as one of the most nearly related of the ordinary toothed whales, and finally point out such differences as I have observed in the other specimens of Cachalot examined.

Commencing with the cranial cavity, as the central point around which the whole head is developed, and of which a view was afforded by a median section of the skull (see Pl. LVI. fig. 1, and woodcuts, figs. 12 and 13, p. 372), its general form is, as said before, roughly speaking, spherical, although slightly flattened on its upper anterior, and also on its lower posterior aspect. Its greatest diameter is diagonally from below upwards and backwards. The extent in this direction is best seen in the woodcut, fig. 12, as the cavity projects upwards for $1\frac{1}{2}''$ on each side of a median ridge, through which the section is made. The cerebral hemispheres must have a remarkable development in this direction, projecting considerably beyond the cerebellum, which, as its limits appear to be indicated by a rather obscure nearly horizontal ridge, would have a small proportionate development. On the other hand, the magnitude of the apertures for the principal nerves, as well as the canal for the medulla oblongata, shows that these were of great relative size. The greatest transverse diameter of the cerebral cavity is $13''$.

The planes and angles formed by the different parts of the wall of the cranial cavity are very remarkable. The lowest part is at the junction of the basioccipital with the basisphenoid. Behind this the basioccipital rises upwards at an angle of 45° from a horizontal line drawn from one end of the cranium to the other, so that the long and capacious canal in the occipital bone, leading to the foramen magnum, rises above the level of the brain-cavity. The basisphenoid is inclined slightly upwards towards its junction with the presphenoid. The concave anterior wall of the cavity formed by the united presphenoid and ethmoid is nearly vertical in its general direction. The anterior half of the roof, formed by the frontal, is straight (somewhat depressed in the young skull), and directed upwards and backwards at an angle of 45° to the horizontal line. The hinder part of the roof, formed by the occipital, arches downwards and backwards.

* Cat. Osteol. Ser. Mus. Roy. Coll. Surg. vol. ii. p. 442, 1853.

In the section of the large skull, the suture between the basisphenoid and presphenoid, and also that between the ethmoid and the frontal, are distinct; all the others are obliterated; but they can be traced more or less distinctly in the young skull.

The portions of the wall formed by the basioccipital below, and by the frontal above, are very thin, while those formed by the occipital above, and the conjoined presphenoid and ethmoid in front, are of vast thickness. The portion of the frontal divided in the section belongs to the bone of the right side, which extends somewhat over the middle line. As in the dolphins generally, the parietal forms no part of the boundary of the brain-cavity in the middle line, but is seen to form part of the lateral wall of the cavity, resting on the alisphenoid, and having the frontal in front and the occipital behind. Above, it has so completely coalesced with the occipital, that even in the young skull its limits cannot be distinguished. The bones forming the periotic capsule are completely excluded from the brain-cavity, and in the adult skull removed to a distance of 14″ from it. By the aid of the mobility of the squamosal in the young specimen, a minute portion of this bone, $\frac{1}{2}''$ by $\frac{1}{4}''$ in dimensions, can be traced in the lateral wall of the interior of the cranium, between the alisphenoid and the parietal.

The foramina at the base of the cranium are only five in number. Several of the nerves find their exit from the cavity by common canals, which divide in passing through the immense mass they have to traverse before reaching their destination.

1. An oval foramen, $\frac{1}{2}''$ in its greatest diameter, situated about 1″ from the middle line, at the junction of the frontal and ethmoid*. It leads into a canal (9″ long on the left side) which runs forwards and outwards, traversing the last-named bone, and opening into a wide fissure in the posterior part of the narial passage between the ethmoid and the vomer. On the right side, the foramen is smaller, and, owing to the conformation of the bones, the canal runs a much shorter course, opening rather behind the upper margin of the blowhole, between the frontal and the ethmoid. This would probably allow the exit of a small olfactory nerve, distributed in the simplest possible manner on the mucous membrane of the air-passage. In several dolphins there are similar channels through the ethmoid bone, though unaccompanied by any increase of extent of olfactory surface by turbinal bones as in the Whalebone-Whales.

2. The exit of the optic nerve is by a comparatively small foramen in the anterior wall of the skull, transversely oval, 1″ by ·6″, 2″ from the middle line, 3″ below the last-mentioned foramen, and about the same distance above the junction of the presphenoid with the basisphenoid. The course of the long canal to which this leads, is outwards, and slightly forwards. The distance from the wall of the brain-cavity to the upper margin of the orbit, is nearly 4 feet.

3. A large oval foramen, situated between the orbitosphenoid plate of the presphenoid and the alisphenoid, 2″ in greatest diameter, and leading into a canal which passes

* In the cast taken from the interior of the cranial cavity, figured at p. 372, this small foramen has yielded no impression. The relative size and position of the four others are well seen.

outwards and forwards. In the young skull the division of this canal into three branches takes place close to the cranial cavity. The first represents the sphenoidal fissure; the second and third, which perforate the alisphenoid, represent the foramen rotundum and foramen ovale respectively.

4. Immediately behind and rather lower than the last is a nearly circular and much smaller foramen, perforating obliquely the outer side of the basisphenoid near its union with the alisphenoid. This appears to be the carotid canal.

5. The remaining nerve-openings are collected into one, large, elongated, funnel-shaped canal, leading outwards and downwards from the side of the lowest part of the brain-cavity. At the bottom of this canal, and 14″ distant from its commencement, is placed the organ of hearing.

Upper surface of the Skull.—The general shape of this region has been already described. We may commence a more special description by taking the narial apertures as central points. The left, which extends close to the median line of the cranium, is nearly circular in outline above, having a diameter of about a foot, and is directed slightly forwards and to the left side. It contracts somewhat, and is more oval in form, below, with the long diameter fore and aft. At its narrowest part it is $7\frac{1}{4}''$ by $11\frac{1}{2}''$. Its upper margin is formed by the vomer on the inner side, the premaxillary in front and the outer side, the maxillary behind this on the outer side, and posteriorly by a rough spongy mass growing out from the left side of the ethmoid, forming a kind of operculum projecting over the narial opening (Pl. LVI. fig. 1, *e*). In the young specimen this singular mass is not fully ossified, and is therefore a much less conspicuous feature in the skull (Pl. LVI. fig. 2). Lower down, the vomer passes all round the back and nearly as far as the middle of the outer side of the passage, while the pterygoid forms the remainder of its inferior boundary. In the anterior and outer wall, a small slip of the palatal appears.

The right blow-hole is placed nearer the hinder part of the skull than the left. It is an irregularly circular canal, with an average diameter of 3″, directed upwards and backwards. The septum which divides it from the left is 3″ wide at the narrowest part.

The great semicircular wall which rises up behind the narial apertures is formed by the extremely compressed hinder portion of the maxillaries and premaxillaries, the frontals and the nasals, the whole being backed up behind and on each side by the supra-occipital, and perhaps containing some portion of the parietals concealed within. The maxillaries form the greatly thickened and sloping lateral edges of the crest. They rise to the highest part of it, but do not meet in the middle line by the space of more than a foot. Their inner edge is extremely thin. They present no special asymmetry in development. On the other hand, the premaxillaries of the two sides differ greatly: passing backwards along from the upper surface of the rostrum, where they lie on each side of the median vomerine groove, the left, turned out of its course by the great blow-hole, ends abruptly in a narrow bifid extremity on a level with the posterior margin of this passage; the right continues onwards, and, passing the blow-hole, expands into a thin broad plate, applied to the anterior surface of the frontal, and reaching to within 6″ of the summit of the crest.

On the left side, corresponding to this plate, overlying the frontal, and resting below on the top of the ethmoid, is a large, flat, very thin, loose lamina of bone (*n*). Its lower edge is thicker and rounded; but it terminates above by delicate irregular digitations. This measures 14″ in breadth, and rather more in height; but a considerable part appears to be wanting from its upper edge in the adult specimen, having probably been lost in maceration, or perhaps never completely ossified. It is more perfect in the young skull, and partially united to the frontal (see Pl. LVII. fig. 1). This I take to be the left nasal bone, as it corresponds in situation and relations with that bone in the Hyperoodon, although, in common with the other bones of the crest, it is excessively flattened out.

In none of the skulls examined could any trace of a right nasal bone be seen. Its development appears to be interfered with by the ascending plate of the premaxillary; or it is possible that it is concealed beneath this. In the fœtal skull in the Museum of the College of Surgeons, described by Owen and Huxley, the left nasal is absent; probably it was not ossified at this early age.

In front of the blow-holes the upper surface of the skull is comparatively flat, although still rising in the greater part of its extent from the centre towards the sides. This region is formed by the premaxillaries, in the shape of a pair of long narrow bands of varying width, with very sharp edges overhanging the median vomerine groove, but mainly by the greatly developed rostral portion of the maxillaries. These bones are very massive, and expand in width in front of the deeply marked antorbital notch (*a o n*). Their flat upper surface is formed of a very thin plate of bone of remarkably dense and brittle texture. Their internal structure is cancellous, the large distinct cells, almost like those of a honeycomb, being filled in the natural state with oil.

The infraorbital foramen (*i f*) is represented by a fissure 10″ in length, and 2″ in breadth, placed between the blow-hole and the antorbital notch, but nearer the latter. This gives passage to the great branches of the fifth nerve destined to supply the enormous upper lip and face.

In the right premaxillary, 15″ in front of the blow-hole, is an oval fossa, 3″ in length, leading into a canal which runs outwards, and communicates with that leading to the infraorbital foramen. There is no corresponding opening on the left side.

Lateral surface of the Skull (Pl. LV.).—The temporal fossa is very small, though scarcely so much reduced as in *Hyperoodon*. It is especially compressed from before backwards, lying deeply between the great projecting masses formed by the squamosal behind and the orbital process of the frontal in front. Above, it has not any distinct limiting ridge as in *Hyperoodon* and most Dolphins, but passes almost insensibly on to the great convex surface formed by the occipital crest. The chief peculiarity of this region is the apparent suppression of the parietal bone, the squamosal and the frontal uniting in a vertical suture for more than the lower half of the fossa, and being separated by a wedge-shaped piece (*p*) of the supraoccipital above. A faint superficial groove, more strongly marked, but still only a groove, both in the young skull and in the fœtal skull but 34″ long, indicates that this wedge-shaped piece may be really the parietal, ankylosed at a very early period to the occipital, even before the proper elements of the latter have coalesced.

The orbit is small, oval, $6\frac{1}{2}''$ high and 11″ long, with very prominent and distinct boundaries, complete, except for a space of $1\frac{1}{2}''$ behind, where it is continuous with the temporal fossa. This completeness and solidity of the margins of the orbit, especially of the lower side, is quite peculiar among Toothed Whales (*Kogia* even, not excepted), and depends upon the remarkable conformation of the jugal bone (*j*). This consists of two parts, meeting at an acute angle at the prominent rounded antorbital process. One (the body of the bone) is wedged in between the under surface of the orbital process of the frontal and the maxillary. The other is a strong process projecting freely backwards along the inferior margin of the orbit, flattened from above downwards, and gradually narrowing behind, where it articulates by an oblique surface with the underside of the end of the zygomatic process of the squamosal. This represents the styliform part of the jugal, common to the Hyperoodon and all other Toothed Whales, though widely differing from it in character.

None of the skulls examined showed any trace of a separation of the body of the jugal bone into two parts, as in *Hyperoodon* and the Ziphioids, where one of the two divisions has been taken for the representative of the lachrymal bone. It is probable that the entire bone must be considered to be composed of the malar and lachrymal coalesced, as in the ordinary Dolphins.

The orbital process of the frontal is longer and narrower than in the Dolphins generally, approaching somewhat to the form it assumes in the true Whales. The supraorbital margin is much arched, and largely uncovered by the maxillary. The postorbital process is strongly marked and pointed, and, as before indicated, does not quite come in contact with the squamosal. The antorbital process is formed by the maxillary and the jugal, being cut at its most prominent part by the horizontal suture between these bones. In front of this is the deep antorbital notch.

The side of the rostrum commences by a broad flat surface of the maxillary, a foot deep, looking outwards and upwards. The borders of this gradually approximate until, at about one-third of the length, they are united into a single sharp edge, much upturned in the middle third, but gradually flattening towards the tip. The last twenty-two inches of the rostrum is formed by the premaxillary alone.

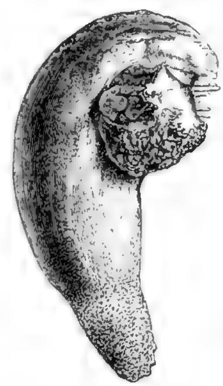
Base of the Skull.—This region is chiefly remarkable for the extent and massiveness of the pterygoids, although falling short of that in the Hyperoodon in this respect. They unite in the middle line for a space of 11″, presenting a broad flattened surface. Behind this they become thin and separate from each other, the usual notch on their posterior free margin being represented by a deep narrow fissure, of which the sides are almost in contact, except at the bottom, where it widens into a triangular space. The external surface of the pterygoid is slightly hollowed, as in *Hyperoodon* and the Ziphioids; but there is no reflexion of the margin to form an outer bony wall to the postpalatal air-sinus, as in the ordinary Dolphins.

The palate bones are largely apparent on the surface, much more than in *Hyperoodon*. The outline of the exposed surface of each is convex in front, and concave behind, where it is overlapped by the pterygoid*. The vomer is widely exposed for the whole of its length in front of the palate bones. A narrow strip of the premaxillary becomes apparent between the vomer and the maxillary near the middle of the rostrum, and gradually widens forwards.

The greater part of the under surface of the rostrum is formed by the broad, convex, triangular maxillary—generally smooth, but having a strongly marked groove (*d.g*) running longitudinally near the middle (evidently the remains of the dental groove), enlarged at intervals by the foramina for the passage of the branches of the superior maxillary nerve and artery, which supply the thick fibrous covering of the palate. It is probable that the rudimentary teeth concealed in the gum of the upper jaw, the existence of which has been repeatedly affirmed and denied, are situated in or near this groove.

Ten such teeth were sent with the present skeleton. Some of these are of hard, solid, yellow ivory; but others are white and friable, splitting into concentric layers, as if they had been calcined. They are all between 2″ and 3″ in length, and about $\frac{3}{4}$″ in diameter at the thickest part. Some are straight, but most of them are more or less curved, one forming a complete half circle. All have a distinct blunt conical crown, $\frac{1}{2}$″ long and from $\frac{3}{10}$″ to $\frac{4}{10}$″ of an inch in diameter, separated by a slight constriction from the expanded root, which constitutes the largest part of the tooth. The surface of the crown differs from that of the fang in being slightly granulated. It shows no signs of attrition; but the apex in all is roughly truncated, giving the appearance of having been broken off. The pulp-cavity is completely closed at the base of the tooth, which, in most of the specimens, is more or less surrounded by rough, irregular, spiculated outgrowths.

Fig. 1.



Rudimentary maxillary tooth, nat. size.

* A thin and narrow plate of the pterygoid, with rounded margin projecting forwards, and partially covering the palatal, both in the adult and young skull (see Pl. LVII. fig. 2), is not ossified in the fœtal skull figured in Huxley's 'Elements,' where the pterygo-palatine suture appears straight and transverse.

The bones containing the organ of hearing have been figured by Camper* and Owen†. They are remarkable for their small size, compared with that of the cranium. Not only are they much inferior to those of the true Whales, but actually less than those of the common Killer (*Orca gladiator*). In general conformation the tympanic and petrosal bones do not differ from those of other toothed Whales; their principal peculiarity is the development of a large mass of curiously laminated bone from the posterior and outer end of the tympanic, close to its attachment to the petrosal‡. This is 6″ long, and thicker at its outer than at its attached extremity. It is composed of a large number of distinct thin plates, only held together by their common attachment to the tympanic. The whole mass partly overlaps and embraces the hinder edge of the squamosal, and partly fits into a groove between the latter and the exoccipital, and serves to attach the petrotympanic much more firmly to the cranium than is the case with other Toothed Whales. It evidently corresponds to the strong tenon-like process of corresponding situation and function in the Whalebone-Whales. The contiguous edge of the squamosal has a laminated character, the ridges and grooves on its surface exactly fitting into those of the appendage to the tympanic.

The petrotympanic is, as in most Dolphins, further steadied in its place by a long, narrow, flat process, which runs out from the squamosal downwards and backwards immediately in front of it. The length of the tympanic is 2″·6, the greatest breadth of the united tympanic and petrosal is 2″·9. As might be expected, there is scarcely any appreciable difference in the size or form of these bones in the young and the adult animal.

The principal dimensions of the cranium are as follows:—

	inches.
Extreme length	201
Extreme breadth (across posterior part of orbital processes of frontals)	87
Extreme height (top of occipital crest to bottom of pterygoids)	65
Length of rostrum (from tip to line drawn across bottom of antorbital notches)	146
Width of commencement of rostrum (inside antorbital notches)	61
Width of rostrum at quarter distance from base, in straight line	58
Right maxillary	23
Left maxillary	24
Right premaxillary	5
Left premaxillary	6
Space between premaxillaries	4

* *Op. cit.* plates xxiv., xxv., and xxvi.

† Brit. Foss. Mammals, p. 526. Natural size, though stated by mistake to be half the natural size.

‡ In the specimens figured by Camper and Owen this process has been broken off.

	inches.
Width of rostrum at middle	47
Right maxillary	13
Left maxillary	13
Right premaxillary	9
Left premaxillary	9
Space between premaxillaries	2
Width of rostrum at three-quarters distance from base	21
Right maxillary	2
Left maxillary	2
Right premaxillary	8
Left premaxillary	$8\frac{3}{4}$
Space between premaxillaries	$\frac{1}{2}$
Premaxillaries extending beyond maxillaries	22
,, ,, ,, vomer	43
Antero-posterior length of orbital process of frontal	21
Length of jugal	29
Height of occipital crest above the bottom of the great supracranial basin behind ethmoid	42
Height of occipital crest above upper edge of foramen magnum	35
Width of occipital condyles	$23\frac{1}{2}$
Height of right condyle (vertical)	$14\frac{1}{2}$
Width of foramen magnum at upper end, between condyles	8

The crania of the different skeletons presented no very marked distinguishing features, beyond such as might depend upon age or individual peculiarity. Of the adult, or nearly adult specimens, those from Caithness and Tasmania are most alike, the former, however, being rather larger and, especially, higher in the occipital crest. The Yorkshire specimen differs from both in the greater development of the rostrum, which is both broader and longer than in the others: and on this chiefly depends the immense size attained by this gigantic skull; for the portion of the cranium behind the antorbital notches is of exactly the same length as in the Caithness, and but one inch longer than in the Tasmanian Cachalot.

In the following Table the individuals are arranged according to their presumed ages, judging by the entire length of the skull. By comparing the figures showing the proportions, it will be seen that, taking the length of the skull without the rostrum as the basis of comparison, there is a relative increase in all the other dimensions during growth, but that both in height and breadth, especially the former, this increase is comparatively slight and irregular, compared with the steady lengthening of the rostrum which occurs as age advances.

	Fœtal. Mus. Roy. Coll. Surg.	Young; Tasmania. Mus. Roy. Coll. Surg.	Young; Sydney. (Wall.)	Paris. (Cuvier.)	Tasmania. Mus. Roy. Coll. Surg.	Caithness. Brit. Mus.*	Yorkshire. Burton Constable.
Length of skull without rostrum ..	14″	24″	34″	57″	55″	56″	56″
Proportion	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Length of rostrum	20	38	80	139	146	156	171
Proportion	**143**	**158**	**235**	**244**	**265**	**279**	**305**
Extreme breadth	18	36	60	94	87	92	102
Proportion	**128**	**150**	**176**	**165**	**158**	**164**	**182**
Extreme height	15	26	44	66	65	70	67
Proportion	**107**	**108**	**129**	**116**	**118**	**125**	**120**

Many of the differences of the skull, dependent upon age, are well illustrated in Pl. LVI., where drawings of median sections of the crania of the young and adult Tasmanian Cachalots are given on the same scale. Extraordinary as the disproportion of the facial part of the skull to the cerebral cavity appears in the older skull here figured, a drawing of the Yorkshire specimen would show the same character in an even more exaggerated degree.

In the same Plate a figure of the section of the cranium of a Hyperoodon has been introduced, as that of the Whale which (except *Kogia*) approaches most nearly in its general characters to *Physeter*. It is easy to see, by this section, how those fantastic and apparently meaningless developments of the cranial bones of *Hyperoodon* and the Ziphioid Cetaceans may become, with little modification, the regular and definitely disposed walls of the huge spermaceti-basin of the Cachalot. The crest, essentially the same in both, is merely flattened out and expanded, as if by pressure from within; and the great maxillary protuberances are reduced in size. The most essential differences between the cranium of *Physeter* and the Ziphioids are, as already pointed out, the absence of a distinct lachrymal bone, and the construction of the zygomatic process of the malar.

Lower Jaw.

Perhaps no part of the skeleton of the Cachalot is so well known as the lower jaw, as few Museums of note do not possess one or more of these tangible trophies of a

* Owing to the imperfect condition of this skull, the dimensions given cannot be relied on as quite accurate.

successful whaling-campaign. It will suffice here to point out that, in this part of its organization, *Physeter* conforms with the other Dolphins in the vertically expanded hinder part of the ramus, and immensely wide opening of the dental canal (see Pl. LVI. fig. 1), characters which separate them from the Whalebone-Whales. It differs from the true *Delphinidæ* in the excessive length and narrowness of the symphysial portion, and consequently great and sudden lateral divergence of the rami posteriorly; but in this it resembles the *Platanistidæ*, particularly *Inia* *. A special peculiarity is, that the rami appear never to become united by osseous ankylosis at the symphysis; at least this is not the case in the oldest specimen that I have had an opportunity of examining. In the largest jaw in the Museum of the College of Surgeons, it was observed, when the rami were separated, that the contiguous surfaces were not flat, but that of the left ramus somewhat convex in its whole extent, fitting into a corresponding concavity in the right ramus. In the jaw belonging to the Tasmanian skeleton, the symphysial portion is not perfectly straight, but has a distinct lateral curve, the concavity towards the left. This is, however, an individual (though not uncommon) peculiarity. Instances are frequently met with among Cachalots of excessive curvature of the lower jaw, amounting to serious deformity †.

The gradual increase in the length of the symphysis, compared with that of the entire jaw, and the relative decrease in width behind, as age advances, are illustrated by the dimensions of three specimens of different sizes in the Museum of the College of Surgeons.

	Entire length ‡.	Length of Symphysis.	Width behind.
Mandible of the young skull from Tasmania	49″	21″	31″
Proportion	**100**	**43**	**63**
Mandible of Tasmanian skeleton	174	102	72
Proportion	**100**	**59**	**41**
Largest mandible from Tasmania, presented by Mr. Crowther	194	124	75
Proportion	**100**	**64**	**38**

The mandible of the Yorkshire Cachalot is almost identical in dimensions with the last of these three.

The form and structure of the mandibular teeth, their changes with age, and mode of implantation are fully described in Owen's 'Odontography.' They present great differences both in number and character in different individuals. In the Tasmanian

* See Description of the skeleton of *Inia geoffrensis*, Trans. Zool. Soc. vol. vi. p. 89 *et seqq.*

† See Murie, 'Proc. Zool. Soc.' 1865, p. 390.

‡ The length is taken from the apex to the middle of a line drawn across the posterior ends of the rami.

skeleton the teeth are all retained in their place by the tough fibrous gum, in which they are to a large extent imbedded, and which supplies the place of close-fitting bony alveolar walls. Those near the middle of the series are about 5″ in length, of which not more than 1½″ projected above the gum in the living animal. The crowns are conical, recurved, and pointed, showing but little signs of wear. The pulp-cavity is widely open at the base. At the hinder end of the series they become smaller, and more pointed; but the last on both sides has a flat and oval crown, scarcely projecting above the level of the gum. They are not symmetrically placed in pairs along the jaw, and are even unequal in number on the two sides, as there are twenty-eight on the left. and but twenty-five on the right.

In the young cranium presented by Mr. Crowther, obtained from a sucking Cachalot, killed by the side of its mother, the teeth were still concealed within the gum. Although, unfortunately, most of them had been lost in preparing the specimen, a sufficient number were preserved to show their general characters. These are simple, cylindrical, nearly straight, obtusely pointed, 1½″ long and rather less than ½″ in their greatest diameter. It is interesting to observe that they show no trace of an enamel covering to the apex, a point which has hitherto been one of uncertainty. Judging by the alveolar depressions at the bottom of the dental groove, there appear to have been 24 teeth on each side in this specimen.

The largest jaw from Tasmania, in the Museum of the College, has 25 teeth on each side; two others from the same locality have 26–26 and 24–23 respectively; and a very old jaw, with massive and much worn teeth, locality unknown, has but 21–20; and a small, but adult specimen (female ?), has 22–22. The exact number of teeth of the Caithness skeleton cannot be ascertained, as the anterior portion of the mandible is wanting. Beale gives 24–24 as the number in the Yorkshire skeleton; but it is doubtful whether this statement refers to the actual teeth, or to the wooden models now in their place, on which of course it is impossible to place absolute reliance.

Hyoid Bones.

The bones of the hyoid arch are very remarkable, not only from their great relative size, but especially for the peculiar breadth and flatness of the basihyal (*bh*) and thyrohyals (*th*) (Plate LX. fig. 1).

The stylohyals (*sh*) are large, subcylindrical, and slightly curved, truncated at both ends, 25″ long, and 4″ to 4½″ in diameter.

The basihyal and thyrohyals are not ankylosed; and, judging by their opposed surfaces, a considerable space occupied by cartilage must have existed between them. These bones are also distinct in the Yorkshire skeleton. The basihyal is nearly flat, though the under surface is somewhat concave from side to side, and convex from before backwards. It is 17″ long and 18″ broad. A truncated process projects forward, for the attachment of the cartilages connecting the stylohyals: this is not bifid, as in most Cetaceans. The bone is very thick at the sides, where the thyrohyals are attached, but becomes gradually thinner towards the posterior (slightly emarginated) border.

The thyrohyals are somewhat triangular, with a thick, rounded, anterior and outer edge, and much thinner behind. The greatest length of each of these is 21″, and the greatest breadth 12″.

The basi- and thyrohyals of the Yorkshire Cachalot, which alone are preserved, only differ from those of the Tasmanian skeleton in their superior size. The basihyal is $18\frac{1}{2}''$ long by $20\frac{1}{2}''$ broad; each thyrohyal is 26″ long by 14″ broad.

In the breadth and flatness of these bones, *Kogia* alone (as ascertained from a cast kindly sent to me by Mr. Krefft, of Sydney) resembles *Physeter*. In the Hyperoodon the thyrohyals are broader posteriorly than in Dolphins generally, and, so far, present an approximation to those of the Cachalot; but, on the other hand, the stylohyals are of quite a different form. The absence of union between the basi- and thyrohyals in an animal showing all other signs of maturity, as the Yorkshire Cachalot, is a very peculiar feature among Cetaceans.

Vertebral Column.

The vertebræ of the Cachalot, especially as contrasted with the large Whalebone-Whales, present generally a rough or, rather, rugged surface, and a coarse and somewhat spongy texture. In all the bones, in fact, there is a tendency to the development of rough, tuberous and spiculated outgrowths from the surface, and also to irregular epiphysial ossifications in the cartilaginous portions of the bone, which afterwards become ankylosed, as around the carpal bones, and on the articular surfaces for the chevron bones on the lower surfaces of the bodies of the caudal vertebræ. The advancing ossifying surfaces have generally a much more spiculated character than in other Cetaceans, being covered with pointed conical eminences, which surround the channels for blood-vessels. This is also particularly well exemplified in the partially ossified carpal bones (see Pl. LXI. fig. 4). The ossification of the ends of the vertebral bodies presents a common character by which they can be distinguished from those of all other Cetaceans with which I am acquainted. When the epiphysis is removed, rather above the centre of the surface (in the dorsal region) is a depressed circular patch, in diameter rather less than one-third of that of the vertebra; in this part the bone has a nodulated appearance,—rather conspicuous pointed tubercles, projecting directly outwards, being scattered over it without definite arrangement (see woodcuts, figs. 5 & 10). Outside of this patch, the more elevated surface is roughened by furrows and intermediate ridges of various lengths and sizes, but all arranged in a tolerably regular manner, radiating towards the circumference of the bone. The epiphyses of course correspond to this surface, being thickest in the central part. On their outer side, or that connected with the intervertebral substance, the limits of this thickened area are distinctly seen in the smoother character of the surface, which towards the margin is roughened by numerous concentrically placed ridges. This arrangement is found throughout the whole vertebral column, as far as the epiphyses are separable, on both anterior and posterior surfaces. In the caudal region, the internal thickened area of the epiphysis is more centrally placed, and occupies a larger relative area, its diameter being three-sevenths of that of the whole centrum.

In a Hyperoodon of about corresponding age, when the epiphysis is removed from the centrum the ridges and grooves of the exposed surface radiate from a central point to the circumference, without any such depressed tuberculated area.

As mentioned before, the entire number of vertebræ is fifty, of which, according to the usual method of division, seven may be reckoned as cervical, eleven dorsal, eight lumbar, and twenty-four caudal. In this enumeration the vertebra that bears the rudimentary last pair of ribs is counted among the dorsal (although in many characters it approaches one of the lumbar series), and the caudal vertebræ commence with the one that bears at its hinder end the first pair of chevron bones *. Placed in series with their bodies in contact, the vertebræ measure 30′ 4″,—the seven cervical being 1′, the eleven dorsal 6′ 8″, the eight lumbar 7′ 6″, the twelve anterior caudal 11′ 8″, and the twelve posterior caudal 3′ 6″.

The following Table gives the weights of all the vertebræ, as well as the length of the body, the greatest width (measured between the extremities of the transverse processes), and the greatest vertical height (from the summit of the spinous process to the most depending part of the body). Corresponding measurements are given of the vertebræ of the Caithness and the Yorkshire specimen, as far as circumstances would permit:—

	Tasmanian Skeleton.					Caithness Skeleton.			Yorkshire Skeleton.		
	Weight.		Length of body.	Extreme breadth.	Extreme height.	Length of body.	Extreme breadth.	Extreme height.	Length of body.	Extreme breadth.	Extreme height.
	lbs.	oz.	in.	in.	in.	in.	in.	in.	in.	in.	in.
1st cervical	51	0	6	37½	18½	6¾	36	21¼	6¼	40	17
2nd–7th cervical (united) }	68	0 {	5¼	32	22¾	9	36½	24	9	35½	..
1st dorsal }			2¾	26¼	21½	5	28	22½	4¼	27	..
2nd ,,	29	0	5½	25½	22	6	24½	23½	5¼	25	..
3rd ,,	29	0	7	23¾	24	6¼	23½	26	6	25	..
4th ,,	29	0	6¾	21¾	25	6½	22¾	28	6½	24	..
5th ,,	30	0	6¾	21¼	25½	7	22¼	28½	6½	23	..
6th ,,	31	0	6¾	20¾	26¼	7¼	21	28½	6½	..	..
7th ,,	31	8	7¼	19¾	26¼	7¼	20½	29	6¾	..	..
8th ,,	32	8	7¾	19¼	26½	7¼	20	29	7	..	..
9th ,,	31	0	8¼	19	26½	8	22½	30	7½	..	..
10th ,,	34	0	8¾	23¾	28	8½	27½	31½	8	26½	..
11th ,,	36	0	9¼	31	29	9	31¼	32	8¾	31	..
1st lumbar	34	8	9¼	31	30¼	9½	32	33	9	29½	..
2nd ,,	37	8	9¾	31¼	30½	10	32	34½	10	29	36
3rd ,,	38	0	10¼	33	32¼	10½	32	35½	10¼	29½	35½

* The arguments in favour of including this vertebra among the caudal series are given in a former paper, *Description of the skeleton of Inia geoffrensis*, p. 100, of the present volume.

	Tasmanian Skeleton.					Caithness Skeleton.			Yorkshire Skeleton.		
	Weight.		Length of body.	Extreme breadth.	Extreme height.	Length of body.	Extreme breadth.	Extreme height.	Length of body.	Extreme breadth.	Extreme height.
	lbs.	oz.	in.	in.	in.	in.	in.	in.	in.	in.	in.
4th lumbar	39	8	$10\frac{1}{2}$	$33\frac{1}{4}$	$30\frac{3}{4}$	11	33	$35\frac{1}{2}$	$10\frac{1}{2}$	$29\frac{1}{2}$	$35\frac{1}{2}$
5th „	40	0	$10\frac{1}{2}$	34	32	$11\frac{1}{2}$	33	36	$10\frac{3}{4}$	30	34
6th „	38	8	11	$33\frac{1}{2}$	$31\frac{1}{2}$	$11\frac{1}{2}$	33	$34\frac{1}{2}$	11	30	32
7th „	43	0	$11\frac{1}{2}$	33	$32\frac{1}{4}$	12	32	†	$11\frac{3}{4}$	31	$31\frac{1}{2}$
8th „	43	0	$11\frac{1}{2}$	32	31	12	†	†	$12\frac{1}{2}$	$31\frac{1}{2}$	32
1st caudal	46	0	12	31	$31\frac{1}{2}$	12	†	†	$12\frac{1}{2}$	$31\frac{1}{2}$	$30\frac{1}{2}$
2nd „	49	0	12	$29\frac{1}{4}$	$31\frac{1}{2}$	12	†	†	..	$31\frac{1}{2}$	30
3rd „	58	0	$12\frac{1}{2}$	$27\frac{1}{2}$	30	12	†	†	12	27	30
4th „	65	0	$12\frac{1}{2}$	$26\frac{1}{2}$	29	12	†	28	12	$25\frac{1}{2}$	29
5th „	66*	0	$12\frac{1}{2}$	23	$28\frac{1}{4}$	12	24	26	12	$20\frac{3}{4}$	27
6th „	58	0	$12\frac{1}{4}$	†	$25\frac{1}{2}$	$11\frac{1}{2}$	$22\frac{1}{4}$	$24\frac{1}{2}$	$11\frac{3}{4}$	$18\frac{1}{2}$	23
7th „	55	0	12	$17\frac{1}{4}$	24	$11\frac{1}{4}$	20	22	$11\frac{1}{4}$	16	22
8th „	45	0	$11\frac{3}{4}$	16	22	$10\frac{3}{4}$	$17\frac{1}{2}$	21	$10\frac{1}{2}$	$13\frac{1}{2}$	21
9th „	40	0	$11\frac{1}{4}$	$14\frac{1}{4}$	21	$10\frac{1}{4}$	$15\frac{1}{4}$	19	10	13	$19\frac{1}{2}$
10th „	34	4	$10\frac{1}{2}$	$12\frac{3}{4}$	20	$9\frac{1}{2}$	$13\frac{3}{4}$	$18\frac{1}{2}$	$9\frac{1}{2}$	$11\frac{1}{2}$	$17\frac{1}{4}$
11th „	28	0	$9\frac{1}{2}$	12	$17\frac{1}{2}$	8	$12\frac{1}{4}$	16	$7\frac{1}{2}$	11	$14\frac{1}{2}$
12th „	20	0	$7\frac{3}{4}$	11	$14\frac{3}{4}$	$6\frac{1}{4}$	12	$13\frac{1}{2}$	$5\frac{1}{2}$	$10\frac{3}{4}$	$12\frac{1}{4}$
13th „	10	5	6	$10\frac{1}{4}$	$12\frac{1}{4}$	$4\frac{1}{2}$	$10\frac{3}{4}$	$9\frac{1}{2}$	$4\frac{1}{4}$	$9\frac{1}{4}$	$9\frac{3}{4}$
14th „	4	13	$4\frac{1}{2}$	$8\frac{1}{2}$	$9\frac{1}{2}$	4	$9\frac{3}{4}$	8	$3\frac{5}{8}$	$8\frac{1}{4}$	8
15th „	3	$0\frac{1}{2}$	4	$7\frac{3}{4}$	$7\frac{3}{4}$	$3\frac{3}{4}$	$9\frac{1}{2}$	$6\frac{1}{4}$	$3\frac{3}{8}$	$8\frac{1}{2}$	7
16th „	2	15	$4\frac{1}{4}$	$7\frac{3}{4}$	7	$3\frac{1}{2}$	$8\frac{1}{4}$	6	$3\frac{1}{4}$	$8\frac{1}{4}$	$6\frac{1}{4}$
17th „	2	7	4	$7\frac{3}{4}$	$6\frac{1}{2}$	$3\frac{1}{4}$	$7\frac{1}{2}$	$5\frac{1}{4}$	$3\frac{1}{8}$	$7\frac{1}{2}$	$5\frac{1}{2}$
18th „	1	11	$3\frac{3}{4}$	$6\frac{1}{2}$	$5\frac{1}{2}$	3	$6\frac{1}{2}$	$5\frac{1}{4}$	3	$6\frac{1}{2}$	$4\frac{3}{4}$
19th „	1	0	$3\frac{1}{2}$	$5\frac{3}{4}$	$4\frac{3}{4}$	$2\frac{3}{4}$	$6\frac{1}{4}$	$4\frac{1}{4}$	$2\frac{5}{8}$	$5\frac{1}{2}$	$4\frac{1}{4}$
20th „	0	5	3	5	4	$2\frac{5}{8}$	$5\frac{1}{2}$	4	$2\frac{1}{4}$	$4\frac{1}{2}$	$3\frac{1}{2}$
21st „	0	$3\frac{1}{2}$	$2\frac{1}{2}$	$3\frac{3}{4}$	$3\frac{1}{2}$	$2\frac{1}{2}$	5	$3\frac{1}{2}$	$2\frac{1}{8}$	$3\frac{3}{4}$	3
22nd „	0	2	$2\frac{1}{4}$	$3\frac{1}{4}$	$2\frac{3}{4}$	..	..	..	2	$2\frac{3}{4}$	$2\frac{3}{8}$
23rd „	0	$1\frac{1}{2}$	$2\frac{1}{4}$	$2\frac{1}{2}$	2	..	..	..	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{5}{8}$
24th „	0	$0\frac{3}{4}$	2	2	$1\frac{1}{4}$	..	..	..	..	..	..

The Cervical Vertebræ exhibit in a very marked degree the antero-posterior compression so characteristic of the Cetacean neck. The length of the bodies of the seven vertebræ of this region taken together, when compared with their own width, or with the length of the whole vertebral column, appears to be less than in any other Mammal.

The atlas is distinct from the other vertebræ; the remaining six are united by their bodies and spines into one consolidated mass, which, in the case of the Tasmanian specimen, is further united with the body of the first dorsal vertebra. This disposition of the cervical vertebræ (the distinctness of the atlas and union of the posterior six) appears to be the rule in all Cachalots' skeletons, although unknown among other Cetaceans. In the most nearly allied forms, *Kogia*, *Hyperoodon*, and *Micropteron*, they are all united into one solid mass, as in *Balæna* among the true Whales. In *Platanista*,

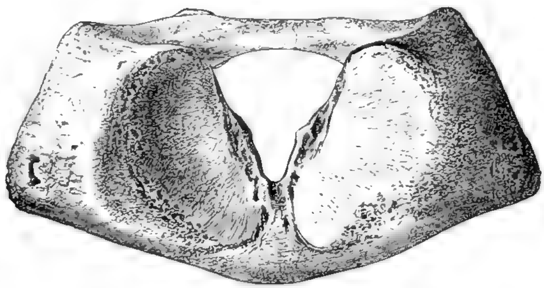
* The vertebræ in this region, as is usually the case in Cetacean skeletons, contain much more oil than at other parts, which partially accounts for their great weight. Elsewhere the vertebræ were free from oil, and dry at the time they were weighed.

† Processes so much injured that accurate measurements cannot be made.

Inia, *Pontoporia*, *Beluga*, and *Monodon** all are separate, as in the *Balænopteridæ*. In the other Delphinoids the atlas, axis, and generally one or more of the other vertebræ are confluent; if any are free, it is at the hinder end of the series.

The form of the *atlas* of the Cachalot is very characteristic. The great vertical depth of the obliquely truncated transverse processes, and the comparative straightness of the upper and lower border, especially the former, give it, when seen either from before or behind, a transversely extended quadrangular figure, quite unlike that of any other Cetacean atlas. It of course partakes of the regional character of great antero-posterior compression, though not to the same extent as the succeeding vertebræ. The whole bone, with all its inequalities, will lie between two planes 8″ apart; and nowhere does the actual thickness exceed 6″. The anterior surface is hollowed out to a depth of $4\frac{1}{2}$″ for the reception of the condyles of the occiput. The posterior surface is remarkable for its flatness.

Fig. 2.



Anterior surface of atlas†.

The form of the neural canal, where it pierces the atlas, is very nearly that of an equilateral triangle, with one of the angles directed downwards. The upper side is almost straight, the outer angles rounded: the lateral sides converge rather rapidly to a point rather below the middle, where their posterior margins form an angular projection, causing a constriction of the opening. Below this the sides approach more gradually towards the inferior angle, which is truncated at the apex. If the anterior margin of the aperture alone could be seen, it would appear more perfectly triangular, with straight sides. Seen from behind, the opening appears divided by the above-mentioned projection on the posterior margin into two parts, an upper transversely elongated oval portion, and an inferior narrow vertically elongated part. The former alone corresponds to the neural canal of the succeeding vertebræ; the latter fits over the rough surface of the axis to which the odontoid ligaments are attached, and affords a passage for them.

* In two skeletons of male Narwhals in the Mus. Roy. Coll. Surg. the bodies of the 2nd and 3rd cervical vertebræ are firmly united.

† The woodcuts of the vertebræ (as the figures in Plates LVIII. and LIX.) are all reduced to $\frac{1}{12}$ the size of nature. The anterior surfaces are represented in every case.

In the Caithness Cachalot the inferior part of the opening is altogether smaller and especially constricted laterally, the sides being nearly parallel and 1″ apart for a distance of $2\frac{1}{2}''$.

The articular surfaces for the occipital condyles are broad and shallow, without any sharply defined projecting border, except at the superior internal angle. They approach each other below, but do not meet by a space of about 2″. The bone between their inner margins and the edge of the neural canal is hollowed into several very rough irregular depressions, especially on the right side.

The neural arch, arising on either side immediately above the condyles, is a nearly straight horizontal bar of bone, slightly thicker from before backwards than from above downwards. Its anterior is thicker than its posterior edge. It presents no appreciable spine, but, on the contrary, is rather hollowed than otherwise above. There is, however, a slight rounded prominence on the middle of the anterior margin. In the Caithness specimen this is more developed, forming an irregular, low, tuberous spine. Posteriorly, on the right side, near the root of the arch, is a nearly circular flattened surface, 4″ in diameter, with an irregular depression in the middle, and of which the edges are developed above and below beyond the surface of the bone from which it springs. This facet closely fits a corresponding one on the commencement of the arch of the axis. It is evidently irregular, no trace of it being present on the other side; but it is worthy of note that a similar articulating facet between the atlas and axis, in a corresponding situation, but on the opposite (left) side, exists in the Caithness specimen.

The neural arch of many Cetaceans and of other Mammals is perforated laterally by a large foramen, through which the first cervical nerve finds a passage. In some, the part constituting the anterior wall of the foramen, and which joins the upper edge of the anterior articulating surface, is absent; and the foramen is then represented by a deep groove with more or less overhanging edges. In *Hyperoodon* the foramen is complete; in *Orca* the same; in *Globiocephalus* very nearly so; also in some of the true *Delphini*, as *D. tursio*. In *Beluga*, *Platanista*, and *Phocæna* it is a mere groove. In the Cachalot the last-named condition is found, though the groove is relatively smaller and shallower than in other genera. It is bounded in front by the sharp, prominent upper edge of the condylar articular surface, behind by the lateral part of the neural arch; internally it descends into the neural canal at its upper and outer angle, and externally is gradually lost in the anterior surface of the upper part of the transverse process.

The inferior edge of the bone presents a tolerably regular curve, the middle part descending 4 inches lower than the sides. When seen from below, it appears slightly hollowed in the middle in front, and posteriorly presents a broad obtuse triangular prominence, which fits into a corresponding depression in the axis. A similar process of the atlas occurs in all other Cetaceans in which this bone is separate; but in the Cachalot it is shorter and more massive than in *Beluga*, *Monodon*, or

Platanista, and, unlike these, has no smooth articular facet on its hinder and upper surface.

There remain now to be described only the lateral processes, which constitute a very peculiar feature in the bone. In all other Cetaceans the transverse processes of the atlas, whether confluent or not with those of the axis, bear but a small proportion in vertical height to the whole bone, but appear as more or less conical (generally obliquely flattened) projections arising opposite to the middle portion of the articular surface, or, as in *Hyperoodon*, from near the lower edge. In the Cachalot they form two short, but very deep, vertically placed crests, rising as high as the top of the neural arch, and extending below almost to the level of the inferior edge of the condylar articular surface. At the ends they are obliquely truncated, being longer at the lower than the upper angles. The middle of the posterior surface near the outer edge is hollowed. The external margin seen from the side appears thicker below than above; it is rough and nodulated, especially near the inferior angle, being probably not completely ossified. It will be observed in the annexed table of dimensions that, although the atlas of the Caithness Whale is in all other respects somewhat larger than that of the Tasmanian, the lateral development of the transverse processes is not so great. This is chiefly due to their being vertically truncated, without any production of the inferior angle.

Dimensions of the Atlas*.

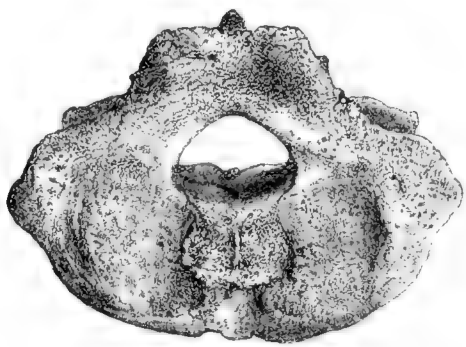
	Tasmanian.	Caithness.
	in.	in.
Extreme breadth	37½	36
Width between outer edges of anterior articular surfaces	23	26
Extreme width of each of these surfaces	8½	10
Extreme height of each of these surfaces	14½	16¾
Width of neural canal	9¾	11
Height of neural canal	10	10½
Height of contracted lower portion of the canal	4	2½
Width of contracted lower portion of the canal at the upper end	3¼	1
Contracting below to	1	1
Height of portion of bone below the neural canal	6½	7¼
Extreme height in middle line	18½	21¼
Vertical height of transverse processes at outer end	14	..
Greatest antero-posterior thickness of the same	5	..
Height of neural arch in middle	2½	3½
Antero-posterior thickness of neural arch in middle	3¾	..
Length of inferior surface of bone in middle line	6	6¾
Width between the outer edges of posterior articular facets	25	..

* My friend Mr. J. W. Clark, Superintendent of the Cambridge Anatomical Museum, has kindly given me a drawing of the atlas of a young Cachalot, stranded at Hartlepool more than two centuries ago, and which is now preserved, with other bones of the same animal, in the crypt beneath the library of the Cathedral at Durham. The extreme width of this atlas is 29″, its height 15″. A comparison of this specimen with that of the Tasmanian and Caithness Cachalots, as representing three different ages, shows that the principal change which takes place is the gradual contraction of the lower part of the central opening, that part, below the true neural canal, which corresponds to the odontoid surface of the axis.

The remaining six cervical vertebræ are completely soldered together, both by their bodies and their neural spines, into one mass. Their individuality can be traced distinctly enough at the root of the neural arches, where, for a short space, they are separated to admit of the passage of the cervical nerves; but their conjoined spines present a solid mass in which no trace can be detected of separate vertebral elements; and their bodies are almost as completely fused together, slight grooves and rows of foramina for blood-vessels on the lateral parts faintly indicating the limits of the several component vertebræ. The union of the seventh to the antecedent vertebræ is more complete than in any other known Cetacean; for even in the Hyperoodon the whole of its neural arch is free. To this mass, in the Tasmanian specimen, the first dorsal vertebra is partially united by its centrum only.

The most remarkable characteristic of these vertebræ taken together is their extreme antero-posterior compression, the four middle bones being most affected. The greatest length, the lateral part of the conjoined bodies, is 9″; and the whole group will lie between two parallel planes no greater distance apart. The conjoined centrums are somewhat flattened from above downwards, and very broad from side to side at the anterior end, but less so posteriorly.

Fig. 3.



Anterior surface of second cervical vertebra.

The anterior surface is, in the main, flat. Its median portion, 8″ broad, is irregular, rough, and slightly raised; in the centre of this is a ridge-like prominence, placed with its longest diameter vertically, and raised not more than $\frac{3}{4}''$ above the surrounding bone; this represents the odontoid process. The lower edge is smoothly hollowed out in the middle to receive the process on the contiguous portion of the atlas. On each side of this hollow and of the median rough surface are the comparatively smooth, slightly depressed, and nearly flat articular facets for the atlas, of an irregularly quadrilateral figure, each measuring 10″ in height, and 8″ in width. They extend quite to the lower edge of the bone. Beyond these externally are the flat anterior surfaces of the broad, obtusely pointed, transverse processes, projecting 5″ from the outer margin of the articular facets. The broad flattened lateral parts of the neural arch rise from directly over the upper edge of the articular facets, and converge rapidly together to form the anterior surface of the broad rugged mass constituting the neural spine. On the right side is a raised flat surface corresponding and fitting to that described on the commencement of the arch of the atlas. The opening of the neural canal, as seen in this aspect, is a transversely elongated lozenge, with the angles rounded off, $8\frac{1}{2}''$ broad, and $6\frac{1}{2}''$ high. The inferior margin is very indistinctly marked in the middle,—the anterior surface of the axis above the rudiment of the odontoid process gradually passing into the flattened floor of the neural canal, which continues to rise throughout the cervical region.

The sides of the mass formed by the conjoined bodies slope gradually downwards and inwards, converging towards the middle line, where they meet in a slightly elevated, rounded, longitudinal keel, in which all trace of the original separation of these vertebræ and even of the first dorsal is entirely lost.

As in the Toothed Whales generally, the transverse process of the axis consists of a single, broad, imperforate plate, springing from the greater part of the side of the body of the bone and the lower part of the neural arch, representing, in situation at least, the upper and lower processes found in the succeeding vertebræ (and in the axis of the Whalebone-Whales), coalesced and with the intermediate space filled up. In relation to the large size of the body of the bone, these processes may be considered short: the condition of the ends, in the Tasmanian specimen, shows that they have not quite attained their complete ossification; but they are only very slightly longer proportionally in the completely adult Caithness Whale. They are much compressed from before backwards, and obliquely truncated externally, the nearly straight end looking upwards and outwards. In the older specimen more advanced ossification of this apophysis has caused the end to approach nearer to a vertical line.

In most Cetacea the inferior transverse process of the cervical vertebræ (*parapophysis*, Owen), arising from the side of the body, increases in development from the third to the sixth, and suddenly becomes obsolete, or nearly so, in the seventh, where the articular facet for the head of the first rib appears as it were in its place, situated, however, not precisely at the same spot on the side of the vertebræ, but rather above and posterior to it. In all known genera of Delphinoids the inferior process of the sixth vertebra attains a considerable development, most strikingly so in those in which the vertebræ are free, as *Beluga* and, especially, *Platanista*. In *Hyperoodon* it is very conspicuous, although the third, fourth, and fifth show no rudiment of the process. In that genus also, at least in one example (Mus. Roy. Coll. Surg. No. 2480 A), contrary to the general rule, a tolerably long inferior process is developed from the body of the seventh vertebra, but on the right side only. In the Tasmanian Sperm-Whale there is no trace of an inferior transverse process on the smooth sides of the bodies of any of the cervical vertebræ as far as that which appears to be the sixth, inclusive. The lower part of the side of the posterior end of the conjoined bodies, or that part which appears to be connected with the seventh neural arch, and may therefore be regarded as representing the centrum of the seventh vertebra, occupies a space as large as the three antecedent vertebræ together (deciphered by the same test), and is raised into two rugged ridges with a groove between, of which ridges the anterior is rather the more prominent. Besides these, there is no indication either of process or of articular facet for the first rib. As the more posterior of these ridges is situated quite at the edge of the vertebral body, and rather higher up than the other, it may be regarded as the representative of this facet; and the rib may have had a ligamentous connexion with it, for the form of its head would not allow it to come in contact with the bone itself. The other is probably a rudiment of an inferior transverse process.

A distinct upper transverse process (*diapophysis*, Owen) is present only on the seventh vertebra. It springs from the middle of the side of the neural arch by a base of about 2″ in breadth, and is of the same length, irregularly triangular, and very much compressed. Certain small irregular projections from the edges of the delicate lamellæ of bone which constitute the lateral parts of the neural arches of the third, fourth, fifth, and sixth vertebræ are the only representatives of their transverse processes.

The neural arches of these vertebræ may be considered in the two portions into which they naturally resolve themselves. 1. The lateral portions, springing up from the conjoined bodies. 2. The united mass forming the roof of the neural canal, composed of the conjoined spines. The lateral parts of the arches are, as before said, all distinct. The first (that of the axis) far surpasses the others in breadth and in stoutness. Next to it the last or seventh is the best developed. Between these two are placed four delicate brittle lamellæ, scarcely thicker than cardboard, the third and sixth being rather stouter than the two middle ones. So brittle are these plates, that in neither of the three sets of cervical vertebræ examined have the whole of them escaped destruction in the cleaning-process; sufficient remains, however, in every case to show that their general arrangement is the same. The intervals between them are of nearly equal width ($\frac{1}{2}''$), but diminish in height from before backwards, the first being $2\frac{1}{2}''$, and the last scarcely more than 1″ high. The upper part of the arch is formed of a transversely elongated rugged mass of bone, flattened from before backwards, with two prominent square shoulder-like lateral projections rising from the anterior surface, and with a small pointed spine in the middle line surmounting the posterior edge. Between this spine and the two shoulders rising on each side and in front of it is a distinct groove. These lateral expansions, which appear to belong chiefly to the axis, are, among Toothed Whales at least, quite peculiar to *Physeter*. Even *Hyperoodon* shows no trace of them, as the conjoined neural arches of the first six cervical vertebræ rise smoothly and gradually into a greatly elevated spinous process. The axis of the *Balænopteræ* presents rugged lateral processes somewhat similar to those of the Sperm-Whale.

As the posterior surface of the body of the cervical vertebræ is ankylosed with the first dorsal, little can be said of its characters. The centrum, however, is very deeply concave, receiving the convex anterior surface of that of the first dorsal; and there is a smooth articular facet (*posterior zygapophysis*) at each side of the neural arch. This facet is more vertical (inclining less backwards at the upper end) than in other Cetacea.

Measurements of the conjoined six posterior Cervical Vertebræ.

	Tasmanian.	Caithness.
	in.	in.
Extreme breadth	32	36½
Extreme height	22¾	24
Breadth between outer edges of articular facets for atlas	23	25
Breadth of anterior opening of neural canal	8½	10
Height of anterior opening of neural canal	6½	7
Height of body of bone below this	9½	10½
Antero-posterior length of superior surface (floor of neural canal).	4	6½
Antero-posterior length of inferior surface	5¼	8½
Antero-posterior length of lateral surface	9	11½
Breadth of posterior surface of body of seventh cervical vertebra	17½	15
Height of posterior surface of body of seventh cervical vertebra	10¾	12½

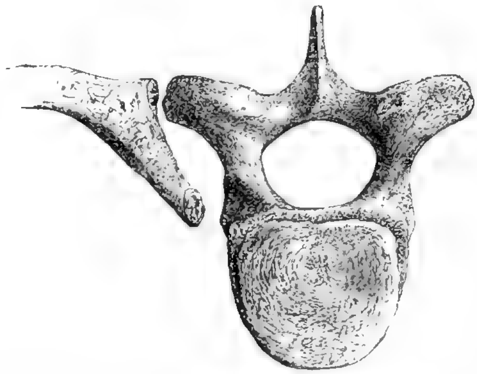
The Dorsal Vertebræ (Pls. LVIII. and LIX.) are eleven in number. The first ten support well-developed ribs; the eleventh, which in many of its characters resembles a lumbar vertebra, has only a rudimentary pair of ribs attached to the extremity of the transverse processes. The first dorsal is ankylosed by the middle part of its centrum (at all events at the upper and lower margins near the middle line, where no trace of a suture remains) to the hinder part of the conjoined six posterior cervical vertebræ. The lateral parts of the centrum are free, as also is the whole of the neural arch.

The body of the first is by very far the shortest in the antero-posterior direction; the second is nearly twice as long; and they continue to increase gradually and progressively throughout the series, as will be seen by the table of measurements. The body of the first is extremely concave on its posterior aspect, the middle part being 3″ deeper than the sides. The second is convex in front, and concave behind to a less degree. In the succeeding vertebræ the anterior and posterior surfaces are nearly flat and parallel. The bodies, at first very broad in proportion to their height, rapidly become narrower; in the fourth the breadth is already less than the height; the sixth, seventh, and eighth are the narrowest; after these there is a slight increase of width.

The neural canal in the first two vertebræ is triangular, but rapidly assumes a transversely oval form, and gradually diminishes in both height and breadth, so much more, however, in the last dimension that in the tenth vertebra the long diameter of the oval is vertical; in the eleventh the lateral contraction is still more marked.

The spinous processes progressively increase in height from before backwards. That of the first is a small irregular tubercle broader than long, and scarcely higher than that of the conjoined cervical vertebræ. That of the second is still inconspicuous, but more compressed from side to side. The great antero-posterior width characteristic of the remainder begins to be seen in the third. The spines of the fifth, sixth, and seventh

Fig. 4.



Anterior surface of the fourth dorsal vertebra and head of right rib.

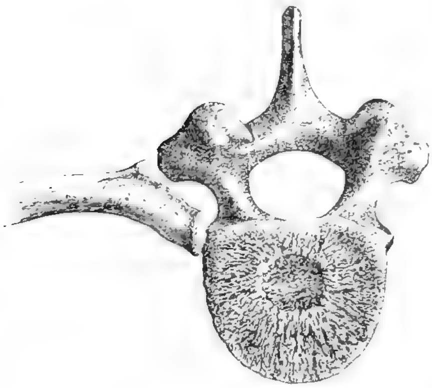
scarcely differ in form and dimensions, being, when seen from the side, nearly square. From the eighth a more rapid increase in vertical height takes place, until the last, by its elevation, narrowness at the base, and expansion at the extremity in the antero-posterior direction, as well as in thickness, resembles that of one of the lumbar vertebræ. As far as the sixth their general direction is vertical; afterwards they have a slight but gradually increasing backward slope.

Well developed rough processes, which can hardly be called articular surfaces, but representing the posterior zygapophyses, are formed on the hinder edge of the sides of the neural arch, at the root of the spine, from the first to the ninth vertebra inclusive. In the tenth they have almost lost their distinctive character, and they are quite obsolete in the eleventh. They lie above and within the prozygapophyses of the succeeding vertebra; but, except in the case of the first two or three, they appear very rudely coadjusted, compared with those of ordinary Mammalia.

The prozygapophyses are at first represented by a flattened surface on the angle formed by the junction of the pedicle, lamina, and transverse process of the vertebra (to use the familiar terms of anthropotomy), or at the root of the diapophysis. Gradually this part increases in prominence, and forms a distinct rounded eminence, projecting upwards and forwards from the side of the neural arch, and bearing the smooth articular surface (distinct as far as the tenth vertebra), to its inner side. The sudden diminution of the diapophysis on the tenth vertebra, and its disappearance on the eleventh (see figs. 7 and 8), leaves this, though somewhat contracted in bulk, a conspicuous and important process on the neural arch, corresponding with those which in the lumbar region form such a characteristic feature in the Cetacean vertebral column. Owen has pointed out, in the description of the skeleton of *Delphinus delphis* (Cat. Osteol. Prep. Mus. Roy. Coll. Surg. vol. ii. p. 450), that these processes belong to the *metapophyses* of his system, as, although near their commencement they bear the so-called prozygapophyses, they soon become distinct from them. This is less readily demonstrated in the Sperm-Whale.

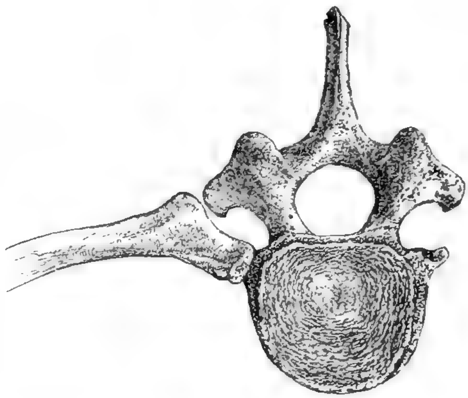
Upper transverse processes for the articulation of the tubercles of the ribs (*diapo-*

Fig. 5.



Eighth dorsal vertebra, epiphysis removed.

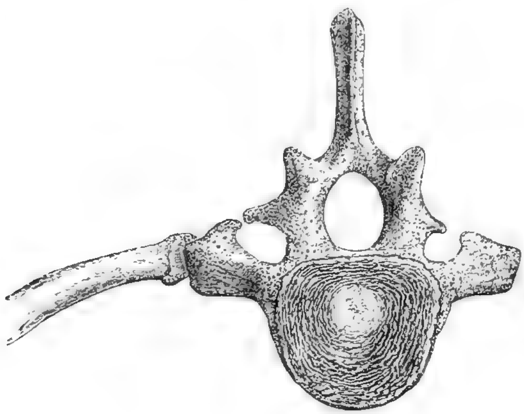
Fig. 6.



Ninth dorsal vertebra.

physes) exist from the first to the tenth vertebra inclusive, arising in all from the side of the neurapophysis, at nearly the same height throughout. They gradually decrease in

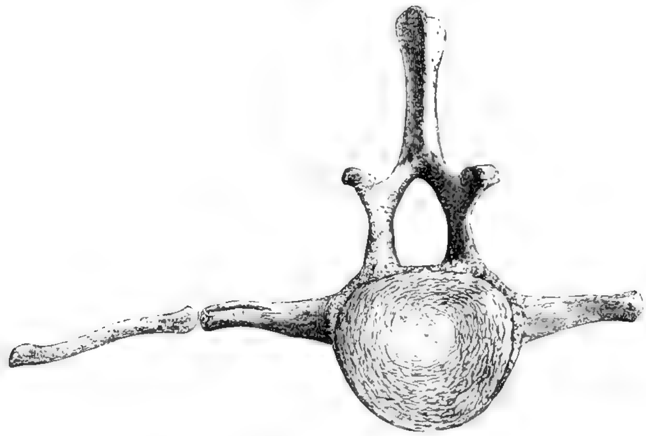
Fig. 7.



Tenth dorsal vertebra.

length from the first to the tenth (see Pl. LVIII.). The first is compressed from before backwards; the next two subcylindrical; the following four are very short, thick, and almost confluent with the bulky, rounded metapophyses. After this the transverse process gradually resolves itself more distinctly into the ascending and forward-directed rounded metapophysis, and the slightly descending and backward-directed diapophysis. The latter rapidly diminish in bulk, the last (tenth, fig. 7) being a comparatively slender conical process which, on the right side, meets within a line's breadth an ascending tubercle of the inferior transverse process to be presently described; on the left side the end of the process appears to be broken off. On the eleventh dorsal vertebra there

Fig. 8.



Eleventh dorsal vertebra and right rib.

is no trace of diapophysis, except perhaps a slight thickening on the corresponding part of the right neurapophysis. The free extremities of all these transverse processes (except the tenth) present roughened articular facets for the tubercles of the corresponding ribs. In the first this facet has a compressed oval figure, with the long diameter vertical; in the second it is subcircular; in the third, fourth, and fifth triangular; in the remainder oval, with the long diameter antero-posterior.

On the upper part of the sides of the bodies are conspicuous articular facets for the reception of the heads of the ribs. These deserve particular attention for the peculiarities they present in the hinder part of the region. They are disposed as follows:—The first vertebra has one facet on its hinder edge for articulation with the second rib. It is in the form of a low rough tuberosity. The second vertebra has a cup-shaped depression, with elevated margins on its hinder edge, for the third rib. The third vertebra has a similar facet for the fourth rib. The fourth vertebra receives in the same manner the fifth rib. The fifth vertebra shows on its anterior edge an indication of an articular surface for the hinder part of the fifth rib, and a large facet on its hinder edge for the sixth rib. The sixth vertebra has a more strongly marked articular facet on the anterior edge, while that on its hinder edge (for the seventh rib) is of reduced dimensions. In the seventh vertebra the articular surface near its front edge, for the seventh rib, is raised upon a small tubercle; while the posterior surface, for the eighth rib, is still further reduced and flat. In the eighth (fig. 5) the anterior facet is still more raised, and the posterior is nearly obsolete. In the ninth (fig. 6) the articular surface on the anterior edge of the body is developed into a distinct process, 2″ in length, springing from the anterior half of the side of the body, obliquely truncated, and having on its outer and anterior surface an oval excavated articular facet, which bears the head of the ninth rib. There is no trace of any articular surface on the posterior edge for the tenth rib. In the tenth vertebra (fig. 7) the above-described tubercle, developed from the anterior articular facet, takes the shape of a long massive process, 6″ in length and nearly as much in antero-posterior thickness, springing from the middle of the side of the body, slightly ascending, compressed from above downwards, more expanded at the end than the middle, ending in a large, oval, concave articular facet for the tenth rib, and having at its upper surface, near the extremity, a subconical, compressed (from before backwards) process, which rises to meet the small subcylindrical upper transverse process, approaching so closely on the right side as to be separated by scarcely a line's breadth. The eleventh vertebra (fig. 8) has no articular facets on the side of the centrum; but the process arising from this part on a level with that of the last-described vertebra, is still longer and more compressed, in fact precisely resembling in situation and general character those found on the lumbar vertebræ, but having at its extremity a small rough articular surface for the attachment of the rudimentary eleventh rib.

In the Caithness and Yorkshire skeletons the same essential characters are found, differing only in details arising chiefly from more advanced age. In the Yorkshire specimen, in the ninth dorsal vertebra, the inferior process is so far developed as to meet the upper one, forming a complete ring of bone on both sides. In the Caithness Whale this ring is complete only on one side in the ninth, but on both sides in the tenth vertebra.

In all known Cetacea (with the few exceptions to be presently mentioned) the transverse process which arises in the fore part of the dorsal region from the side of the neural arch, and is evidently serially homologous with the upper transverse process (*diapophysis*) of the cervical vertebræ, falls gradually and almost insensibly in its point of origin from the vertebra, until, leaving the arch, it comes to be placed upon the body of the vertebra, and is perfectly continuous serially with the transverse processes of the lumbar vertebræ, which, from their situation, would be taken to represent the inferior processes (*parapophyses*) of the cervical region. We find, moreover, after leaving the region of the neck, no trace of two lateral processes on the same vertebra.

The remarkable peculiarity of the Cachalot's spinal column is, that, tracing the upper transverse process backwards from the neck, it never descends from its original position on the arch, but, after a great reduction in importance, it completely disappears in the eleventh vertebra; while, on the other hand, a new process, springing from the side of the centrum of the eighth or ninth vertebra, and being at first only a development of the articular facet for the head of the rib, gradually becomes more distinct, and ultimately forms the main transverse process, serially continuous with those of the lumbar region. We have thus in the hinder part of the dorsal region of the Sperm-Whale a perfect repetition of the characters of the cervical vertebræ of ordinary Mammals, as far as the transverse processes are concerned, an upper one springing from the arch, a lower one springing from the body, and uniting at their extremities so as to form a complete bony ring.

In this important character of the spinal column *Hyperoodon* agrees with *Physeter*; and this appears to me one of the most striking points of affinity between these two genera. In the skeleton of the Hyperoodon in the Hunterian Collection in the College of Surgeons, upper transverse processes are regularly developed from the arches of the dorsal vertebræ as far as the seventh, but cease in the eighth. The lower processes arising from the body begin in the seventh, which has thus two processes, which (in this immature specimen at least) do not meet at the ends; but the bony ring is completed by the attachment of the proximal end of the rib to both processes, recalling exactly the condition of the cervical vertebræ of the Crocodiles. In several adult Hyperoodons' skeletons, I have seen the upper and lower transverse processes of the seventh dorsal vertebra united so as to form a complete ring.

It will be very important to ascertain whether *Kogia* and the Ziphioids agree in this respect with *Physeter* and *Hyperoodon*, as certainly might be predicated from their general affinities. With regard to the first-named, the only published description* of the skeleton at Sydney gives no information on this point; but the unique skeleton of the *Micropteron sowerbyense*, belonging to the last-named group, now in the Royal Museum at Brussels, shows the following characters:—The seventh dorsal vertebra has a transverse process springing from the arch; to this the tubercle of the seventh rib is articulated, while its head joins the body in the usual way. The eighth vertebra has no process from the arch, but one projecting from the body at a level with the facet for the attachment of the head of the seventh rib; to this the end of the eighth rib is fixed. The transposition of the transverse process from the arch to the body is thus as abrupt as in *Physeter* and *Hyperoodon*, the only difference being that the two processes do not coexist on any one vertebra as in those genera. The principle, however, is the same†.

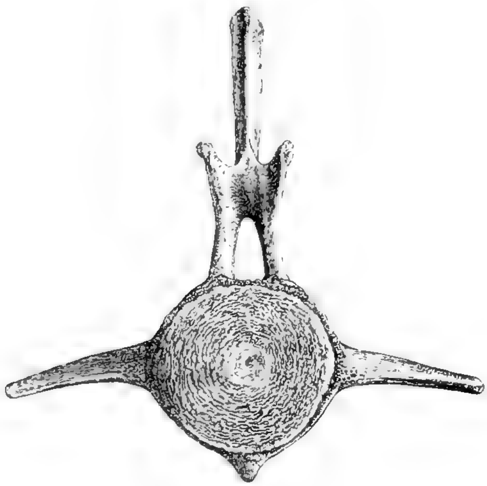
Lumbar Vertebræ.—The eight lumbar vertebræ present a remarkable similarity to one another, both in form and dimensions. Their bodies increase slightly but progressively in length from the first to the last. One of their most characteristic features is the form of their infero-lateral surfaces, much hollowed out and converging to a strong

* Wall, *op. cit.*

† For the condition of the rib-attachments in *Platanista* and *Inia*, in some respects intermediate between those of the *Physeteridæ* and *Delphinidæ*, see "Description of the Skeleton of *Inia geoffrensis*," &c., Trans. Zool. Soc. vol. vi. pp. 98–103.

keel running along the middle line below. They are also flattened between the neural arch and the transverse processes, so that the general form of the end of the body of one of these vertebræ is pentagonal, or like a lozenge with the upper angle cut off. The first of the series is rather different in form, having no distinct keel. In the older individuals, as the Caithness specimen, the keels of the lumbar vertebræ are developed to a still greater extent than in the Tasmanian skeleton.

Fig. 9.



Fifth lumbar vertebra.

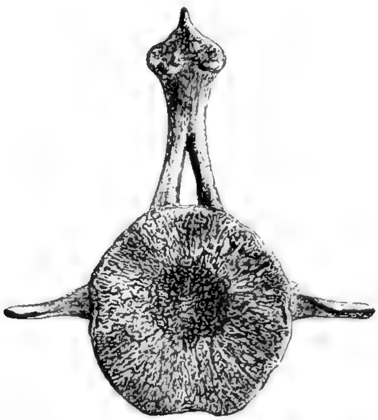
The transverse processes are comparatively short (considerably less than the diameter of the centrum); they have a very slight downward inclination, are of moderate breadth, flat, and roundly truncated at their ends. They increase slightly in length to the fifth, and then slightly diminish.

The spinous processes are high and broad, with a moderate slope backwards; the club-like lateral expansion noted in the upper end of the spinous process of the last dorsal vertebra is seen also in the first lumbar, though in a less marked degree, and gradually subsides in the following two or three. The height of the spine of the last lumbar vertebra presents a considerable diminution. As in the Cetacea generally, the metapophyses are strong, well-marked processes, projecting upwards and forwards from the neural arch, embracing the hinder margin of the spine of the antecedent vertebra. They do not form such broad expanded plates as in the true Whales; but, on the other hand, they are more distinct than in many other Delphinoids. One great peculiarity which distinguishes them from most others, even including *Hyperoodon*, is their gradual elevation upon the neurapophyses in passing from before backwards. In the first lumbar vertebra they arise from the laminæ of the neural arch by the sides of the canal, and their upper edge is $6\frac{1}{2}''$ above the top of the body; in the last they spring from the fore part of the spine, altogether above the junction of the laminæ at the roof of the neural arch, and their upper margin is 11″ above the top of the body. There are not any corresponding processes on the hinder edge of the spine, as in *Platanista.*

The *Caudal Vertebræ* are twenty-four in number, of which twelve or more appear, by the form of their inferior surfaces, to have supported chevron bones, although but ten of these bones were sent with the skeleton.

As is usual in this extensive region, the characters of the different vertebræ vary greatly. The first differs but slightly from the last lumbar vertebra. The centrum is more regularly circular when seen from the end, but rather higher than broad, the keel is no longer distinct, the sides are less hollowed, and on the hinder edge of the under surface are two distinct articular facets for the first chevron bones. The transverse processes are short, horizontal, and rounded at the ends, as in the lumbar region; the spinous process is slightly shorter, the metapophyses higher upon it, and the neural canal more contracted. The body of this vertebra is slightly larger than that of the last lumbar. In the succeeding seven there is very little change in respect to size; afterwards the diminution is more rapid. The reduction in the size of the centrum of the thirteenth as compared with the twelfth, and of the fourteenth as compared with the thirteenth, is so extraordinary that, unless there were abundant evidence to the contrary, one might be tempted to suppose that several vertebræ had been lost from each interval. The fifteenth, again, is considerably smaller than its predecessor. Then follow two of almost equal size, after which a gradual and steady reduction takes place down to the terminal vertebra.

Fig. 10.



Fourth caudal vertebra, without the epiphysis.

The great irregularity in the diminution of the caudal vertebræ will be best appreciated by a reference to the table of the weights of the different members of the series given at p. 328.

The neural arch forms a distinct canal as far as the fifteenth caudal vertebra; in the sixteenth and following vertebræ the processes which represent it do not meet across the middle line. In the Caithness Cachalot the canal terminates at the eleventh caudal, in the Yorkshire specimen at the twelfth. In the anterior vertebræ (with elongated bodies) the neural laminæ arise from little more than the anterior half of the body, but posteriorly, as the bodies decrease and the laminæ actually increase in the antero-posterior direction, they come to occupy nearly the whole length of the upper surface of the centrum. This is best seen in the ninth and tenth. In the first caudal vertebra the metapophyses form prominent flattened wing-like processes, projecting forwards and outwards from the front border of the neural spine, having a deep groove between them for the reception of the hinder edge of the spine of the last lumbar vertebra. Their upper and anterior edges are thickened, rough, and slightly everted. They are placed about halfway between the upper surface of the centrum and the highest part of the spine. In the five following vertebræ their height from the centrum remains almost precisely the same; but the spine gradually diminishes, so that in the sixth its upper edge comes to be on a level with these processes; at the same time they alter in character, becoming shorter and thicker, and terminating in a nearly circular, flat, but very tuberculated or rugged surface, looking upwards and forwards; after the third they are so truncated and placed so near together upon the anterior thickened edge of the neural spine, as to have scarcely any groove between them, and to have quite lost the "clasping" character they exhibit in the lumbar region. In the seventh caudal vertebra they have disappeared altogether, in consequence of the diminution of the height of the spine, or are only slightly indicated in the laterally thickened anterior extremity of the spinous process. Thereafter the spinous processes are of a very simple nature, compressed from side to side, elongated from before backwards, and truncated above. The eleventh is less compressed; the twelfth of quite another form, broad and flat above, the sides meeting at a very open angle; the thirteenth a mere irregular low tuberosity, perforated by a small canal $\frac{6}{10}''$ high by $\frac{4}{10}''$ wide. In the fourteenth and fifteenth the canal is much smaller in front than behind; in the last it is not so large as a goose-quill, and bridged over only for the space of half an inch. In the remaining vertebræ the upper surface of the bone has four tubercles, arranged in pairs—two near the front and two near the hinder edge, the anterior pair being the largest. Traces of these can be discovered as far as the penultimate vertebra.

In the anterior vertebræ of the series the transverse processes project outwards with an inclination slightly downwards and forwards, from rather below the middle of the side of the body. They soon diminish in length, and increase in width from before backwards. In the ninth vertebra they are reduced to roughened longitudinal ridges; in the tenth they have entirely disappeared, and their place is taken by a slight groove. In the Caithness Cachalot the transverse process is rudimentary in the tenth, and absent in the eleventh caudal vertebra; in the Yorkshire skeleton it is indicated by a ridge in the eighth, and is completely wanting in the ninth; so that in this respect the Tasmanian specimen holds an intermediate position between the two northern ones.

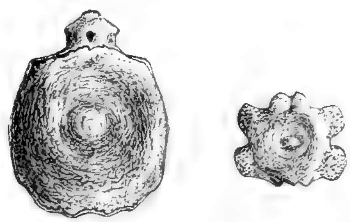
On the hinder edge of the transverse process of the fifth caudal vertebra, close to its origin from the body, is a deep notch, for the passage of a blood-vessel; in the two following vertebræ this notch increases in depth, being continuous with a vertical groove on the side of the body of the bone. In the eighth the notch is enclosed so as to form a large oval foramen $\frac{8}{10}''$ by $\frac{5}{10}''$ in diameter, perforating the base of the transverse process, rather behind the middle of the centrum. In the ninth vertebra the foramen is placed nearer the median line, and therefore still further enclosed in the bone. It is here and in the succeeding vertebra nearly midway between the anterior and posterior extremity. This foramen is an important feature in all the remaining caudal vertebræ, being found even in the penultimate, and presents several peculiarities worthy of note. As before said, it first appears as a distinct foramen in the eighth vertebra; or it may rather be described as a broad vertical groove on the side of the centrum, bridged over for a space of $2\frac{1}{2}''$ by the base of the short transverse process. In the tenth vertebra it has become a canal, 7″ in length; but the lower opening is still placed on the side of the body of the vertebra. In the eleventh the lower opening is placed at the angle between the side and the inferior surface, 5″ from the opening of the canal of the opposite side. In the twelfth they have moved toward the middle of the inferior surface, being separated from each other only by a narrow bony septum (less than 1″ in width). In the next three vertebræ the septum is still narrower; in the sixteenth it suddenly widens to 2″; and thence onward the inferior openings are gradually placed rather further from each other, until in the last few vertebræ the canals have gained the lateral position they possessed on their first appearance. In the meanwhile the upper orifices of these canals, advancing up the sides of the bodies of the vertebræ, soon come to be placed on each side of the middle of the upper surface, and maintain this situation to the end, only approaching nearer to each other as the vertebræ diminish in size.

The articular surfaces for the chevron bones are remarkably large and prominent, with elevated edges, and rough cup-like depressions in their middle. In many of these depressions a small, loose, irregular epiphysial plate is lodged. The first caudal vertebra has a pair of subcircular facets at its hinder edge, of which the left is considerably the larger, though somewhat less prominent; to these the first (ununited) hæmapophyses fit closely. In the Caithness Cachalot, these bones are ankylosed to the body of the vertebra, though not meeting each other at their free ends. In the second vertebra, the hinder facets are of larger size; but none are developed on the anterior edge. In the third, the facets on the anterior edge are slightly indicated, the posterior ones have increased still more. In the following nine vertebræ, the two pairs of facets are well developed, the anterior ones at first comparatively small, but towards the end of the series almost equalling the hinder ones in importance. On the thirteenth vertebra articular facets are faintly indicated on the anterior edge only.

Having now examined the modifications of the different parts of the caudal vertebræ, their bodies, neural arches, transverse processes, arterial foramina, and articular facets for hæmapophyses, a few words must be said on the peculiarities of the different vertebræ of the hinder part of the series taken as a whole.

The first twelve, or chevron-bone-bearing vertebræ, present a gradual and steady change in size and general character from first to last, this change consisting of the gradual reduction in size of the centrum, reduction of the neurapophysis, and reduction, to absolute disappearance, of the transverse processes. In the thirteenth caudal vertebra, a great change takes place in the size of the body, though the same general form is maintained. The anterior and posterior surfaces are nearly subcircular; but the absence of any transverse processes, and the presence of a roughened low tuberosity representing the neurapophysis, and of the inferior tuberosities for the attachment of the hæmapophyses, make the whole bone higher than broad. The most remarkable feature about this vertebra is the rapid manner in which it diminishes posteriorly, the posterior surface for the attachment of the intervertebral substance being 2″ less in diameter than the anterior.

Fig. 11.



Twelfth and seventeenth caudal vertebræ.

The succeeding vertebra is of very simple character, being reduced to a centrum with a slight tubercle covering the neural canal to represent the spinous process; in consequence of this, the whole bone is still slightly higher than broad. After this a sudden change in form takes place; in the fifteenth and all the succeeding vertebræ the breadth predominates over the height. The fifteenth to the twentieth inclusive present very uniform characters. They may be described generally as transversely elongated oblong bodies, flattened before and behind, above and below, and at each side. The upper and under surfaces are remarkably alike, so much so that it requires close attention to very minute characters to be able to distinguish them. The upper surface shows on each side, about midway between the median line and the outer edge of the bone, the funnel-shaped opening of the large circular arterial canal, which perforates the vertebra nearly vertically. The quadrangular space between these perforations bears at each corner four tuberosities, an anterior and a posterior pair, remnants of the neurapophysis, divided longitudinally by the narrow groove representing the neural canal, and cut, as it were, in two in the opposite direction by a wider groove connecting the two lateral, vertical, vascular canals. Of these four tuberosities, the anterior are larger than the posterior pair. In the first vertebra of the series now being described, the longitudinal groove is bridged over by a narrow bar of bone, and the anterior and posterior tuberosities of each side are confluent, but having a canal running under them connecting the vascular canals. In the second there is no connexion across the middle line; but the anterior and posterior tuberosities unite across the groove on the right side.

The under surfaces also present four tuberosities in the corresponding situation, but placed slightly further from the middle line, and showing less dissimilarity in size between the anterior and posterior pair. They very much resemble in form and situation the processes which bear the hæmapophyses in the anterior caudal vertebræ. The lower openings for the vascular canals, which in the first vertebra of this group are placed so near as not to allow of an interval of more than $\frac{1}{2}''$ between them, in the next are $2''$ apart, and then gradually become somewhat more distant proportionally to the size of the vertebræ. As their upper ends remain in the same position, the canals, from being quite vertical, gradually acquire an upward and inward direction. Along the middle of the lateral surface of all these vertebræ is a strongly marked longitudinal groove, bounded above and below by large rough tuberosities, of which the upper one is rather the more prominent, especially at its anterior corner. This peculiar form of the side is one of the most characteristic features of these vertebræ, and begins suddenly in the first of this group.

It now only remains to speak of the special peculiarities of the last four caudal vertebræ. If we take any one of these, say the third from the end (the twenty-second caudal), we shall find that it consists of much more than a simple centrum, the part which often is alone represented in this region; but to recognize in it any of the ordinary elements of a typical vertebra is by no means easy. We can, however, trace a gradual modification from those last described to the one which terminates the whole series. Excluding for the present this last named, the other three diminish rapidly in breadth, though but slightly in length. The anterior and posterior surfaces, to which the intervertebral substance is attached, are deeply hollowed. All the processes gradually subside, with the exception of the anterior part of the upper lateral tuberosity, which obtains an increased development, forming a distinct process, projecting upwards and forwards, from the anterior upper angle of the bone. The vertical canals continue; but their lower openings (which were already somewhat further apart in the hinder vertebræ of the last group), have, as it were, cut their way out of the bone, and form deep grooves on the sides, before perforating the upper lateral process, much in the same manner as in those vertebræ where these holes first made their appearance. The penultimate vertebra is so much elongated, and constricted in the middle by these grooves on each side below, and by the one connecting the two foramina (here much reduced in diameter) on the upper surface, that at first sight it looks like two vertebræ which have coalesced, as not unfrequently occurs in this region among true Whales. The last vertebra is a rough, broad, oval nodule of bone, truncated in front, obtusely pointed behind, flattened from above downwards. Traces of the vascular grooves are to be detected on its sides. The contiguous surfaces of this and the penultimate are both concave; but the irregularities of their prominent edges correspond exactly, and they have evidently been in close apposition.

The last twelve vertebræ of the tail of another Cachalot, sent to the Museum by Mr. Crowther in 1866, resemble those of the skeleton in their general characters, and evidently correspond vertebra for vertebra, but with considerable individual deviations. They are, in the first place, all rather shorter in proportion to their breadth. The entire length of the twelve placed in apposition is 38″, while the twelve corresponding vertebræ of the skeleton measure 42″, the breadth of the former slightly exceeding that of the latter. The neural arch is not completely closed in by bone even in the first of the series. The penultimate is much shorter than that of the specimen described above. The terminal vertebra is altogether smaller, and does not present the broad, depressed character of the other, but is a simple rough subconical nodule. The first of the set had a perfect chevron bone attached to its hinder edge, $5\frac{1}{2}''$ in greatest depth, and 4″ in length. The second had another, consisting of two distinct oval plates $2\frac{1}{4}''$ deep by $2\frac{1}{2}''$ long. There were no further traces of hæmapophyses, which, from the state of the specimen, must have been preserved if they had ever existed.

The Tasmanian, Sydney *, Caithness, and Yorkshire Cachalots resemble each other in possessing a distinct atlas, followed by six ankylosed cervical, and ten dorsal vertebræ bearing well-developed ribs. They agree, moreover, in possessing eight true lumbar vertebræ. The Sydney specimen, however, according to the published description, wants the vertebra intermediate between the dorsal and the lumbar series, found in the other three, and hence has one vertebra less in front of the first chevron bone. Of remaining or caudal vertebræ, the Tasmanian and Sydney specimens have twenty-four, the Yorkshire specimen (presuming it to be complete) twenty-three, while in the Caithness one the number cannot be stated with certainty. The Yorkshire and Sydney Cachalots, therefore, agree in the entire number of vertebræ being forty-nine, while the Tasmanian skeleton possesses fifty. These differences are so trifling that they may be the result of accident or individual peculiarity; they certainly by themselves afford no assistance in discriminating between a northern and southern species of the genus.

Nor do we find, on reverting to the special characters of the vertebræ, any more

* Wall, *op. cit.*

certain indications of difference. Each of the three vertebral columns which have passed under more immediate observation shows certain peculiarities; but what similar part of the organization of any given species of animal will not do so? And it must be remembered that, in these huge bones, differences of form and proportion are rendered most conspicuous which would almost escape observation in specimens of the size of those with which we are more accustomed to deal, and, further, that the ossification in the Sperm-Whale, more even than in other large Cetaceans, seems to have a special tendency to exuberant and irregular development, producing a great amount of individual character in the rugged masses composing the skeleton.

It may be as well, however, to bring together the principal points of difference, such as they are, in the three skeletons. The first to be mentioned relates to the length of the column when the vertebræ are placed in close apposition. This is, in the Yorkshire one, 29′ 5″, in the Caithness one (allowing for the missing caudal vertebræ) 29′ 3″, in the Tasmanian one 30′ 4″. It must be remarked that the last, though the longest, is the least mature of the three animals. In the first two the correspondence is exceedingly close. With regard to the third, something must be probably allowed for the fact that the loose epiphyses of the ends of the vertebræ, having become detached in maceration, could not be made to fit again so closely as they would if ankylosed; and hence the length of each vertebra was increased to a very slight extent. The differences in the proportions of the individual vertebræ are given in the Table at p. 327. They are not inconsiderable, but are as great in the case of the two British specimens as between either of these and the Tasmanian one. The greater height of the lumbar vertebræ of the two former as compared with the latter, is chiefly due to the increased development of the keel of the body, apparently a consequence of superior age. Slight differences in the atlas, chiefly relating to the form of the lower part of the central opening, and to the development of the transverse processes, have been already spoken of in the description of that bone.

In the annexed Table I have given the vertebral formula of the principal members of the group of Delphinoid Cetaceans, as far as I have been able to ascertain them from perfectly reliable sources.

PHYSETERIDÆ.

Physeter macrocephalus australis (Mus. Roy. Coll. Surg.), C. 7, D. 11, L. 8, C. 24=50.
P. macrocephalus australis (Wall), C. 7, D. 10, L. 8, C. 24=49.
P. macrocephalus borealis (Yorkshire), C. 7, D. 11, L. 8, C. 23=49.
Kogia grayii (Wall), C. 7, D. 14, L. C. 30=51.
Hyperoodon rostratum (Mus. Oxford and Vrolik), C. 7, D. 9, L. 10, C. 19=45.
H. rostratum (Amsterdam and Roy. Coll. Surg.), C. 7, D. 9, L. 10, C. 18=44.
Micropteron sowerbyense (Van Beneden), C. 7, D. 10, L. 10, C. 19=46.
Ziphius cryptodon (Burmeister), C. 7, D. 10, L. 12, C. 20=49.

PLATANISTIDÆ.

Platanista gangetica (Eschricht), C. 7, D. 11, L. 8, C. 25=51.
Inia geoffrensis (Brit. Mus.), C. 7, D. 13, L. 3, C. 18=41.
Pontoporia blainvillii (Burmeister), C. 7, D. 10, L. 7, C. 18=42.

DELPHINIDÆ.

Beluga leucas (Mus. Louvain), C. 7, D. 10, L. C. 33=50.
Monodon monoceros (Mus. Roy. Coll. Surg.), C. 7, D. 11, L. 6, C. 26=50.
Phocœna communis (Mus. Leyden), C. 7, D. 13, L. 14, C. 30=64.
P. communis (Mus. Roy. Coll. Surg.), C. 7, D. 13, L. 14, C. 30=64.
P. communis ♀ (Mus. Roy. Coll. Surg.), C. 7, D. 13, L. 14, C. 32=66.
P. communis ♂ (Mus. Oxford), C. 7, D. 12, L. C. 46=65.
Neomeris phocœnoides (Mus. Leyden), C. 7, D. 13, L. 13, C. 30=63.
Orca gladiator (Mus. Leyden), C. 7, D. 11, L. 10, C. 23=51.
O. gladiator (Mus. Cambridge), C. 7, D. 12, L. C. 33=52.
Pseudorca crassidens (Reinhardt), C. 7, D. 10, L. 9, C. 24=50.
Globiocephalus melas (Mus. Roy. Coll. Surg.), C. 7, D. 11, L. 12, C. 28=58.
G. melas (Middlesex Hosp.), C. 7, D. 11, L. 13, C. 28=59.
G. ——? (Tasmania, Mus. Roy. Coll. Surg.), C. 7, D. 11, L. 14, C. 27=59.
Delphinus sinensis (Mus. Roy. Coll. Surg.), C. 7, D. 12, L. 10, C. 22=51.
D. guianensis (Van Beneden), C. 7, D. 12, L. 14, C. 22=55.
D. tursio (Mus. Leyden), C. 7, D. 13, L. 17, C. 25=62.
D. heavisidii (Mus. Leyden), C. 7, D. 13, L. 15, C. 30=65.
D. superciliosus (Mus. Leyden), C. 7, D. 13, L. 23, C. 30=73.
D. delphis (Mus. Roy. Coll. Surg.), C. 7, D. 13, L. 24, C. 31=75.
Lagenorhynchus leucopleurus (Mus. Leyden), C. 7, D. 15, L. C. 59=81.
L. albirostris (Mus. Cambridge), C. 7, D. 14, L. C. 67=88.

It will be seen from this Table that the total number of vertebræ varies extremely in different genera, and even in species of some natural genera, the variation being chiefly in the lumbar and caudal regions. The well-marked group *Physeteridæ*, comprising the five genera placed at the head of the list, are all characterized by rather a small number of vertebræ; but among the other families there are many which have quite as few as some of the former. For instance, the vertebral formulæ of *Platanista*, *Beluga*, *Monodon*, and *Orca* closely resemble that of *Physeter*. It is singular that the most nearly allied genus, *Kogia*, differs so much in the number of dorsal vertebræ. On the whole, little reliance can be placed on these numbers for classificatory purposes, as shown by the extraordinary excess to which they run in *Lagenorhynchus*, a form otherwise not possessing any special modification.

The characters of the cervical region of the genus *Physeter* have already been shown to be quite peculiar to itself. The dorsal region presents a remarkable disposition of the transverse processes, which points to a close affinity with *Hyperoodon* and the Ziphioids. The lumbar and caudal regions also, in some characters, especially their short transverse processes, approximate to those of the same forms; the spinous processes, however, fall far short of the excessive height, and the bodies of the vertebræ present but little of the peculiar elongation, so characteristic of those groups.

Chevron Bones.

Ten chevron bones were sent with the skeleton; but it would appear from the distance to which these bones extend backwards, as ascertained with certainty on the detached tail described at p. 347, that fourteen is the complete number. By a careful comparison of the articular surfaces on the vertebræ with those on the different chevron bones, the missing ones were ascertained to be the fifth, sixth, and the thirteenth and fourteenth.

The first (See Pl. LIX.) is represented by a pair of small styliform bones. They are not quite alike, the right being rather the longest, and the left much the thickest. They both end in a point, and are slightly hollowed on their inner side, and flattened externally. They fit most closely, by an expanded, rough, subcircular base, to the corresponding facets on the hinder margin of the body of the first caudal vertebra. The dimensions of these bones are:—

	Right.	Left.
	inches.	inches.
Length	6″	5″·2
Diameter at base	2″·2	2″·8
Diameter at middle, antero-posterior	1″·9	2″·3
,, ,, transverse	1″·3	1″·5

From the Yorkshire skeleton these bones are absent. In the Caithness specimen they are more massive and irregular in shape, and are completely ankylosed to the body of the vertebra. Their free extremities diverge from each other and project strongly backwards.

In the succeeding bones (up to the fourteenth) the two lateral laminæ are united below, and form a prominent spine. The second is comparatively small and narrow, and has the spine slightly developed. In the third the spine is very large, both long and broad, and truncated below. In the fourth it is somewhat shorter, but more massive and rounded at the lower end. The entire length of the second bone is $10\frac{3}{4}''$, of the third 21″, and of the fourth 20″. The lower edge of nearly all the remaining bones has been cut off by a sharp instrument in preparing the skeleton; so I am not able to give their correct length or configuration. The surfaces for contact with the vertebræ are expanded, massive, rough, and hollowed; and many of them have imbedded within them separate epiphysial ossifications, more or less ankylosed either to the chevron bone or to the body of the vertebra.

In both the Caithness and Yorkshire skeletons the number of the chevron bones is obviously incomplete; the former has only eleven, and the latter ten. Those that are present differ very notably in form and dimensions both from each other, and from those of the Tasmanian skeleton; but this is the most unsatisfactory part of the whole examination, owing to the imperfection of the materials and the difficulty, in incomplete sets, of ascertaining with precision which are the corresponding bones.

Ribs.

The ribs, though tolerably long, are (with the exception of the first) slender and light for the size of the animal, at least when compared with those of a *Balæna* of corresponding magnitude. This character is best illustrated by stating that in the skeleton of the nearly adult *Balæna mysticetus*, in the Mus. of Roy. Coll. of Surgeons, 46′ in length, the twelve pairs of ribs weighed 7 cwt. 60 lbs.; in the Cachalot, several feet longer and of corresponding age, the eleven pairs weigh less than 3 cwt. Nevertheless their tissue is dense and compact.

It is stated by Wall that the ribs of the left side are of larger dimensions than the corresponding ones of the right. In order to ascertain whether there is a similar want of symmetry in the specimen under consideration, I weighed all the ribs; and the result shows considerable individual differences in corresponding ribs, and a very trifling general preponderance of the left side over the right—the total weight of the ribs of the right side being 163 lbs. $9\frac{1}{2}$ oz., and those of the left side 164 lbs. $5\frac{1}{2}$ oz.

Weight and Measurements of the Ribs (excluding the rudimentary eleventh pair).

		Weight.		Extreme length in straight line.	Circumference at middle.	Circumference at inferior extremity.	Curve*.
		lbs.	oz.	in.	in.	in.	in.
1	R.	27	6	45	14	29	$10\frac{1}{2}$
	L.	27	4	47	14	28	11
2	R.	25	13	$63\frac{1}{2}$	$11\frac{1}{2}$	$20\frac{1}{2}$	22
	L.	25	1	63	$11\frac{1}{2}$	20	21
3	R.	25	0	70	$9\frac{1}{2}$	$17\frac{1}{2}$	28
	L.	25	13	$71\frac{1}{2}$	$9\frac{3}{4}$	18	27
4	R.	21	8	71	$9\frac{1}{4}$	16	29
	L.	23	2	74	$9\frac{1}{2}$	$16\frac{3}{4}$	29
5	R.	19	8	68	$8\frac{3}{4}$	14	30
	L.	21	7	72	$8\frac{3}{4}$	15	29
6	R.	19	5	$67\frac{1}{2}$	9	$12\frac{1}{2}$	29
	L.	19	7	$68\frac{1}{2}$	$8\frac{3}{4}$	12	28
7	R.	17	7	$65\frac{1}{2}$	$8\frac{3}{4}$	10	26
	L.	16	15	$66\frac{3}{4}$	$8\frac{1}{4}$	$10\frac{1}{4}$	25
8	R.	15	3	63	$8\frac{1}{2}$	8	22
	L.	13	15	65	8	$8\frac{1}{2}$	$22\frac{1}{2}$
9	R.	10	6	61	7	$7\frac{1}{2}$	19
	L.	10	5	63	$6\frac{1}{2}$	$8\frac{1}{2}$	18
10	R.	9	$7\frac{1}{2}$	56	7	$8\frac{3}{4}$	11
	L.	8	$4\frac{1}{2}$	$55\frac{3}{4}$	$6\frac{3}{4}$	8	$11\frac{1}{2}$

* Taken by standing the rib with its two ends on the floor, and measuring from the latter to the interior of the highest part of the arch.

The first rib (Pl. LX. fig. 2) is very different from the others in form. Though by far the shortest, it weighs absolutely more than any of the others, this being occasioned by its great thickness, especially towards the inferior end. It is very broad throughout, but much compressed from before backwards. At the angle it bends very abruptly, the main part of the rib, or that below this point, being almost straight. The inner concave border is very sharp, the outer one more rounded. The tubercle is very largely developed, forming a great expanded rugged crest at the upper extremity of the bone, by which it articulates with the end of the transverse process of the first dorsal vertebra. The capitular process is quite rudimentary, being a slight angular projection marked off from the tubercle by a shallow depression. It may have had a ligamentous union with the rough elevation near the hinder border of the body of the seventh cervical vertebra; but there must have been an interval of fully 6 inches between them. At the lower end the whole bone is twisted on itself, the anterior surface turning outwards, and the inner edge forwards. The size of the bone also is increased greatly, not only in breadth, but in thickness—the last alteration mainly affecting the inner or anterior part, so that the sharp edge previously mentioned becomes quite rounded, and the surface of the truncated inferior extremity is much wider at its inner than its outer end.

The second rib partakes somewhat of the massiveness of the first, though it is considerably longer, and of very different general form. Its curve is tolerably regular, though the principal bend is, as usual, in the neighbourhood of the angle. It is flattened from before backwards, and has a sharp internal edge. The tubercle is much reduced in size, and presents a broad oval surface for articulation with the transverse process of the second dorsal vertebra. The neck is a well-developed compressed process, tapering towards the apex, where it is somewhat dilated, and must have reached very nearly, if not quite, to the small articular surface on the side of the body of the first dorsal vertebra. A very prominent crest extends backwards from the tubercle, terminating rather abruptly at the angle. This distinguishes the second rib from the first, as well as from those that come after it in the series. The outer surface is much more regularly convex than that of the first rib. The anterior surface gradually becomes external towards the lower end; and the expansion of this part (less marked than in the first) affects chiefly the middle of the bone, the truncated end presenting a regularly oval surface.

The third rib is longer, but thinner than the second. Its curve is rather wider; it is less compressed and wants the prominent sharp inner concave border, and also the crest above the angle; its tubercle is less rounded, but rises into a sharp angular process surmounting the flat inwardly turned articular surface; its capitular process is longer and more dilated at the end. The inferior extremity is still considerably enlarged, but less than in the last.

The fourth, fifth, and sixth ribs closely resemble the third, and each other; but the following changes may be observed gradually occurring in them. They become more slender and rounded in the middle part of the shaft. The capitular process becomes slightly shorter, but at the same time thicker; and the capitulum itself becomes larger and more irregular in shape. The tubercle becomes rather less prominent. The inferior end of the rib presents a less marked enlargement, and is more regularly cylindrical.

Each of these ribs articulates in the usual way by the tubercle with the transverse process of the corresponding dorsal vertebra, and by the head with the facet on the hinder edge of the body of the preceding vertebra. The last two may also have had a slight connexion with the body of the corresponding vertebra.

The seventh rib has a shorter but very thick neck, the capitular surface of which is produced backwards, so that it articulates distinctly with the bodies of two vertebræ, chiefly, however, with the one in front of that to which its transverse process is attached. The articular surface of the tubercle is much elongated in the fore-and-aft direction.

The eighth repeats much the same condition at the upper end; it may be distinguished, however, by its greater slenderness, especially at the lower end, which presents scarcely any appreciable enlargement.

The form of the upper end of the ninth rib is very characteristic. The neck is still shorter than in the last, and very obliquely truncated; but its articular surface is large, and, contrary to what obtains in the preceding, particularly so at the hinder part, as it articulates chiefly with the raised facet on the body of its own vertebra. The tubercle is large and overhangs the posterior hollowed surface of the capitular process. Below the tubercle the rib is very slender, and has a slight twist backwards. The lower part is flattened from without inwards, and has a prominent sharp ridge on the posterior margin.

The tenth rib is considerably shorter than the ninth. The capitular process is entirely absent; but the expanded upper end, which articulates only with the end of the transverse process of the tenth dorsal vertebra, is divided by a vertical groove into two unequal surfaces, of which the anterior larger one represents the base of the neck, and the smaller posterior one the tubercle. The lower end is flattened and twisted somewhat backwards.

The eleventh rudimentary pair of ribs are nearly straight, the longer one having a slight sigmoid curve. They are largest at their attached extremity, and gradually taper, but are slightly enlarged again at the tip. In the greater part of their length they are flattened from above downwards; but, having a slight twist on their own axis, the longest one becomes towards its distal extremity flattened almost in the opposite direction. The proximal ends are truncated, having an oval, slightly convex articular surface, which was tipped with cartilage. These bones offer few characters indicating the side of the body to which they respectively belong. One (probably the right) is $13\frac{3}{4}''$ in length, and $2\frac{3}{4}''$ in greatest diameter at the proximal end; the other is $11''$ in length, and $2\frac{1}{2}''$ in diameter at the same point.

The ribs of the Caithness and Yorkshire skeletons agree in their number and general characters with those of the present specimen. In the former, the two rudimentary eleventh ribs are preserved, and are $13\frac{1}{2}''$ and $12\frac{1}{2}''$ long respectively, and somewhat stouter than in the Tasmanian Cachalot. In the skeleton at Burton Constable they are not present; but the condition of the ends of the transverse processes of the corresponding vertebræ clearly indicate their former existence. In the Sydney skeleton, ten pairs of fully developed ribs are described. The small eleventh pair, if they existed, may easily have escaped observation, especially as the animal was scarcely more than half-grown.

The skeleton at Paris has fourteen pairs of large ribs, with indications on the transverse processes of a fifteenth. Their articular surfaces, as well as the corresponding processes of the vertebræ, are much decayed and broken; but, as far as can be ascertained, they appear to follow each other in a regular and natural sequence, and afford no certain evidence that the skeleton has been artificially compounded. The first pair have rudimentary capitular processes, larger on the left than the right side. These are followed by ten pairs with well-developed capitular processes reaching to the bodies of the vertebræ in the usual way. The last three are connected only with the lower transverse processes, which are strongly developed and hollowed out at the end for their reception.

In all the true Dolphins (*Delphinidæ*) the anterior ribs (about half of the series) have long heads, by which they are connected with the body, or root of the arch, of the vertebra in front of that to which the tubercle is attached. Near the middle of the series this head suddenly ceases to be developed, and the ribs articulate only to one vertebra, by the tubercle. It will be seen from the preceding description that in the Cachalot the condition of the upper end of the ribs, and their mode of connexion with the vertebræ, is quite different. Of the Cetaceans whose osteology is thoroughly known, *Hyperoodon* comes nearest to *Physeter* in this respect, as already mentioned when speaking of the transverse processes of the thoracic vertebræ. The form of the first rib of the Cachalot, however, is very peculiar—the absence of a distinct head reaching the body of the vertebra having no counterpart among Toothed Whales, not even in *Hyperoodon*.

Sternum.

The sternum (Pl. LX. figs. 3 and 4), is a large, massive bone, though of rather spongy texture. Its general form is roughly triangular, the apex being turned backwards. The broad anterior edge, nearly equal to the sides in length, is tolerably straight. It is composed of three distinct portions—two large anterior lateral pieces, and a small posterior median piece. The former have probably each consisted of an anterior and posterior portion, though the traces of this distinction are well-nigh obliterated. The latter, in like manner, appears to be the result of fusion across the middle line of two lateral portions; so that the sternum was originally ossified from three pairs of distinct centres, as shown by Wall in the figure of the young skeleton at Sydney.

The contiguous borders of the large anterior pieces do not come in contact for the whole of their length, but leave an oval median aperture, 11″ long, and 8″ in greatest width, the fore end of which is 7″ from the anterior margin of the bone. The greatest breadth across the entire sternum, close to its anterior end, is $42\frac{1}{2}''$ in a straight line. Its extreme length is 47″. The posterior piece, of an irregularly quadilateral form, is $10\frac{3}{4}''$ wide near the front, and contracts to $6\frac{1}{2}''$, expanding again slightly at the hinder extremity. Its extreme length is $14\frac{3}{4}''$, being more produced backwards on the left side than on the right. As seen in the side view (Pl. LX. fig. 4), the whole bone is considerably curved in the longitudinal direction, and is very unequal in thickness. The superior lateral angles form very large and massive prominences, bearing rugged oval surfaces for articulation with the expanded lower end of the first rib. Below this the bone becomes comparatively slender, and then thickens again at the junction of the first and second piece, where is situated a small cup-shaped articular surface for the cartilage of the second rib. The second piece retains throughout a considerable vertical thickness. At its hinder extremity is the surface for the attachment of the cartilages of the third rib.

The sternum of the Caithness Cachalot presents the same general form, but is broader in proportion to its length. The two anterior pieces are united together for a space of 8″ in front of the median foramen, but are still disjoined behind it. The foramen is smaller and more circular, being 6″ in length by 5″ in breadth. The most notable difference, however, is in the hinder piece, which is represented only by a median spheroidal nodule of bone, 4″ in diameter, which fortunately still remains *in situ*, imbedded in a mass of dried cartilage. The greatest breadth of this sternum is 46″, its length 32″.

The sternum of the Yorkshire skeleton comes nearer again to the Tasmanian, both in general proportions and in the development of the hinder portion. Its extreme breadth is 44″, and its length, including the hinder piece, which is 12″, is 45″. As in the last-described adult specimen, the anterior portions are united across the median line in front of the foramen, but not behind. The foramen itself is of a different form from that in either of the others, being very long and narrow, 14″ by $4\frac{1}{2}''$.

All the specimens appear to agree with that described by Wall in having surfaces for the direct attachment of the cartilages of four pairs of ribs—the first to the anterior corners (where the bone is broadest), the second to the junction of the ankylosed first and second pieces of the sternum, the third to the hinder end of the second piece, and the fourth to the third piece, or, in the Caithness skeleton, to the cartilaginous mass in which this is imbedded.

The sternum of the Cachalot resembles that of its nearest congeners, *Hyperoodon* and *Ziphius*, in general principle of construction, being formed from three pairs of ossific centres, but differs in its rugged massiveness, in its broad triangular shape, and especially in the tardy union of its lateral parts across the middle line.

Neither of the three skeletons of Cachalots in this country has any vestige of ossified sternal ribs. Wall says, "the sternal parts of the ribs are all cartilaginous"*. We may therefore conclude that *Physeter* resembles its congeners *Kogia*, *Micropteron*, and *Hyperoodon* in this important character.

Pectoral Limb.

Besides the limb-bones belonging to the skeleton, from which unfortunately some of the phalanges were lost, Mr. Crowther has kindly placed at my disposal two pairs of complete fins of adult male Cachalots, with all the bones in their natural connexion. Nothing is therefore wanting in the materials for completing our knowledge of this portion of the skeleton.

In relation to the entire size of the animal, the pectoral limb of the Cachalot is comparatively small, the length of its osseous parts from the head of the humerus to the terminal phalanges being 4′ 10″, or about $\frac{1}{11}$ of the entire skeleton. The terminal portion is broad, and rounded or almost truncated at the extremity, the digits being spread apart, and all five well developed, especially the second, third, and fourth, which do not differ greatly in length. This form of hand is also found in the other *Physeteridæ*, the *Platanistidæ*, and *Beluga* and *Monodon* among the *Delphinidæ*. It has its greatest contrast in the narrow lanceolate fin, with adpressed digits, of which the second and third far exceed the others, characteristic of *Delphinus*, and which reaches its extreme development in *Globiocephalus*.

An observation in Wall's memoir† has given rise to the idea, since repeated in other works, that there is a want of symmetry in the two pectoral limbs of the Cachalot, the bones of the right being described as "considerably larger than those of the left." However this may be with the specimen in the Sydney Museum, there is certainly no appreciable difference either in size or form in the bones of the two pectoral limbs in any of the skeletons that I have examined.

The *scapula* is higher in proportion to its breadth than in any other Cetacean; indeed it is the only one known in which the height actually exceeds the greatest transverse breadth. The whole of the outer surface (corresponding to the infraspinous fossa of the ordinary mammalian scapula) is remarkably concave, and the internal surface is in a corresponding degree convex‡. The spine, as is usual in the Cetacea, has a very narrow base of origin, placed near the neck of the bone, and so close to the anterior edge as to reduce the supraspinous fossa to almost imperceptible

* *Op. cit.* p. 28.

† *Op. cit.* p. 5.

‡ In the Sydney skeleton, according to Wall's figure, the internal surface of the scapula is placed outwards. The same is the case with the skeleton at Burton Constable, the articulator having doubtless been misled in both cases by the above-mentioned peculiarity.

dimensions; on the other hand it is very long, projects slightly outwards, and then directly forwards, and is expanded vertically at its acromial termination. The coracoid, which arises immediately below the spine, but rather to the inner side, or just above the anterior edge of the glenoid fossa, is a stout, compressed, truncated process, somewhat dilated at its extremity, and of about half the length of the acromion. The glenoid fossa is a very broad and irregular oval, with prominent margins. On the posterior internal part of the margin the surface of the bone is rough, as if the process of ossification were not complete; and in the cartilaginous mass which covered it a detached, rough, irregular epiphysial nodule was imbedded.

The scapulæ of the different specimens examined present slight variations in form and proportions, as will be seen by the following table of dimensions. There is nothing, however, in this bone or in the other osseous structures of the limb to distinguish the Tasmanian from the northern Cachalots.

Dimensions of Right Scapula.

	Tasmanian.	Yorkshire.	Caithness.	Paris.
	inches.	inches.	inches.	inches.
Extreme length, from highest part of superior border to anterior margin of glenoid fossa	36½	39¾	37	
Length from centre of superior border to middle of glenoid fossa	32½	36	34	35
Length of anterior margin, from anterior superior angle to anterior margin of glenoid fossa	36¼	41	36	
Length of posterior margin, from posterior superior angle to posterior margin of glenoid fossa	26¼	26	27½	26
From anterior superior angle to origin of acromion process	21	22½	21	
Breadth between anterior and posterior superior angles	29	34½	29¾	27
Breadth immediately above the root of the acromion process	12	13¼	12½	13
From posterior inferior angle (hinder margin of glenoid fossa) to end of acromion	23½	26½	22	
Length of acromion	13¾	16½	13	14
Vertical height of acromion at narrowest part (near its root)	5½	6	5½	4¾
Vertical height at broadest part (near its extremity)	9¾	11	11	8
From posterior inferior angle, to end of coracoid process	16½	19½	16¾	21
Length of coracoid process	7	12	8¾	11
Vertical height of coracoid process at its narrowest part, near middle.	2¾	3¾	3½	
Vertical height at its thickest part, near its extremity	3	5	5	3½
Length of glenoid fossa, including its thickened margin	9½	9	8	10
Breadth of glenoid fossa, including its thickened margin	8	8	8	

In the superior height of the scapula compared to its breadth, *Physeter* presents much the same deviation from the other Dolphins as *Balæna* does from the other Whalebone-Whales. The scapula of *Hyperoodon* is intermediate between that of *Physeter* and the low broad form so characteristic of the typical *Delphinidæ*. In *Kogia* the scapula appears to follow more closely the ordinary type.

Humerus.—The shaft of the humerus is much compressed from side to side. The head is not marked off by a very distinct neck, and the broad single tuberosity is not particularly prominent. The most distinguishing peculiarity of this bone, found in all the specimens examined, but not seen in the Dolphins generally, is a rough rounded tubercle, projecting downwards from near the middle of the radial border, and connected by a broad ridge with the lower part of the tuberosity. Immediately beyond this tubercle, the border of the shaft is deeply hollowed out. The distal end is divided nearly equally into two rugged and irregular hollowed facets, meeting at an angle of about 150°. The radial facet is considerably broader than that for the ulna.

In both the aged animals from the British coasts, the extremities of the radius and ulna are ankylosed to the contiguous surfaces of the humerus; and this is partially the case on the left side in the Tasmanian skeleton, but not on the right; nor has it occurred in either of the other specimens sent by Mr. Crowther. It must be observed, however, that in neither of these has the epiphysis forming the head of the humerus, and which includes nearly the whole of the tuberosity, coalesced with the shaft. In none of the specimens is there any trace of a distal epiphysis to the humerus. A considerable difference will be observed in the form of the two humeri figured in Plate LXI.

The *radius and ulna*, in nearly all the specimens examined, are united together at their proximal extremity, and in one case (the Caithness skeleton) also at the distal end. In the greater part of their length there is a considerable space between them, chiefly occasioned by the narrowing of the middle part of the ulna; for the corresponding border of the radius is nearly straight.

Each bone has an epiphysis at either extremity, that at the proximal end being a thin plate, comprising only the articular surface, and early ankylosed, the other being larger and more tardy both in ossification and in union with the shaft. In all the specimens in which the head of the humerus is still free, this epiphysis is also ununited; and its rugged, irregular surfaces, and small size compared with the extremity of the bone to which it is applied, show that the portion preserved is only the ossified nucleus of a larger cartilaginous mass. In the absence of the epiphyses the surfaces of the lower ends of the bones are deeply concave.

The ulna is lighter and more compressed, as well as shorter, than the radius. It is very broad at the distal extremity, and, being contracted at the middle, has rather an hourglass-form. From its free border, near the proximal end, rises a well-developed, compressed olecranon process, expanding as it rises, and terminating in a semicircular margin.

The radius has far less character about its outline, the borders being approximatively parallel.

The free or distal end of the lower epiphysis of both bones is divided into two facets, conforming with the outline of the contiguous carpal bones.

Dimensions of the Bones of the Arm.

	Tasmanian skeleton.	Tasmanian. No. 1.	Tasmanian. No. 2.	Yorkshire.	Caithness.	Paris.
Humerus.	inches.	inches.	inches.	inches.	inches.	inches.
Length	$19\frac{1}{4}$	$22\frac{3}{4}$	$18\frac{1}{4}$	$20\frac{3}{4}$	20	$17\frac{1}{2}$
Breadth (vertical, or from the radial to the ulnar border) of head	$8\frac{3}{4}$	9	8	....	$8\frac{1}{4}$	....
Breadth at narrowest part	6	$7\frac{1}{4}$	6	$6\frac{1}{2}$	$7\frac{1}{2}$	6
Breadth at lower end	$10\frac{1}{2}$	$11\frac{1}{2}$	$9\frac{3}{4}$	$11\frac{1}{2}$	$10\frac{3}{4}$	9
Thickness at head	$8\frac{1}{4}$	$8\frac{1}{2}$	$7\frac{1}{4}$	....	8	....
Thickness at middle	$4\frac{1}{2}$	$4\frac{1}{4}$	4	....	4	....
Radius.						
Length (between middle of each extremity without epiphysis)	$13\frac{1}{2}$	$15\frac{1}{2}$	12	$13\frac{1}{2}$	$13\frac{1}{4}$	$11\frac{1}{4}$
Breadth at upper end	$7\frac{1}{4}$	$7\frac{3}{4}$	6	$7\frac{3}{4}$	...	$5\frac{3}{4}$
Breadth at middle	6	7	$5\frac{1}{2}$	$6\frac{1}{2}$	$6\frac{3}{4}$	$5\frac{1}{2}$
Breadth at lower end	$7\frac{3}{4}$	$9\frac{1}{4}$	$8\frac{1}{4}$		$8\frac{1}{4}$	7
Ulna.				9		
Length	$12\frac{3}{4}$	14	$11\frac{1}{4}$	$12\frac{1}{4}$	12	$10\frac{1}{2}$
Breadth at upper end, including olecranon	10	12	$10\frac{1}{2}$	12	11	10
Breadth at middle	$5\frac{1}{4}$	5	$5\frac{3}{4}$	$4\frac{3}{4}$	5	5
Breadth at lower end	$9\frac{1}{2}$	9	$8\frac{1}{2}$	9	$8\frac{1}{4}$	8
Greatest width of interosseous space	2	$2\frac{3}{4}$	2	....	$2\frac{1}{2}$	....

The *carpus* (Pl. LXI. fig. 1) is very remarkable on account of its width and shortness, the bones of which it is composed being so extended laterally as to appear almost as if in a single row. As in most of the Toothed Whales*, ossification of the carpal elements advances more rapidly than in the Whalebone-Whales; and in the older specimens the contiguous surfaces of the bones are brought into close apposition. In the younger individuals each bone is surrounded, except on its smooth free (dorsal and palmar) surfaces, by a layer of cartilage; and consequently its exterior presents the peculiar and characteristic appearance described at p. 326. Moreover, in many cases, a kind of epiphysial ossification has taken place in this cartilage, so that the bones are surrounded by a more or less complete case of thin osseous matter, which appears ultimately to unite with them (see Pl. LXI. fig. 4). This mode of ossification of the carpal bones, by a peripheral as well as a central nucleus, is, I believe, peculiar to the Cachalot. It has occurred to a much greater extent in the carpus of the entire skeleton than in the detached limb figured at Pl. LXI. fig. 1; indeed, in the latter, the peripheral ossifications were so small and so slightly adapted to the contiguous surfaces, that, their attachments having been lost during maceration, they could not be replaced with certainty, and so do not appear in the figure.

All the specimens agree in the number and relative position of the carpal elements. Besides a bone projecting freely from the ulnar side of the carpus, probably correspond-

* *Orca* is an exception.

ing to the pisiform *, they are five in number, differing little from each other, either in size or form. Although, as before said, they are so extended as to appear almost to form a single row, it may be readily seen that the central bone and that placed at either extremity really belong to what is ordinarily considered the proximal row of the carpus, while the two others constitute its distal row, thus conforming to what may be called the typical form of the Cetacean carpus.

The determination of the homologies of the carpal bones of the Cetacea with those of other Mammalia is beset with difficulties, and has consequently led to some differences of opinion among those anatomists who have attempted it. The most recent essay on this subject is that of Dr. Van Bambeke †, who, however, laboured under the great disadvantage of having very insufficient materials at his command. I have been able to examine a considerably larger number of specimens, comprising nearly all the known genera, but must still admit that the determination of homologies of parts from the comparison of adult, or nearly adult, individuals is but provisional, and awaits, for its verification, the opportunity of tracing their development through the earliest stages of existence.

The results of these observations on the carpal bones in the *Odontoceti* (to which group it is alone necessary to refer to illustrate the anatomy of the Cachalot) may be stated in the following propositions. It may be premised that every species appears liable to certain individual variations, and that sometimes the different sides of the same animal are not precisely alike either in the arrangement or even the number of the carpal ossifications. Such cases have often afforded a valuable clue to the identification of particular bones.

1. The pisiform bone is represented in *Delphinus tursio* by a small ossification on the ulnar border of the carpus, and attached to the lower end of the ulna itself. In *Inia* a similar ossification projects from the same border of the carpus, but on a level with the bones of the second row ‡. In *Physeter* it occupies a more normal position. These are the only instances that I have met with of the occurrence of this element in an ossified state in any of the Toothed Whales, though it must be admitted that, as it is a part so liable to be removed in cleaning the skeleton, it may be more frequently developed than our prepared specimens would indicate.

2. Excluding the above, the carpus of the Odontoceti appears never to consist of more than six bones, three belonging to the proximal and three to the distal row.

3. The three bones of the proximal row are constant, and may easily be identified as corresponding to the scaphoid, semilunar, and cuneiform of anthropotomy, or the

* This was wanting in the limb figured, having probably been removed during the partial process of cleaning it had undergone before I received it. The bone represented in the figure is taken from the hand of another specimen, in which it was still *in situ*.

† "Sur le Squelette de l'extrémité antérieure des Cétacés." Mém. de l'Acad. Roy. de Belgique, t. xviii. 1865.

‡ As in the Chelonians.

radiale, *intermedium*, and *ulnare* of Gegenbauer. The middle one is usually the largest and most thoroughly ossified. In the genus *Orca* alone there is no ossification, even in the adult animal, corresponding to the cuneiform.

4. The three bones of the distal row are generally represented by distinct ossifications in *Hyperoodon*, *Beluga*, and *Monodon*. These appear to correspond with the trapezoid, magnum, and unciform of human anatomy.

5. In most cases the bones of the distal row of the carpus are reduced to two, which appear to correspond best with the trapezoid and unciform, the magnum being either absent or amalgamated with the trapezoid. I here differ from Dr. Van Bambeke, who considers that the two bones of the distal row represent the magnum and the trapezoid, the unciform being absent. My reasons are:—

a. The magnum in mammals generally is a smaller and less important bone than the unciform.

b. In those animals in which the carpus approaches most nearly to that of the Cetacea in configuration and functions, but retains all its elements distinct, as the Manatee, the magnum and the trapezoid are particularly reduced, while the unciform is large, and occupies the position of one of the well-developed bones of the cetacean carpus.

c. In those Cetaceans in which all the bones of the second row are developed, and can be distinctly recognized, as in *Hyperoodon*, the magnum is small.

d. In the skeleton of a *Beluga* I have found the magnum present, while in the carpus of another animal of the same species, otherwise completely ossified, its place was occupied by cartilage.

e. Whenever the magnum is present as a distinct bone, it is placed exactly above the middle of the third metacarpal bone, and has a carpal bone on each side of it, articulating with the second and fourth metacarpals respectively. In the Cetacea having but two bones in the second row of the carpus, the middle of the proximal end of the third metacarpal corresponds with the interval between these bones, which articulate respectively chiefly with the second and fourth metacarpals, each taking a portion of the third. Sometimes this interval is so large as to suggest the absence of a bone.

f. It is, however, not improbable that the bone which in general position corresponds with the trapezoid, as it forms the chief support to the second metacarpal, may also contain the representative of the magnum. This seems clearly to be the case in the carpus of *Micropteron sowerbyense*, according to a sketch kindly sent me by Professor Van Beneden, in which a single, transversely elongated bone corresponds to the bases of both the second and third metacarpals. This view is also confirmed by the extremely reduced condition of the trapezoid in the Manatee.

6. The trapezium appears never to be present as a distinct bone, although the first metacarpal so often assumes the characters and position of a carpal bone that it may easily be taken for it. The rudimentary and simple character of the bones of the manus of the Cetacea is well illustrated by the difficulty of interpreting the nature of the

bone which generally appears at the radial end of the distal row of the carpus. Although in the manus of some forms, *e. g. Globiocephalus*, and some *Delphini*, one could scarcely hesitate, at first sight, to identify it with the trapezium, the following considerations induce me to agree with Dr. Van Bambeke in naming it the first metacarpal.

a. Its characters are in many species intermediate between those of a carpal and a metacarpal bone. This is the case in *Phocæna, Pseudorca, Physeter*, and some *Delphini*; while in *Monodon*, and especially in *Delphinus tursio*, it has perfectly acquired the characteristic elongation of a metacarpal.

b. There is a great tendency for the metacarpal at the other extremity of the series (the fifth) to assume many of the characters of a carpal bone, especially at its proximal end.

c. The most crucial test appears to be afforded by its early ossification, corresponding in this respect with the true metacarpals. Thus in the genus *Orca*, while there is but a single ossific nodule in the middle of the cartilaginous carpus, the bone in question is as well ossified as are the undoubted bones of the metacarpal segment.

It is quite possible that the trapezium may be contained in the bone which I have called above " scaphoid," and that this should, therefore, be named " trapezio-scaphoid ;" but of this I am not able to furnish any proof.

7. The cuneiform always directly supports the fifth metacarpal, and frequently some part of the fourth. Moreover, in those hands in which the ulnar side of the carpus is greatly reduced, *e. g. Globiocephalus*, the fifth metacarpal has even a connexion with the ulna itself. This condition of the Cetacean carpus is illustrated in other mammals in which the manus approaches or attains the form of a paddle,—as in the Seals, and more distinctly in the Sirenia, the fifth metacarpal is in more or less direct relation with the cuneiform of the proximal row. The same occurs also in some terrestrial mammals, as the Armadillos.

The carpus of the Cachalot follows the simplest type of the Cetacean manus, the chief peculiarity being its shortness and lateral expansion, by which the bones of the second row are, as it were, forced up between those of the first, so as to bring them all nearly on the same level. There is, however, no difficulty in identifying them. According to the foregoing propositions, they will represent:—the scaphoid or trapezio-scaphoid (Plate LXI. fig. 1, *s*), the lunar (*l*), the cuneiform (*c*), the unciform (*u*), the trapezoid or trapezo-magnum (*t*), the pisiform (*p*). The symmetry of their arrangement is well seen in the figure*.

The *digits* are five in number. The bones of which they are composed are tipped at each end by a thin layer of cartilage, which in no instance among the specimens examined contained an osseous epiphysis; nor is there any sign of a terminal epiphysis having been united to any of these bones. This is somewhat remarkable, as in some

* In Wall's description the distal epiphyses of the radius and ulna are taken for bones of the carpus.

of the Toothed Whales, *e. g. Globiocephalus*, the metacarpals and phalanges are completed by very large epiphyses. The cartilaginous plates terminating two contiguous bones are not blended together as in the Whalebone-Whales (where the phalanges appear only as separate ossifications in a continuous rod of cartilage), but are quite distinct, and, when a longitudinal section is made, show a free space between them, not unlike a synovial cavity; but the dry condition of the specimens prevented a very satisfactory investigation of this point.

The digits spread considerably from each other, giving breadth to the hand; the fifth especially stands far apart from the others; but the first, or thumb, is, as usual, adpressed towards the second digit. The first is by far the shortest; the second the longest; the third almost equal to it; the fourth slightly, and the fifth considerably shorter. The phalanges generally are elongated, compressed, and narrower at the middle than at the ends, the last peculiarity being more characteristic of the metacarpals and proximal phalanges than of those situated more distally.

The exact enumeration of the phalanges of the digits, for any given species of Cetacean, is never very easy, as the terminal bones are often slow and irregular in their ossification, sometimes being represented only by cartilage, or by minute nodules of bone readily lost in the process of preparation.

As none of the hands belonging to the skeletons examined were quite perfect, I have given a figure of this part from another specimen, in which all the bones are retained in their exact relative position and distance apart (Plate LXI. fig. 1). The pisiform bone and the terminal phalanx of the second finger were wanting in this otherwise complete specimen; they have been added to the figure from another of the separate pectoral limbs sent to the Museum by Mr. Crowther.

The first digit has a short metacarpal, the broad upper extremity of which articulates above with the scapho-trapezium, and by its side with the second metacarpal. This is succeeded (in the specimen figured) by a single slender tapering phalanx, the apex of which reaches rather below the articulation between the metacarpal and first phalanx of the second digit. Although in the present specimen this is a single bone, it appears usually to consist of two, the terminal one being much the smaller, and generally more or less ankylosed to the other. In some cases I have found them completely distinct. In one of the hands belonging to the Tasmanian skeleton, these phalanges are not only united together, but also to the distal half of the contiguous second metacarpal (see Plate LV.).

The second digit has a large metacarpal, which may be distinguished from all the others, by its superior size, and by a small lateral articular surface on the radial side of its proximal extremity, where it is in relation with the first metacarpal. This bone is followed by five phalanges gradually diminishing in size.

The third digit has likewise five phalanges, besides the metacarpal; and the fourth has four. The metacarpal of the fifth digit differs from the others in being narrower in proportion to its length, and having less of the hourglass-shape, its outer border being nearly straight. It is followed by three phalanges, which rapidly decrease in size.

Length of Bones of Manus.

	Tasmanian skeleton.	Tasmanian No. 1.	Tasmanian No. 2.	Yorkshire.
	inches.	inches.	inches.	inches.
1st digit, metacarpal....	$2\frac{3}{4}$	$3\frac{3}{4}$	$2\frac{1}{2}$	$4\frac{1}{2}$
phalanges	$5\frac{1}{4}$	$4\frac{3}{4}$	$3\frac{1}{2}$ & 3	$3\frac{1}{2}$ & $2\frac{1}{4}$
2nd digit, metacarpal....	$5\frac{1}{2}$	$7\frac{1}{4}$	5	$5\frac{1}{2}$
1st phalanx ..	5	6	4	$4\frac{3}{4}$
2nd ,, ..	4	5	$3\frac{1}{4}$	$3\frac{1}{2}$
3rd ,, ..	....	3	$2\frac{1}{4}$	$1\frac{1}{2}$
4th ,, ..	....	2	$1\frac{3}{4}$	....
5th ,, ..	....	....	1	....
3rd digit, metacarpal....	$5\frac{1}{4}$	$6\frac{1}{4}$	5	$5\frac{1}{2}$
1st phalanx ..	$4\frac{3}{4}$	6	$3\frac{3}{4}$	$4\frac{3}{4}$
2nd ,, ..	$3\frac{3}{4}$	$4\frac{1}{2}$	$3\frac{1}{4}$	4
3rd ,, ..	$2\frac{3}{4}$	3	$2\frac{1}{4}$	$2\frac{1}{2}$
4th ,, ..	....	$1\frac{1}{2}$	$1\frac{3}{4}$	....
5th ,, ..	....	$\frac{3}{4}$	1	....
4th digit, metacarpal....	$4\frac{3}{4}$	6	$4\frac{1}{4}$	$4\frac{3}{4}$
1st phalanx ..	4	$5\frac{1}{4}$	$3\frac{1}{4}$	4
2nd ,, ..	$3\frac{1}{4}$	$3\frac{3}{4}$	$2\frac{3}{4}$	$3\frac{1}{4}$
3rd ,, ..	$2\frac{1}{2}$	$2\frac{1}{4}$	2	$1\frac{1}{4}$
4th ,, ..	....	$1\frac{1}{4}$	$1\frac{1}{4}$	....
5th digit, metacarpal....	$4\frac{3}{4}$	$5\frac{3}{4}$	4	$4\frac{1}{2}$
1st phalanx ..	$3\frac{1}{4}$	$3\frac{3}{4}$	$2\frac{3}{4}$	3
2nd ,, ..	....	$2\frac{1}{2}$	$2\frac{1}{4}$	2
3rd ,, ..	....	$\frac{1}{2}$	1	....

Pelvis.

In all known Toothed Whales the sole rudiment of a pelvis is formed by a pair of elongated subcylindrical bones (*ossa ischia*) placed horizontally and nearly parallel to the vertebral column*, opposite to the junction of the lumbar and caudal regions, and giving support to the crura of the penis or clitoris, as the case may be. In no species of this group have any such accessory bones or cartilages representing the hinder extremities, as those discovered by Reinhardt in *Balæna mysticetus*, and subsequently by other observers in several of the Whalebone-Whales†, been hitherto observed. It must be remarked, however, that they have never been looked for with much care in any of the larger members of the group, as the Cachalot or Hyperoodon.

The description and figure given by Wall‡, which represent each lateral half of the pelvis of a young female Cachalot as composed of two bones, placed end to end, does not accord with the general observation upon the more common Dolphins, that each of the ischial bones ossifies from a single centre. Unfortunately I have no materials to con-

* In the Porpoise, their anterior extremities diverge from each other.

† Eschricht, Nordisch. Wallthiere, p. 136; W. H. Flower, Proc. Zool. Soc. 1865, p. 704.

‡ *Op. cit.* p. 32, and pl. i. fig. 4.

firm this description. In addition to the single bone which accompanied the skeleton, Mr. Crowther has presented to the Museum two other pelvic bones, taken also from adult male animals; but neither of them bears traces of any original segmentation.

They all present the general characters common to the corresponding bones in other Toothed Whales, but have, as is so frequently the case, strongly marked individual peculiarities. They are all more or less compressed, slightly expanded at one end, which was tipped with cartilage, and present some modification of a sigmoid curve. The bone which belonged to the skeleton (see Pl. LX. figs. 5 and 6) is 14″ long; at the middle its diameters are 1″·3 and 0″·95; at the expanded end 2′ and 1″·1. Its surface generally is simple and smooth; but at 4″ from the smaller end one of the margins rises into a triangular elevation surmounted by two short rough processes having different directions.

Of the two other bones (which, though apparently belonging to opposite sides of the body, are stated to have been taken from different individuals), one (Pl. LX. fig. 7), though closely corresponding in actual length and thickness to the last, is so strongly curved that in a straight line its two extremities are but 12″ apart. Its surface is more angular, presenting several strong longitudinal ridges and grooves. Near the middle of its greatest convexity is a small but prominent spine 0″·4 in length; but otherwise there is no appearance of the lateral process so well marked in the last. Both ends were tipped with cartilage.

The third bone (fig. 8) is the largest of the three. It is distinguished by a very regular sigmoid curve, by its smoothness, and the absence of all spine or process, and especially by its great compression, and corresponding width in the opposite direction. Its length is 14″·1, its diameters at the middle 2″·4 and 0″·9, at the broader end 3″·7 and 0′·9. As in the first-described specimen, the more pointed extremity is smoothly rounded and evidently complete; the condition of the other end shows that it had a cartilaginous continuation.

The principal part played by these bones in the economy of the animal would prepare us to find that they presented considerable differences according to the sex of the individual to which they belonged; but in those genera in which the entire magnitude of the male and female differs but little, we do not generally find a very marked difference in the pelvic bones. Thus, in two perfectly adult Porpoises of nearly equal dimensions, the length of the pelvic bones of the male was $5\frac{1}{2}$″, of the female $4\frac{1}{4}$″*. In the Hunterian collection is a dried preparation of the penis of a Hyperoodon with the ischial bones still attached to the crura. The animal, from the size of these and other parts preserved in the Museum, as well as from a statement of Hunter, must have been much larger than the ordinary *Hyperoodon rostratum*, and probably belonged to the supposed species called *H. latifrons*, Gray, regarded by Eschricht as the adult male of

* It appears, according to Eschricht's observations, that in the genus *Orca* the pelvic bones show considerable sexual differences. (Recent Mem. on Cetacea, Ray Soc. 1866, p. 176.)

the former. The right bone is 10″·2 in length in a straight line, the other half an inch shorter. They differ in many particulars from the same bones in the Cachalot. They have a single, strong, and tolerably uniform curve, are but slightly compressed, much thickest in the posterior half, and gradually tapering forwards, and, though presenting some well-marked longitudinal ridges, have no angular processes projecting from the surface. The disparity in size between these bones and those of a perfectly adult female of *H. rostratum* in the Museum of the University of Oxford is extraordinary, the latter being but 5″ in length, and very much more slender in proportion. As the male Hyperoodon does not exceed the female in bulk so much as the male Cachalot is said to do the opposite sex, we may expect to find fully as great a difference in the pelvic bones of the two sexes of this animal. In the Museum of the Royal College of Surgeons is a bone (No. 2460, Osteol. Series) presented by the late Dr. Buckland, and described in the catalogue as "the left pelvic bone (ischium) of a Cachalot (*Physeter macrocephalus*)." It may possibly have belonged to a female of this species, though it presents but little resemblance to those of the males above described, and, indeed, is more like that of the Hyperoodon. Its length is $8\frac{3}{4}''$; its general form that of a club, being dilated towards one extremity, and much attenuated at the other. It is but slightly compressed, and has a single strongly marked curve.

Conclusion.

In the foregoing description of the skeleton of the Cachalot I have made but little comparison with animals of the genus *Kogia*, having in fact had no opportunity of doing so. The only two skeletons at present existing are both at Sydney, and no adequate description of them has yet been published. From such indications as we have (further elucidated by some photographs kindly sent me by Dr. Bennett and Mr. Krefft), there can be no doubt that they belong to a genus which, both in external and osteological characters, is perfectly distinct from, though nearly allied to, *Physeter*. In the sketch of the classification of the Cetacea, appended to the description of the skeleton of *Inia**, the genera *Physeter* and *Kogia* are united to form the subfamily *Physeterinæ*, which, with the *Ziphiinæ* (including *Hyperoodon*, *Ziphius*, &c.), form the very natural family Physeteridæ. A detailed examination of every part of the skeleton of *Physeter* has perfectly corroborated the position then assigned to this genus. Materials are at present greatly wanted to complete our knowledge of the osteology of the Ziphiinæ; hence it is impossible to say to which of the genera of that section *Physeter* approximates most closely.

After a concise and masterly analysis of the almost inextricably perplexed literature of the zoology of the Cachalots†, Cuvier came to the conclusion that, up to the time at which he wrote, but a single species could be considered to be truly known. Since then the claims of at least one distinct species to a place in the zoological system have been

* Trans. Zool. Soc. vol. vi. p. 110, 1867.

† 'Ossemens Fossiles,' edit. 1836, vol. viii. p. 189.

urged, and on far safer and more scientific grounds than the vague descriptions and partly imaginary drawings on which most of the earlier *Physeteres* and *Catodontes* were founded. Of these the most important is that set forth in the oft quoted memoir of Wall, where the detail with which the skeleton of the southern Cachalot is described and compared with what was known of the Cachalot inhabiting the northern seas, has succeeded in establishing, to the satisfaction of most zoologists, the species *P.* (*Catodon*) *australis* as distinct from *P.* (*Catodon*) *macrocephalus*. The diagnostic characters relied upon are as follows:—1. The entire head as compared with the body is relatively smaller. 2. The skull is shorter in proportion to its width and height. 3. The lower jaw is proportionately shorter. 4. The form of the sternum is different. It has been already shown that the first three of these characters depend simply upon the immature condition of the specimen described. In the fourth the author has been misled by Beale's description of the incorrectly articulated skeleton at Burton Constable, in which the body of the hyoid is appended to the hinder end of the sternum. Putting aside these supposed distinctive characters as valueless, there is not one other, presenting any approach to a specific distinction, pointed out throughout the memoir. *Catodon australis*, therefore, as founded and characterized in Wall's work, can have no existence as a zoological species.

It will be gathered from the foregoing memoir that, although numerous discrepancies have been met with among various bones of the different skeletons examined, in some cases so marked that, if two individuals alone were known, they might easily have been considered specific, the comparison with a third example has nearly always proved a corrective to such a supposition,—and that, taken as a whole, the Yorkshire skeleton differs from the Caithness skeleton as much as the Tasmanian does from either. I am therefore quite unable, from the materials at present available, to point out any constant difference of specific value between the Cachalot inhabiting the Australian seas and that occasionally visiting our northern coasts.

It must not be inferred from this statement that I deny the possibility of their being specifically distinct. Similarity of osteological characters does not prove unity of species. Who would have suspected the specific distinction of the Lion and the Tiger, or the Quagga and the Zebra, if these animals were only known by two or three skeletons of each? But, at the same time, no new species should be admitted into the system, unless its distinction is established either by well-marked and constant (1) anatomical characters, (2) external characters, (3) geographical distribution, or (4) peculiarity of habit and mode of life. On no one of these points has it yet been shown satisfactorily that the southern and northern Cachalots differ.

With reference to the geographical distribution, it may be remarked that, unlike the Right Whales, the Cachalots are essentially inhabitants of the tropical and warmer parts of the temperate seas, and that they pass freely from one hemisphere into another. Between the North Atlantic and the Australian seas there is no barrier interposed to animals of such great powers of locomotion: they are known to round Cape Horn; and in fact there is scarcely a spot between the two seas where they have not actually been encountered. Whatever may have been the case in former times, the Cachalot can hardly now be considered a regular inhabitant of the seas bordering Europe. Those that occasionally appear are either solitary stragglers, or more often dead and partially decomposed carcasses, floated northwards, probably by the Gulf-stream. The occurrence of a "school" of Cachalots, like that at Città Nuova, in the Adriatic, in 1853, is quite exceptional*.

Many museums contain lower jaws of very small Cachalots, which, judging from the condition of the bones and teeth, are perfectly adult. One, in the Museum of the Royal College of Surgeons, is 6′ 10″ in length. The symphysis is 40″; and it has twenty-two teeth on each side. Another, in the Oxford University Museum, is 7′ $0\frac{1}{2}$″ in length. These are usually considered to be the jaws of the female of the common species; if this is not the case, they must indicate a second species of the genus. An entire skeleton, or even a cranium of a female Cachalot, is still a desideratum, and one which ought soon to be supplied, as, owing to its comparatively small size, it would not be beyond the means, as to cost or space, at the disposal of many museums.

It is a singular circumstance that the deformed and twisted jaws before mentioned appear all to be of a size corresponding with those just referred to.

There is good reason to believe that, as with all the other large Cetaceans, the magnitude of the Cachalot has been greatly exaggerated. Leaving out of the question all earlier and even less trustworthy descriptions, Beale states that he was present at the capture of a Cachalot which measured the length of eighty-four feet†; while F. D. Bennett says, "the largest size authentically recorded of the Sperm-whale is seventy-six feet in length, by thirty-eight in girth; but whalers are well contented to consider sixty feet the average of the largest examples they commonly obtain"‡. It is probable that the natural and often unconscious proneness to exaggerate the size of such an object, especially where measurement with anything like scientific accuracy is almost impossible from the very circumstances of the case, must be allowed for, in the former of these statements. The only indications on which we can absolutely rely are the osseous remains, which perfectly corroborate the latter part of the information given by Bennett. No single specimen of all the different skeletons, or fragments of skeletons, some of which are quite aged, examined by me give any evidence of a greater length of skull and vertebral column than fifty-five feet, if quite so much. The soft parts of the head, and the portion of the flukes projecting beyond the median notch of the tail, which corresponds to the termination of the bony column, might bring the animal in the flesh up to sixty feet; and from the tolerable uniformity in the size of all the adult skeletons, skulls, and lower jaws (now in considerable quantity)

* Heckel, in Wiener Sitzungsber. d. Math.-Naturw. Cl. Bd. ii. (1853) p. 765.

† *Op. cit.* p. 15.

‡ 'Narrative of a Whaling Voyage,' vol. ii. p. 154.

known, I venture to question whether the Cachalot frequently, if ever, exceeds that length, *when measured in a straight line.* Mr. Crowther assures me that the specimen described in this memoir was considered a full-sized animal. But the most important evidence upon this head is derived from a magnificent lower jaw, also presented to the Museum by that gentleman, which was considered in the colony "unique on account of its great size." This jaw measures in a straight line, from the tip to a line drawn across the hinder edges of the rami, 16′ 2″, or 1 inch longer than that of the Yorkshire skeleton, and but 20″ longer than that of the Tasmanian skeleton. The fact that the animal to which this jaw belonged was considered by experienced men a giant among Cachalots gives a good indication of what size the ordinary individuals attain.

Lastly, a few words on the zoological designation of the Cachalot, presuming that there is at present but one well-established species. Following the rules laid down by the Nomenclature Committee of the British Association, we find in Linnæus's 'Systema Naturæ' (12th edit. 1766), the genus *Physeter* including every animal, then known or imagined, with which the Cachalot can possibly be identified. Of the four species assigned to this genus, the one called *macrocephalus* is without doubt that especially founded upon the common Cachalot, notwithstanding the error in the diagnostic expression, "*fistula in rostro.*" The *P. catodon* was a small species, probably the Beluga; the *P. microps* and *tursio* had high dorsal fins; while the references under the head of *P. macrocephalus* to Clusius's description, the statement as to the size and the number of the teeth, and especially to the "*spermaceti e ventriculis cerebri*," all point indisputably to the great Sperm-Whale.

Artedi's name of *Catodon* has been revived as the generic designation of the Cachalot by several zoologists, whose faith in Sibbald is so great as to retain in the system, upon the strength of his description and figure alone, an animal of which, as Dr. Gray says, "there is not a bone, nor even a fragment of a bone, nor any part that can be proved to have belonged to a specimen of this gigantic animal, to be seen in any Museum in Europe"*. If the Linnean genus *Physeter* is to be kept in abeyance until the rediscovery of Sibbald's "*Balæna macrocephala tripinna*" †, it is to be feared that it may ultimately disappear altogether from zoological literature.

* 'Cat. Seals and Whales in Brit. Mus.' (1866), p. 215.

† 'Phalainologia Nova,' 1692.

DESCRIPTION OF THE PLATES.

PLATE LV.

Skeleton of the Tasmanian Cachalot, as mounted in the Museum of the Royal College of Surgeons. Scale $\frac{1}{24}$. The ribs and pectoral limb of the distant side are omitted for the sake of greater distinctness. The small eleventh rib is almost entirely concealed by the one in front of it.

It is but due to the long-continued and valuable services rendered to the study of comparative osteology by my namesake, Mr. James Flower, the articulator to the College, whose mechanical skill, combined with extensive and accurate anatomical knowledge, has enabled him to bring the art of mounting skeletons to the greatest degree of perfection yet attained, to mention his name in connexion with this, his greatest work.

pm. premaxillary.
m. maxillary.
d. g. dental groove.
pl. palatal.
f. frontal.
s. squamosal.
j. jugal.
so. supraoccipital.
eo. exoccipital.
sh. stylohyoid.
bh. basihyoid.
th. thyrohyoid.
p. parietal ?

PLATE LVI.

Fig. 1. Vertical longitudinal section of the skull of the same Cachalot.
Fig. 2. A similar section of the skull of a very young Cachalot, from Tasmania.
Fig. 3. A similar section of the skull of a nearly adult Hyperoodon, in the Museum of the Royal College of Surgeons.
All $\frac{1}{12}$.

pm. premaxillary.
m. maxillary.
v. vomer.
e. ethmoid.
if. foramen corresponding to the "infraorbital."
f. frontal.
so. supraoccipital.
bo. basioccipital.
as. alisphenoid.
bs. basisphenoid.
ps. presphenoid.
pt. pterygoid.
pl. palatal.
n. nasal.

PLATE LVII.

Cranium of a young male Cachalot from Tasmania, presented (as were all the other specimens from which these figures were taken) to the Museum of the Royal College of Surgeons by W. L. Crowther, Esq. The animal was supposed by the whalers to be about ten months old.

Scale $\frac{1}{9}$.

Fig. 1. Upper surface.

Fig. 2. Lower surface.

ty. tympanic bone. *aon.* antorbital notch.

The other letters as in the former Plates.

PLATE LVIII.

Vertebral column of the skeleton of the Tasmanian Cachalot, seen from above.

Scale $\frac{1}{12}$.

PLATE LIX.

Vertebral column and chevron bones of the same skeleton, seen from the side. The fourth and fifth chevron bones were missing.

Scale $\frac{1}{12}$.

PLATE LX.

Fig. 1. Hyoid bones of the same skeleton.

sh. stylohyal. *bh.* basihyal. *th.* thyrohyal.

Scale $\frac{1}{12}$.

Fig. 2. First rib of the right side of the same skeleton. Anterior view.

Scale $\frac{1}{12}$.

Fig. 3. Sternum of the same skeleton. External surface.

Scale $\frac{1}{12}$.

Fig. 4. The same. Side view.

Scale $\frac{1}{12}$.

Figs. 5, 6. Two views of the pelvic bone of the same skeleton.

Scale $\frac{1}{6}$.

Figs. 7, 8. Two other pelvic bones of Tasmanian Cachalots, referred to at p. 365.

Scale $\frac{1}{6}$.

PLATE LXI.

Fig. 1. Bones of the anterior extremity of another Cachalot, from Tasmania.

Scale $\frac{1}{6}$.

h. humerus. *r.* radius.

u. ulna. *o.* olecranon.

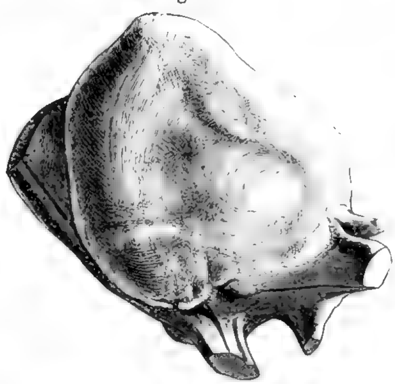
e. lower epiphysis of the radius.
e′. lower epiphysis of the ulna.
s. scaphoid or trapezo-scaphoid.
t. trapezoid or trapezo-magnum.
l. lunar.
u. unciform.
c. cuneiform.
p. pisiform.

Fig. 2. Scapula of the skeleton of the Tasmanian Cachalot, from below.
Scale $\frac{1}{12}$.

Fig. 3. Outer surface of the scapula and bones of the arm of the same skeleton.
Scale $\frac{1}{12}$.

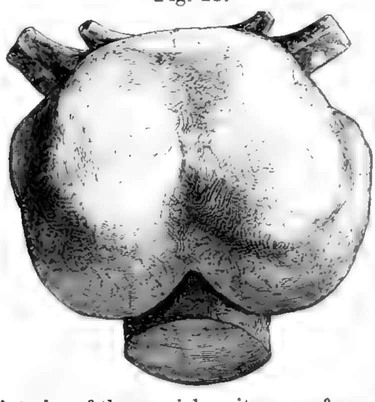
Fig. 4. One of the carpal bones of the same skeleton, showing the peripheral epiphysial ossification.
Scale $\frac{1}{2}$.

Fig. 12.

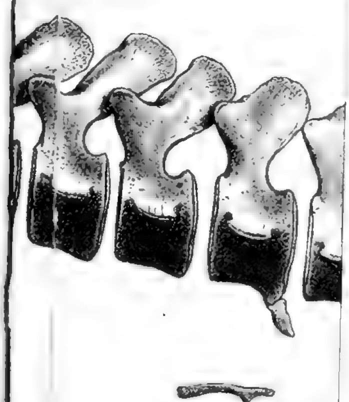


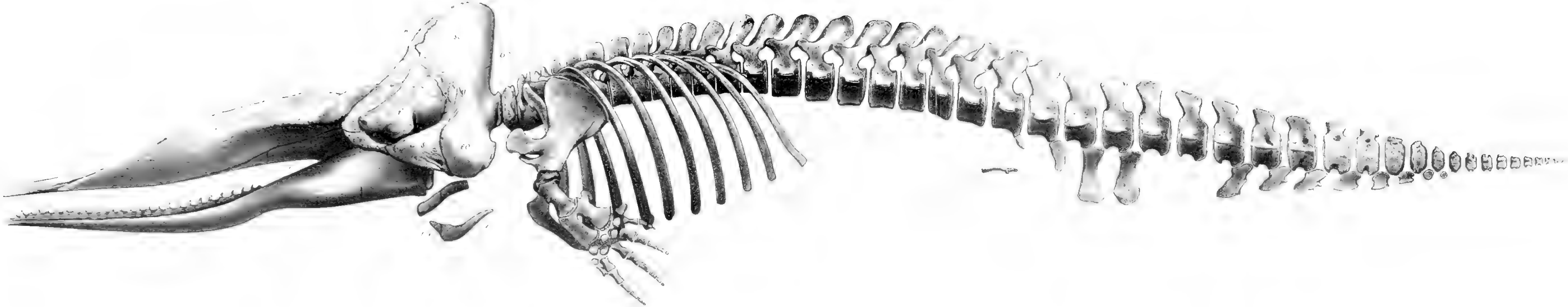
Side view of a cast of the interior of the cranial cavity, $\frac{1}{6}$ natural size. (See p. 316.)

Fig. 13.



Cast of the interior of the cranial cavity, seen from above, $\frac{1}{6}$.





PHYSETER MACROCEPHALUS

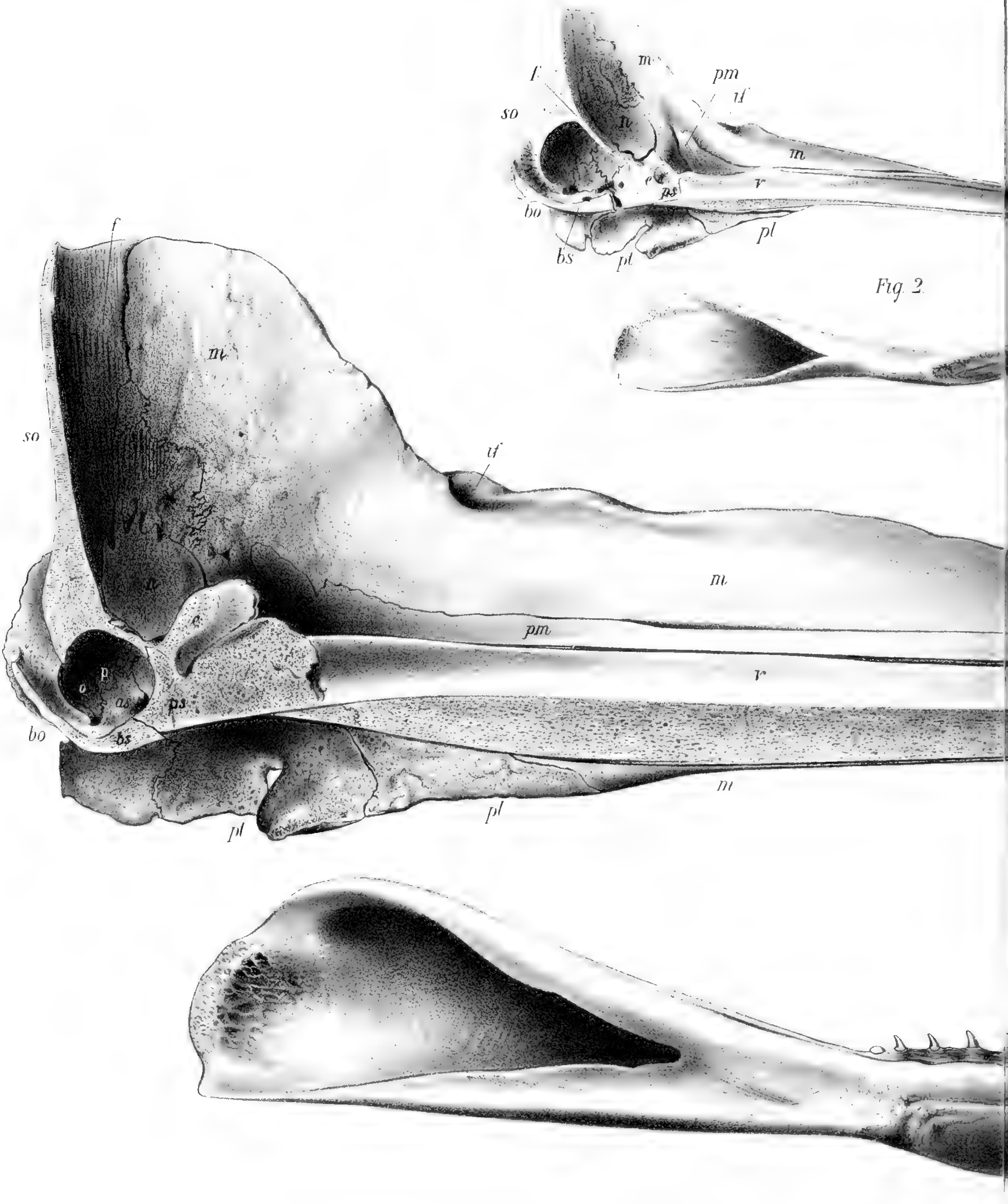


Fig. 2

J. Smit del.

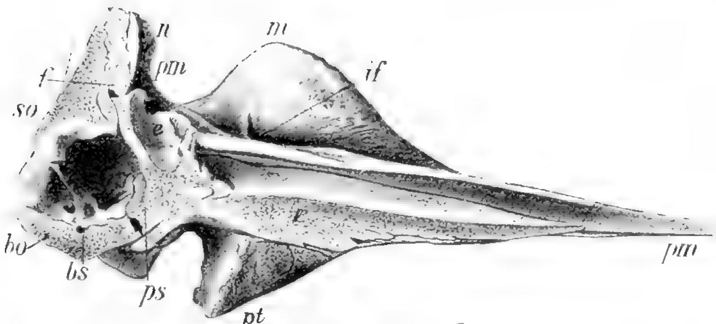


Fig 3

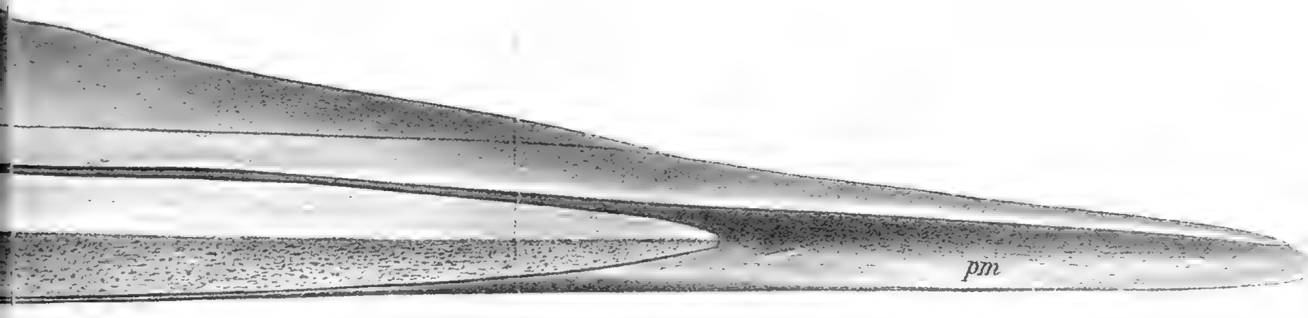
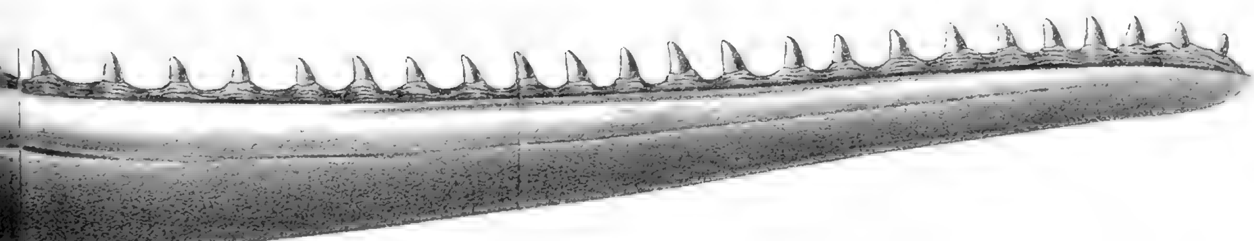


Fig 1



M & N Hanhart imp

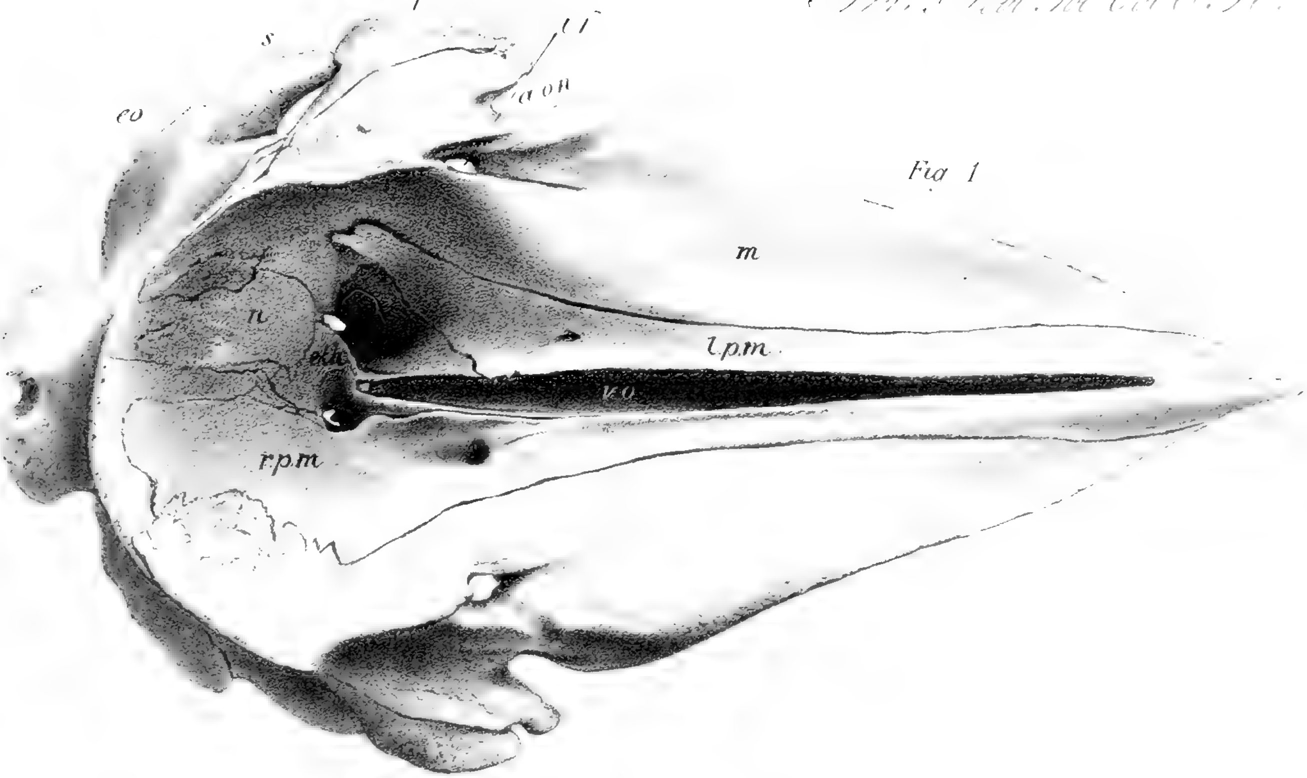


Fig. 1.

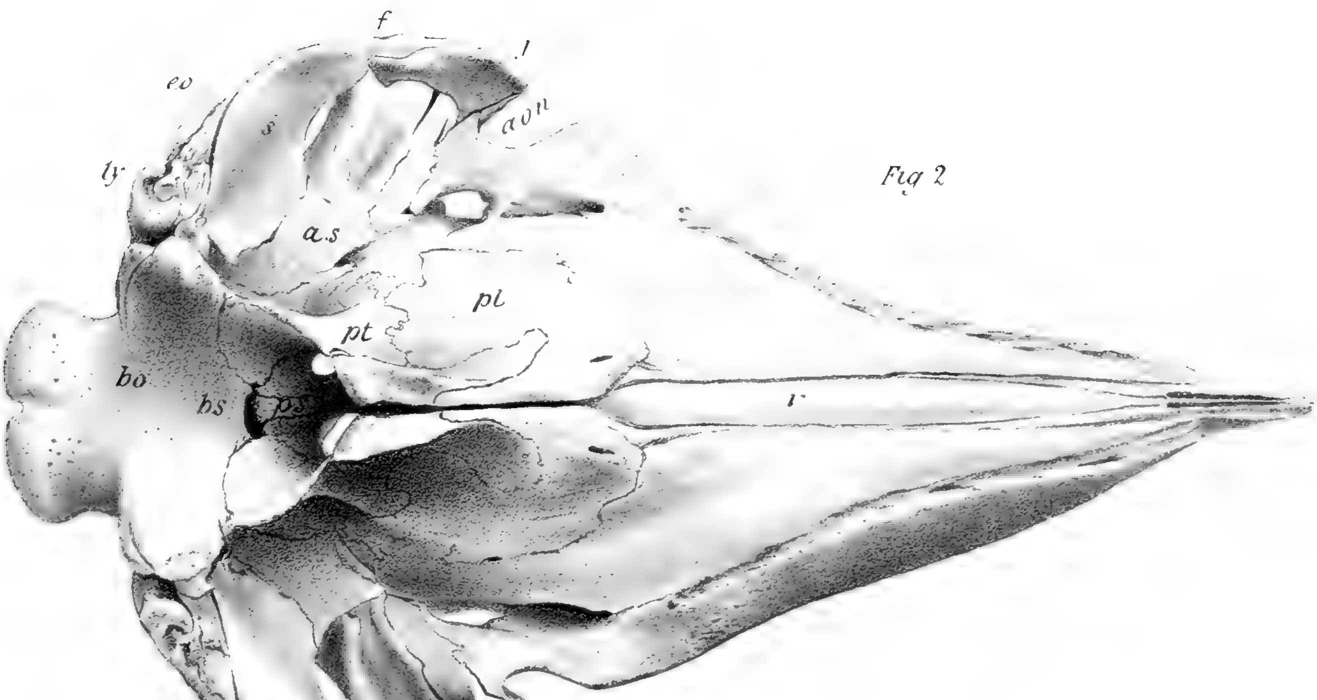
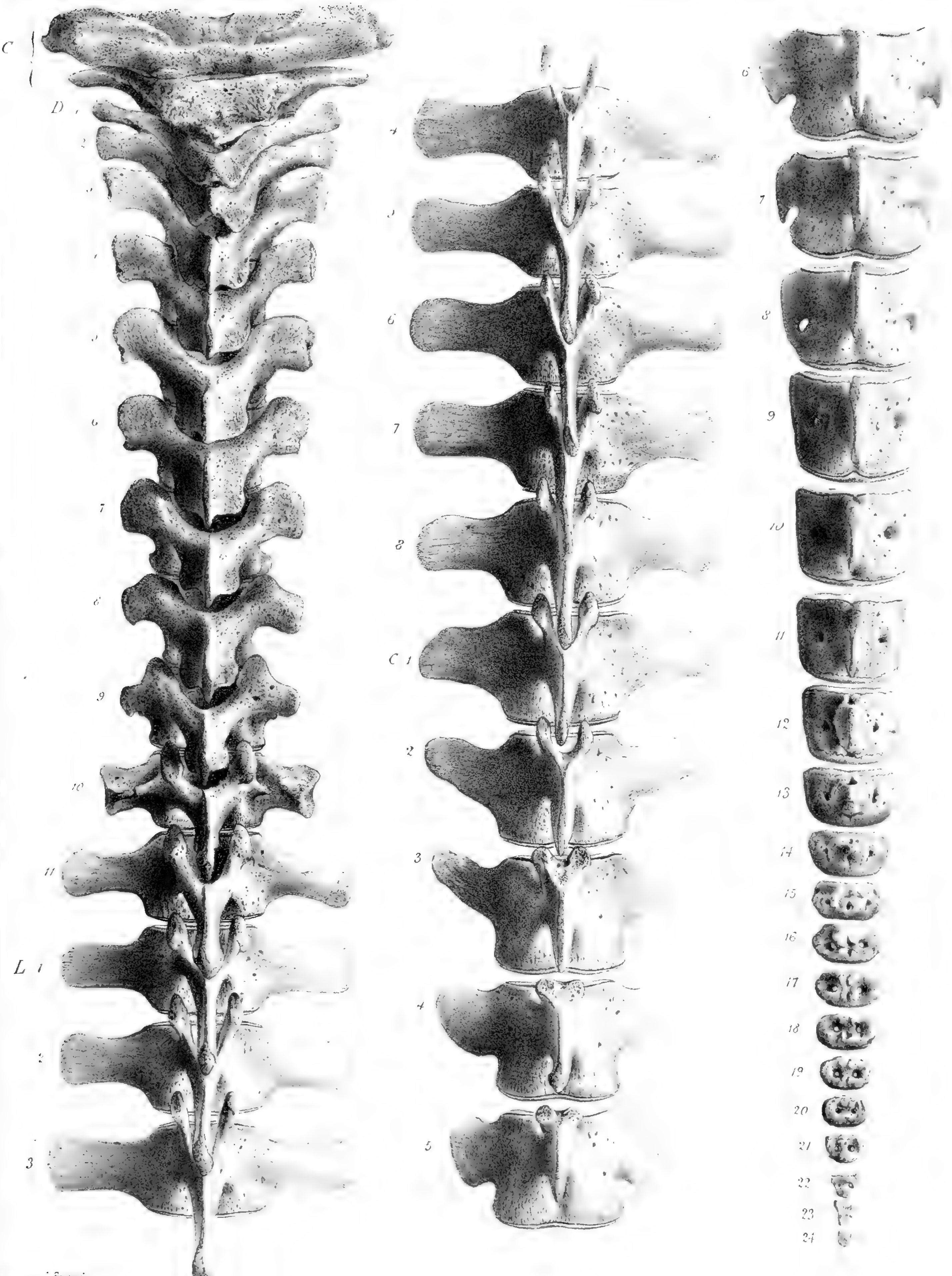


Fig. 2.

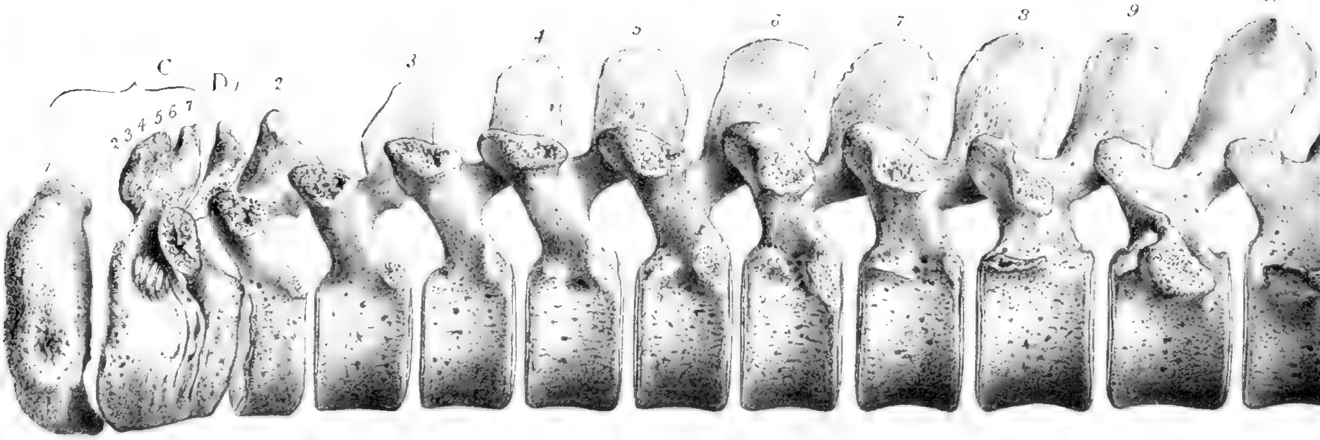
J Smit lith

M & N Hanhart imp

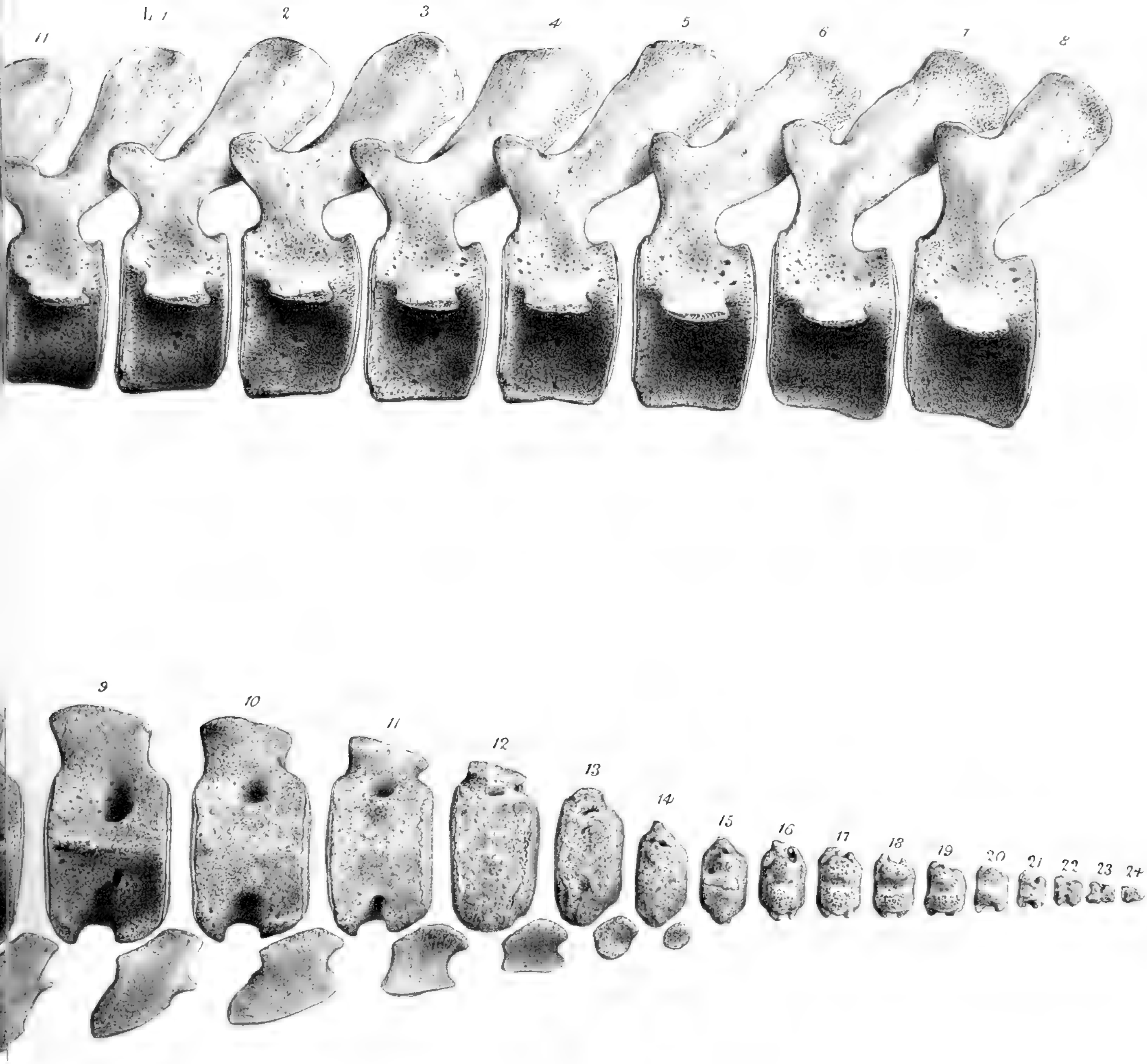


J Smit lith

M&N Hanhart imp



J. Smit lith.



M&N Hanhart imp

Fig 1

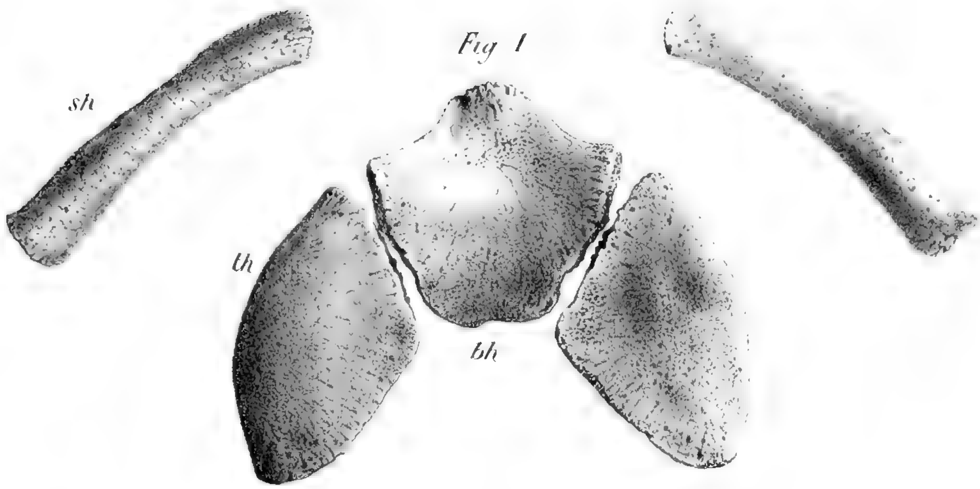


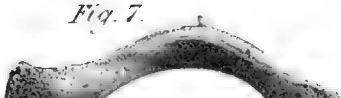
Fig. 3

Fig 2

Fig 4

Fig 5.

Fig. 7.



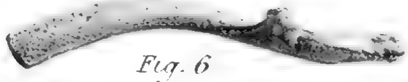


Fig. 6

Fig 8

J. Smit lith

M & N Hanhart imp

Fig 1

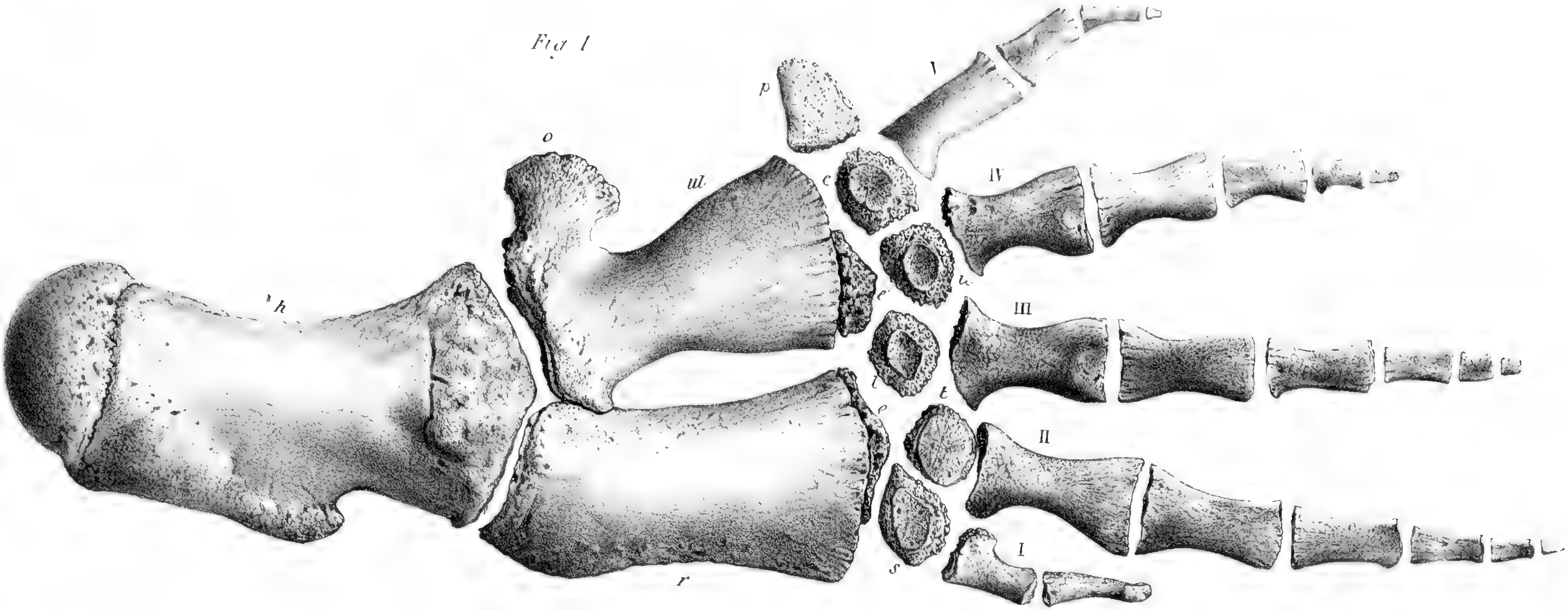


Fig 2

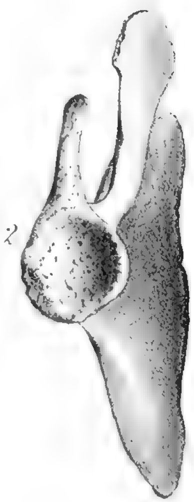


Fig 3

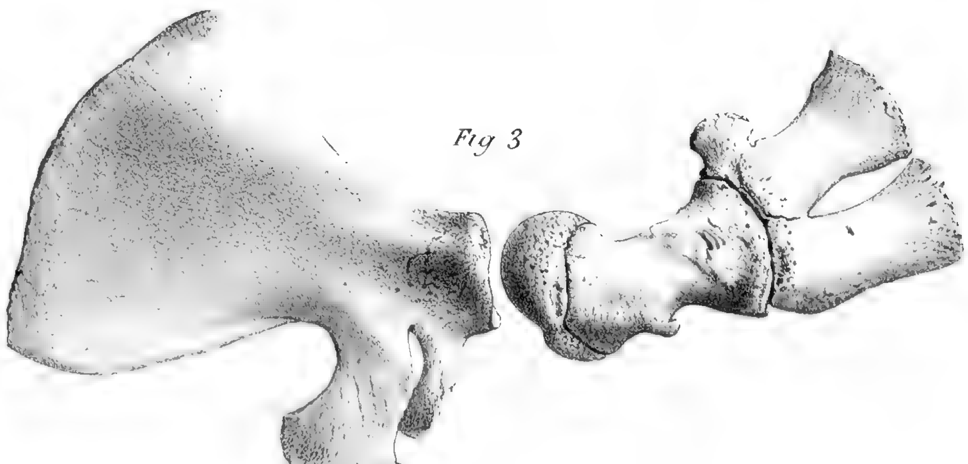
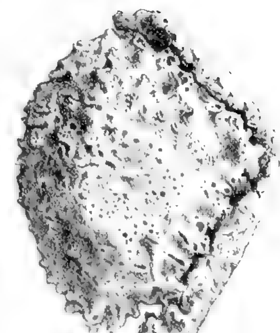


Fig 4



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XIII. *On a Picture supposed to represent the Didine Bird of the Island of Bourbon (Réunion). By* ALFRED NEWTON, *M.A., F.L.S., F.Z.S., &c.*

Read February 14th, 1867.

[PLATE LXII.]

PICTORIAL evidence contributes so largely to what we know of the Dodo and its allies, that in calling the attention of the Society to the old water-colour drawing now exhibited I should not deem any apology requisite, were it not that this drawing has been already displayed at a meeting only a few months ago. But as on that occasion the exhibitor, Mr. Tegetmeier, did not place on record the remarks he made (P. Z. S. 1866, p. 201), and as I have reason to believe these remarks did not touch the points to which I am about to advert, I trust I may be excused for again submitting the drawing to the inspection of the Society. I must first of all express my thanks to Mr. Tegetmeier for the opportunity he has given me of examining the drawing, and also to the owner of it, Mr. C. Dare, of Clatterford, in the Isle of Wight, for his kindness in permitting it to be copied for our 'Transactions.'

It will be remembered that in the late Mr. H. E. Strickland's work, 'The Dodo and its kindred,' the former existence of at least three distinct species of Didine birds was very clearly demonstrated. Of these the true Dodo (*Didus ineptus*) was presumed to have been peculiar to the Island of Mauritius, the Solitaire (*Pezophaps solitarius*) to that of Rodriguez, and the third (which Mr. Strickland left unnamed) to that of Bourbon, or, as it is now called, Réunion. Of the first two there were then no inconsiderable remains known; but of the third it was believed that nothing existed, save a few scanty notices, which were industriously compiled by that lamented naturalist from the narratives of various voyagers. The earliest of these, Tatton, who visited Bourbon in 1613, speaks of "a great fowl of the bigness of a Turkie, very fat, and so short-winged that they cannot flie, beeing white." In 1618 Bontekoe passed three weeks in the island; and his account confirms the former statement. He calls the birds "*Dodeersen*," the name often applied to the true *Didus ineptus*, whence we may suppose they generally resembled that species; but he does not mention their colour. Carré, in 1668, speaks of the Bourbon brevipennate, "Il ne ressembleroit pas mal à un Coq d'Inde, s'il n'avoit point les jambes plus hautes. La beauté de son plumage fait plaisir à voir. C'est une couleur changeante qui tire sur le jaune." In the following year a French colonist from Madagascar, the Sieur Du Bois*, gives a more detailed, but, I suspect, a not very accurate, account of the species, under the name of "*Solitaires.*" Here it is said of them, again, that they "ont le plumage blanc." Thus two out of the four eye-witnesses speak to the plumage of the Bourbon Didine bird being *white*; a third calls it "a changeable colour, which verges upon yellow," which, as Mr. Strickland justly observes, "is rather vague, but seems to imply a pale yellowish or cream-coloured tint, which another author might easily have described as white" ('The Dodo,' &c., p. 60). The fourth witness does not mention the colour at all.

This fourth witness, Bontekoe, however, furnishes some other evidence of value. He calls the birds by the name of the true Mauritian Dodo; and, from his description, they undoubtedly much resembled that species in form. But further, one edition of Bontekoe's work, published at Amsterdam by Gillis Joosten Zaagman in 1646, contains a figure professing to be that of the Bourbon "*Dodeers.*" This is reproduced in fac-simile by Mr. Strickland; and though that gentleman says (*op. cit.* p. 63) "there can be no doubt" it "refers to the true Dodo of Mauritius," I see no reason whatever for arriving at that conclusion. This figure is unlike all the original representations of the true Dodo in several minor points, but especially in one respect. The first four primaries are directed *downwards, and at the extremity forwards.* Now, in every picture and figure of the true Dodo that I know of, all the primaries are directed *backwards.*

I think, therefore, we may not unreasonably infer:—

1. That the Didine bird of Bourbon in general shape resembled the true Dodo (*Didus ineptus*) of Mauritius.

2. That the plumage of the Didine bird of Bourbon was white, with some admixture of yellow.

3. That in the Bourbon Didine bird the first four primaries of the wing were not directed backwards, but downwards and forwards.

A glance at the picture now exhibited (Pl. LXII.) will show how far it fulfils these conditions.

But, on the other hand, I must not pass over what seems to be a formidable objection to the supposition I have laid down. Du Bois describes his "*Solitaires*" as having "le becq fait comme celuy des *Bécasses*, mais plus gros." Nothing more unlike a Woodcock's bill can be imagined than that of the bird represented in Bontekoe's figure and the drawing here! But not one of the other eye-witnesses refers to such a peculiarity. Two of them liken the Bourbon bird to a Turkey, the third to a true Dodo; surely, then,

* When Mr. Strickland wrote, in 1848, he was only able to cite this witness from a MS. copy of a journal presented by Mr. Telfair to this Society, and still in our library, in which the name of the author was not given, but merely his initials. From a note of M. Milne-Edwards in a recent number of the 'Annales des Sciences Naturelles' (vol. vi. pp. 42–44, July 1866), we learn the name of the author of this journal, which, we are informed, was published at Paris in 1674.

if it had possessed a Scolopacine bill, the fact would have been mentioned. I venture to suggest that Du Bois must have written some other word, and that "Bécasses" is a false reading, or else that a treacherous memory supplied the statement.

It now remains for me to remark on the picture exhibited. It represents apparently a flooded meadow, in the pools of which various aquatic birds are distributed, while the Dodo is standing, with an expression of alarm on his countenance, on a scanty bit of dry ground. By his side is seated a fine *Bernicla ruficollis*, somewhat too brilliantly coloured perhaps; and the other birds portrayed are *Cepphus grylle* (engaged with a small eel or snake), *Mergus castor* (a female or immature male), *Ciconia alba*, *Clangula glaucion*, *Fulix fuligula*, and *Mareca penelope* (a female). These are all drawn with much attention to detail, and generally very fairly coloured. The Dodo and the Goose form the principal figures in the composition. The beak of the Dodo, as represented here, also demands a word of comment; instead of terminating in the formidable *dertrum* to which we are accustomed in the pictures* of the Saverys and that of Goeimare (Trans. Zool. Soc. iv. p. 197), its tip is rounded off, as if it had undergone the operation known among falconers as "coping." Now I cannot help thinking that in this point we have some grounds for believing that the subject of the figure must have been a bird kept in captivity. The Dodo was no doubt able with its powerfully-hooked beak to inflict very serious injury; and it is not at all improbable (so it seems to me) that the keeper of such a bird would consult his own safety, and, by trimming an offensive weapon so likely to be used against him, deprive it of the means of doing harm. On this account, therefore, I think there seems to be a strong probability of this drawing having been taken from a living subject which had been brought to Europe and kept in some aviary. It is further to be remarked that the inside of the Dodo's mouth in this drawing is coloured of a bright red, and a red ring is seen surrounding the eye, though whether this be intended for the iris or an orbit it is not so easy to say. I believe that all the pictures of *Didus ineptus* concur in representing the iris of that species to be yellow.

And now as to the artist by whom this drawing was executed. In its left hand corner are to be plainly seen the letters  and on consulting Brulliot's 'Dictionnaire des Monogrammes' I find (p. 321, Nouv. Ed. Sec. Partie. Munich: 1833) that this is the signature of PIERRE WITTHOOS, "qui peignait à la gouache des fleurs, des insectes, et des plantes avec beaucoup d'art et de vérité," and who died at Amsterdam in 1693. It is therefore quite possible that the figure I have before mentioned in Zaagman's edition of Bontekoe, published, according to Strickland, shortly after the

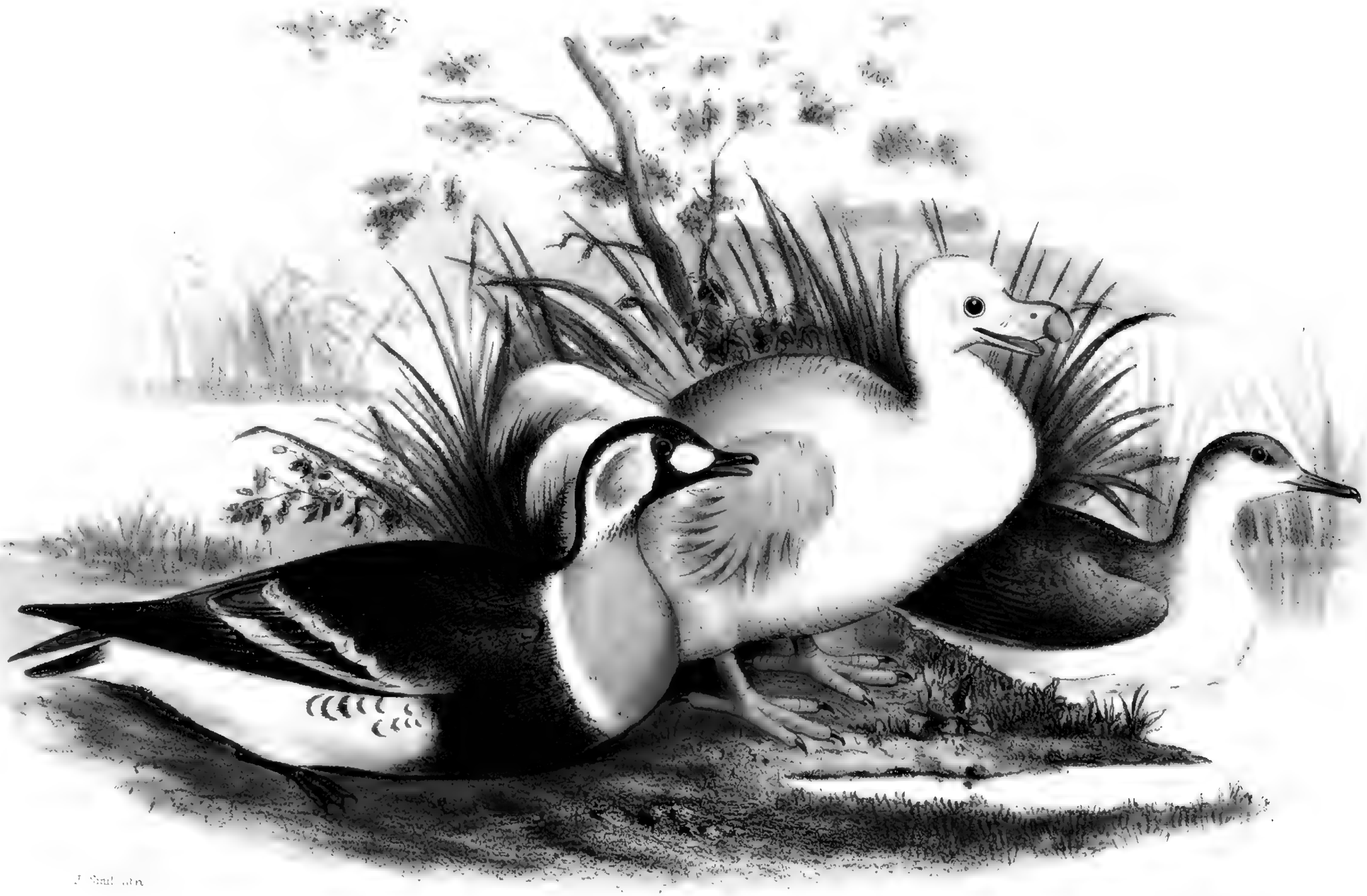
* Professor Schlegel has already suggested that the picture of the Dodo in the British Museum was drawn from a bird the beak of which had become unnaturally elongated in captivity (Verslag. en Mededeel. der Kon. Akad. van Wetensch. 1854, p. 237, note).

year 1646, at Amsterdam, and the present drawing were both taken from the same source, probably a bird brought from the Island of Bourbon, and kept alive in that town.

From a recent paper by Mr. W. J. Sterland in a popular periodical* I learn that a portion of the picture now exhibited† was copied and engraved some years ago in the 'Illustrated London News' (no. 821, vol. xxix. p. 303, Sept. 20, 1856). On referring to the place indicated I find that the woodcut there given is a most wretched misrepresentation, while the accompanying notice by Mr. W. W. Coker and Mr. Gould does not at all bear upon the subjects to which I have here adverted.

* Hardwicke's 'Science-Gossip,' No. 25, Jan. 1, 1867, pp. 5, 6.

† P.S. April 1868.—The original picture, I am informed, has been recently deposited in a "museum" at Carisbrook Castle, in the Isle of Wight.



XIV. *An account of the Fishes of the States of Central America, based on collections made by* Capt. J. M. Dow, F. Godman, Esq., *and* O. Salvin, Esq. *By* Albert Günther, *M.A., M.D., Ph.D., F.R.S., F.Z.S.*

Read March 22nd, 1864, and December 13th, 1866.

[Plates LXIII. to LXXXVII.]

§ 1. *Introductory Historical Remarks on the Collections forming the basis of this Memoir.*

Before proceeding to the enumeration and description of the fishes known to exist in the States of Central America, I may be permitted briefly to notice the circumstances which enable me to submit to the Society the results contained in the present memoir.

Mr. Salvin started in the year 1859 on his second excursion to Guatemala, chiefly with the intention of working out the ornithological fauna of that country. But having had his attention directed by me to the fact that its cold-blooded vertebrates were almost entirely unknown, he made and brought home a small collection of reptiles and fresh-water fishes, which proved to be of sufficient interest to encourage him to pay still more attention to this subject on a third excursion, which he undertook in company with Mr. Godman in the year 1861. By far the greater part of the materials which form the basis of this memoir were obtained on this occasion. Not only did the two travellers extend their excursions to various parts of Guatemala, but Mr. Salvin also visited Panama, where he met and collected in company with Capt. Dow, of the Panama Railway Company's Steamer 'Guatemala.'

Capt. Dow, indeed, had commenced to collect fishes previously to this, having sent several collections to the Smithsonian Institution in Washington, and to the Zoological Society of London, whence they were transferred to the British Museum; and for the last three years he has continued his researches with such zeal and liberality that I cannot abstain from acknowledging here the great services he has rendered to the cause of science.

The collections made by these gentlemen contained not less than about 1500 examples, in a perfect state of preservation, many of considerable size. In addition to these, I have examined a few which had been purchased of a dealer for the British Museum having been collected at Puerto Cabello in the Bay of Honduras, and, finally, those collected by Dr. Seemann, originally deposited in the Collection of Haslar Hospital, and now in the British Museum. The latter have lost much of their scientific value, as, unfortunately, no record was kept of the localities where they were obtained; and only in a few cases have I been able to avail myself of specimens of this collection, viz. where the original label, with the name of the collector, has been accidentally preserved.

§ 2. *Topographical Features of the Localities explored.*

As regards the topographical features of the localities explored by Messrs. Dow, Godman, and Salvin, I have been favoured by the latter gentleman, by whom also the accompanying map has been prepared, with the following notes:—

Lakes.

AMATITLAN.—The Lake of Amatitlan is situated in lat. 14° 29′ N., long. 90° 35′ W., in the Republic of Guatemala. Its elevation above the sea-level is about 4500 feet. Being only a short distance on the southern side of the main ridge, it collects the waters of a few small streams, which it discharges at its southern extremity, into the river Michatoya, a mountain-torrent for half its course, then expanding, like all the rivers of Guatemala which flow into the Pacific, into a broad shallow stream with a shifting sandy bed. The lake is very deep, and its water clear. The volcanoes of Pacaya and Agua rise amongst the mountains of its southern border, the whole forming a landscape of great beauty. Fish are caught during the rainy season near the outlet into the river Michatoya, and are sent to the market of the City of Guatemala.

ATITLAN.—The Lake of Atitlan is elevated 5000 feet above the sea. Like the last-mentioned it lies in Guatemala on the southern side of the main ridge, in lat. 14° 43′ N., long. 91° 14′ W. It has no visible outlet. The water is clear and fresh, and the lake of great depth. The hills on three sides attain to a height of 2000 feet above the lake. On its southern border the two large volcanoes of Toliman and S. Pedro rise, their bases being washed on one side by the lake, giving one the idea that one of them (that called Toliman) has in rising acted as a dam and stopped the outflow of the waters of a mountain-valley. A few small streams enter the lake, the water of which rises during the rainy season, to fall again in the dry. On the mountain-slope below, several streams take their rise, supplied probably by the filtration of water from the lake; but it would appear, from the alteration of the water-level in accordance with the season of the year, that it is chiefly influenced by evaporation. A number of Indian villages surround the lake; at one of them, Panajachel, a small collection of fish was made. Fish never seem to grow to any size in this lake, the Mojara (*Heros*) being quite diminutive. The Indians fish with round nets amongst the reeds that grow at the mouths of small streams. The lake itself is about twenty-two miles long, and twelve miles wide.

DUEÑAS.—This lake is little more than a depression in one of the elevated (5000 ft.) plains forming the tablelands of Guatemala. Its depth is nowhere more than 6 feet, and its banks are everywhere clothed with reeds. A small stream connects the lake with the river Guacalate. Here, too, fish are caught by the Indians in round nets, which are held by both hands, pushed in amongst the reeds, and suddenly brought to the surface.

HUAMUCHAL.—This name applies properly to a series of small lakes situated in about lat. 14° 32′ N., long. 92° 13′ W., close to one another, about six miles from the mouth of the river Tilapa on the Pacific coast. The place is not shown on any map; but it is near the large Lake of Tamachian, with which, in the rainy season, all these smaller lakes are connected. During this period of the year the river Tilapa overflows its banks and inundates the whole country round. In the dry season water remains in depressions of the land, forming the lagoons of Huamuchal; but in years of great drought even these dry up, the fish being destroyed; but a fresh supply finds its way from Lake Tamachian during the next inundation. The water is slightly brackish. The fish are taken in drag-nets, salted, and sold to Indians coming from the Altos of Guatemala.

MANAGUA.—According to Mr. J. Bailey this lake is about fifty or sixty miles long, by thirty-five miles wide. Its depth varies from 2 to 10 and 15 fathoms, but in its deepest part reaches to as much as 40 fathoms. Its elevation above the sea is 156 feet. On its south-western border the lake is separated from the Pacific by a series of comparatively low hills, the lowest section of which, through the Plain of Leon, is only 230 feet above the ocean-level. The high mountains of the Republic of Honduras approach the north-eastern border of the lake. On its south-eastern side an opening communicates with the Lake of Nicaragua. Commencing with the Fall of Tipitapa, of 22 feet height, the river widens into the Estero of Panaloya, and thence into the larger lake.

NICARAGUA.—The same authority gives a length of one hundred and five miles to this lake, and a width of about forty-five, its depth being about 15 fathoms. The surface of the lake is studded with numerous islands, some of them, as Omotepec, being volcanic cones. The elevation of the lake above the mean ocean-level is given as 128 feet. The same line of low hills which divides Lake Managua from the Pacific separates Lake Nicaragua from the same ocean; but at no point is the elevation so low as at that above indicated. The river San Juan, a deep stream with several rapids, flows out of the south-eastern end of the lake, and falls into the Atlantic Ocean, at the port of Greytown, or San Juan del Norte.

PETEN.—The Lake of Peten is situated in lat. 17° 10′ N., long. 90° W., and is one of several lakes formed at the base of the Promontory of Yucatan. Its length is about thirty miles, its width eight miles, and elevation above the sea 500 feet. The water is quite fresh, clear, and of considerable depth. Neither the Lake of Peten nor the adjoining Lake of Yasha has any outlet; and in both the water is rapidly increasing in expanse—so much so that several streets of the town of Flores, which stands on an island in Lake Peten, have been absorbed within a few years, and the posts of huts, which formerly were on dry ground, may now be seen standing in deep water. This increase of water can only be accounted for by supposing that a common subterranean outlet has been stopped up, or that the land of this district is experiencing a gradual subsidence. All the fish obtained here were caught with a hook and line, or speared. All the natives, even quite small children, are very expert in using a light spear formed of bamboo cane with an iron barb at the end.

YZABAL.—This lake, which is also called the Golfo Dulce, is about thirty or forty miles long, and ten to fifteen miles wide, and has a tolerably uniform depth of about 35 to 40 feet. It is situated in lat. 15° 30′ N., long. 89° 15′ W., at the bottom of the Bay of Honduras. One large river, the Polochic, enters this lake; and it has a narrow but deep outlet to the sea, called the Rio Dulce, which is navigated by small schooners plying between Belize and the town of Yzabal. It was near this last-mentioned place that a few species of fish were obtained.

Rivers.

Bayano.—This is a river which rises in the narrow part of Central America, and flows into the Pacific a little to the southward of the Bay of Panama.

Cahabon.—The town of Cahabon, where a few fishes were obtained, is situated on an affluent of the river which bears this name. The main stream rises in the same marsh as the Polochic, but takes another valley, in Vera Paz, and again joins the Polochic, when they both flow into the Lake of Yzabal, and thence into the Atlantic.

Chagres.—This is the principal river of the Isthmus of Panama. It flows into the Atlantic. The fish were obtained near the railway bridge at Barbacoas, about halfway across the isthmus.

Chisoy.—Of the numerous names this river bears, I have chosen this for the principal stream which forms the large river that flows out into the Laguna de los Terminos, in the Bay of Campeachy. This branch is also known as the Rio Negro; and after receiving the water of the Rio de la Pasion, or Rio de Santa Isabel, as it is also called, the two are usually called the Usumacinta. Fishes were collected from this river near the Indian village of Cubulco; and a number were also procured by poisoning with herbs a small stream near Saouchil, an Indian village below the town of Coban, in Vera Paz.

Guacalate.—Is one of the numerous rivers which drain the southern watershed of the main ridge into the Pacific. It flows past Antigua, the old capital of Guatemala. Fishes were obtained about 3500 feet above the sea, where the river is still quite a torrent.

Motagua.—This river, the second largest in Guatemala, rises in the main ridge, and flows, with high mountains on either side, nearly due eastward into the Atlantic. Fishes abound in this river; and nearly every year a considerable length is poisoned, and a large quantity obtained. On one of these occasions a collection was made a little below the bridge over which the highroad from Guatemala to Vera Paz passes. Another collection came from lower down the stream, below the village of Tocoy.

San Geronimo.—Is a tributary of the Chisoy before mentioned. A small collection was made near the village of San Geronimo, in a plain at the foot of the mountains whence it takes its rise.

Santa Isabel.—A small stream flowing into this river, one of the principal branches of the Usumacinta, was poisoned, and a number of small fishes obtained.

San Salvador.—A few small fishes were caught by Capt. Dow in a warm stream near the capital town of this republic.

Marine localities.

Belize.—All fishes from Belize were from the market, and were caught amongst the coral reefs which line this coast.

Cardon[1] Island.—Is situated at the mouth of the fine harbour of Realejo, in Nicaragua. Fishes were found at low tide in the pools amongst the rocks, and caught with a landing-net.

Chiapam.—The whole coast of Guatemala, bordering the Pacific Ocean, is studded with a number of lagoons formed at the mouths of the numerous rivers which flow down from the neighbouring mountains. All these rivers are charged with volcanic sand, which is thrown back by the heavy surf that rolls in on this coast. The body of water brought down during the dry season is often insufficient to reduce this sandbar; and it frequently happens that all outlet to the sea is stopped. The accumulation of water during the rainy season breaks this barrier; but it again forms when the water subsides. About the period of the cessation of the rains the natives cut an artificial channel, which, at first widening of itself, often remains open some months, each tide bringing a great quantity of fishes into the lagoon, which are there netted by drag-nets. The water is almost salt, but varies in this respect according to the size of the river which enters it. A few fishes were also obtained by a hook and line from a canoe in the open sea.

Libertad.—This is an open roadstead, the port of the City of San Salvador. Whilst we were lying at anchor here a few fishes were caught with a hook and line.

Panama.—Most of the fishes taken in the Bay of Panama were found in the pools amongst the rocks at low tide. A reef running out from the town was an excellent locality; one spring tide Capt. Dow and I secured twenty-four species in the course of half an hour.

San José.—Is the port of Guatemala on the Pacific side; a few fishes were caught here in the open sea in a canoe.

§ 3. *Definition of the Boundaries of the Fauna treated of in this Memoir.*

Although we may presume that our account contains a tolerably complete list of the species inhabiting the localities visited, particularly as on several occasions poison (the best means for securing a complete series of the fishes of a certain locality) was resorted to, yet there is still a wide field for future explorers in a country where several forms (such as *Heros*, *Pimelodus*, and the *Cyprinodontes*) are so much developed and specialized. Of the fishes of Yucatan we still know absolutely nothing. The list of the marine fishes of the Atlantic coast will, without doubt, be considerably swelled, as the gentlemen mentioned paid much less attention to the Atlantic marine fauna (which would have yielded comparatively few novelties) than to the freshwater fauna. And knowing how little advantage is derived from, and how much confusion is caused by, receiving into a

[1] This name is misspelt "Cardova" in several places in the 3rd volume of the 'Catalogue of Fishes.'—A. G.

fauna species which may be *expected* to belong to it, although they are not yet discovered within its limits, I have excluded all species not actually known from Guatemala, although they have been obtained north and south of it. A collection made by Mr. Godman at Belize was of great value in determining this part of the fauna.

Numerous species of fishes have been described from Mexico[1]; and if we were better acquainted with their geographical distribution, it would have been useful to treat at least of the southern portion of them, in conjunction with the Guatemalan species. Unfortunately but a small proportion of the exact localities are known, so that at present no line can be drawn to indicate where the preponderance of nearctic types over tropical ones terminates. Thus, confining myself to the fishes occurring between the political boundary of Guatemala in the north and the Isthmus of Darien in the south, I would repeat that, previously to the receipt of the collections forming the basis to this Memoir, only a small number had been described, as will be seen from the following remarks:—

§ 4. *Historical account of Publications previous to this Memoir.*

It would be of but little advantage to enumerate the few isolated species incidentally described in general works or memoirs as occurring in Guatemala or Panama. However, I must mention that the first traveller who collected fishes in these states appears to have been Baron von FRIEDRICHSTHAL. I am not aware that any account of his travels has been published; but in a paper published by the late JACOB HECKEL in 'Annalen des Wiener Museums,' vol. ii. 1840, a single species is described, which is stated to be from Friedrichsthal's Central-American Collection, and which I have recognized as belonging to the Lake-Peten fauna (*Heros friedrichsthalii*). The greater part of the collection made by this gentleman evidently remained unpublished until 1864, when Dr. F. STEINDACHNER determined from it four other species (Denkschr. Akad. Wiss. Wien, xxiii.), viz.:—*Heros urophthalmus* (Gthr.), *Heros triagramma*=*H. salvini* (Gthr.), *Heros melanopogon*, and *Petenia splendida* (Gthr.). As we have received four of these species from Lake Peten, it is very probable that Baron Friedrichsthal visited and collected in that locality.

In the second place I have to mention Dr. SEEMANN, who, as naturalist attached to the expedition of the 'Herald,' brought to England a collection of Central-American fishes. These, as I have mentioned above, were originally deposited in the collection of Haslar Hospital, but no record as regards the origin of the specimens was kept, so that most of them are lost for the purposes of this Memoir.

In the year 1861 I received the first collections from Mr. SALVIN and Capt. DOW. The species belonging to the families treated of in the 3rd volume of the 'Catalogue of Fishes' were described therein; and a separate account of those sent by the latter

[1] Prof. Troschel enumerates some 130 freshwater and marine species in Müller's 'Reisen in den Vereinigten Staaten,' &c.

gentleman from the Pacific Coast of Central America was published in the Society's 'Proceedings' for 1861 (Nov. 26); it contained fourteen species, ten of which were new.

In the following year the 4th volume of the 'Catalogue of Fishes' was published, containing the descriptions of those species of Pharyngognaths and Anacanthines which had arrived from our travellers, who were then engaged in collecting.

In the year 1863 Mr. Gill published a descriptive enumeration of a collection of "Fishes from the western coast of Central America, presented to the Smithsonian Institution by Capt. J. M. Dow." He distinguished in it the following twenty-five species, of which I consider eighteen to have been new to science (Proc. Ac. Nat. Sc. Philad. 1863, p. 162):—

1. *Diapterus dowii*, sp. n.=*Gerres dovii.*
2. *Pomacanthodes zonipectus*, Gill.
3. *Centropomus armatus*, sp. n.
4. *Epinephelus analogus*, sp. n.=*Serranus analogus.*
5. *Promicropterus decoratus*, sp. n.=*Rhypticus decoratus.*
6. *Bairdiella armata*, sp. n.=*Corvina armata.*
7. *Ophioscion typicus*, sp. n.=*Corvina ophioscion.*
8. *Amblyscion argenteus*, sp. n.
9. *Caranx panamensis*, Gill,=*Caranx speciosus* (Forsk.).
10. *Carangoides dorsalis*, sp. n.
11. *Carangus marginatus*, Gill,=*Caranx hippos*, L., var.
12. *Oligoplites inornatus*, sp. n.=*Chorinemus inornatus.*
13. *Exocœtus dowii*, sp. n.
14. —— *albidactylus*, sp. n.?=*E. bahiensis* (Ranz.).
15. *Upeneus grandisquamis*, sp. n.
16. *Trichidion opercularis*, sp. n.=*Polynemus opercularis.*
17. —— *approximans*=*Polynemus approximans* (Lay & Benn.).
18. *Mugil guentherii*, Gill,=*M. brasiliensis* (Agass.).
19. *Batrachoides pacifici*=*Batrachus pacifici* (Gthr.).
20. *Dormitator microphthalmus*, Gill,=*Eleotris maculata* (Bl.).
21. *Leptarius dowii*, sp. n.=*Arius dovii.*
22. *Sciades troschelii*, sp. n.=*Arius troschelii.*
23. *Ælurichthys panamensis*, sp. n.
24. *Atractosteus tropicus*, sp. n.=*Lepidosteus tropicus.*
25. *Urotrygon mundus*, sp. n.

At later periods Mr. Gill has described some other species incidentally, which will be referred to in the general list.

A small collection made by Prof. M. Wagner on the Isthmus of Panama, between 7° and 9° lat. N., and 77° and 83° long. W., was examined by Messrs. Kner & Stein-

DACHNER, who gave a preliminary account of it in 'Sitzgsber. bayer. Akad. Wiss.' 1863, pp. 220–230, and more detailed descriptions in 'Abhandl. bayer. Akad. Wiss.' 1864 (1865), pp. 1–61. Prof. M. Wagner added, besides, a detailed account of the hydrographical peculiarities of this part of Central America (pp. 65–92). The species treated of in these Memoirs are the following:—

1. *Pristipoma humile*, sp. n.
2. *Dajaus elongatus* (K. & St.)=*Agonostoma nasutum* (Gthr.).
3. *Dajaus monticola* (C. & V.).
4. *Acara cæruleopunctata*, sp. n.
5. *Heros altifrons*, sp. n.
6. *Heros sieboldii*, sp. n.
7. *Eleotris pictus*, sp. n.
8. *Engraulis macrolepidotus*, sp. n.
9. —— *poeyi*, sp. n.
10. *Xiphophorus gillii*, K. & St.,=*Pœcilia*, sp. ?
11. *Macrodon brasiliensis*, K. & St.,=*M. microlepis* (Gthr.).
12. *Saccodon wagneri*, sp. n.
13. *Pseudochalceus lineatus*, sp. n.
14. *Chalcinopsis striatulus*, sp. n.
15. —— *chagrensis*, sp. n.
16. *Chalceus atrocaudatus*, sp. n.
17. *Tetragonopterus æneus* (Gthr.).
18. —— *gronovii* (C. & V. ?).
19. *Bagrus* (?)*arioides*, sp. n.=*Arius multiradiatus* (Gthr.).
20. *Pimelodus modestus* (Gthr.)
21. —— *cinerascens* (K. & St.)=*P. wagneri* (Gthr.).
22. *Loricaria uracantha*, sp. n.
23. —— *lima* (Kner).
24. *Hypostomus plecostomus* (K. & St.)=*Plecostomus*, sp.
25. *Ancistrus cirrhosus* (C. & V.).
26. *Acanthias vulgaris* (Risso ?).

Finally, having received in 1864 the last collections made by Messrs. Godman & Salvin, I gave preliminary notices of the new species in the 'Proceedings' of this Society, embodying the numerous contributions to our knowledge of the Siluroids and Characinoids in the fifth volume of the 'Catalogue of Fishes,' to which were added the Cyprinodontes and Scombresocides in the sixth (1865–66).

§ 5. *General List of Central-American Fishes.*

After these introductory remarks on the contributions to the ichthyology of Central

America preceding this Memoir, I at once proceed to give a list of all the species known to exist in these countries. There are comparatively few which I do not know from autopsy; their names are printed in italics. An asterisk (*) marks those which are described or remarked upon. The second column contains chiefly the names of the localities where they have been found within the limits of Central America. The localities of species occurring on both sides of the Isthmus are printed in italics; of these I shall treat again subsequently. Finally, the letter M signifies that a species is marine, B that it is known from brackish, and F that it is from fresh water.

ACANTHOPTERYGII.

Fam. PERCIDÆ.

CENTROPOMUS, *Cuv.*		
1. *appendiculatus, *Poey*	Chagres R. (Cuba, Mex., Surin.)	F. & M.
2. *medius, *Gthr.*	Chiapam	B.
3. *nigrescens, *Gthr.*	Chiapam	B.
4. *parallelus, *Poey*	Chagres R. (W. Indies, Bahia)	F. & M.
5. *armatus, *Gill*	Chiapam	B.
6. *ensiferus, *Poey*	Belize (Cuba, Jamaica, Guyanas)	B.
CENTROPRISTIS, *Bris. de Barnev*		
7. *macropoma, *Gthr.*	Panama	M.
SERRANUS, *Cuv.*		
8. *creolus, *C. & V.*	*Atl. & Pac.*	M.
9. striatus, *Bl.*	Atlant.	M.
10. coronatus, *C. & V.*	Atlant.	M.
11. undulosus, *C. & V.*	Atlant.	M.
12. *sellicauda, *Gill*	Pacific Coast	M.
13. *analogus, *Gill*	Pacific Coast	M.?
PLECTROPOMA, *Cuv.*		
14. *afrum, *Bl.*	*Atl. & Pac.*	M.
RHYPTICUS, *Cuv.*		
15. *decoratus, *Gill*	Pacific Coast	M.
MESOPRION, *Cuv.*		
16. chrysurus, *Bl.*	Atlant.	M.
17. griseus, *C. & V.*	*Atl. & Pac.*	M.
18. uninotatus, *C. & V.*	*Atl. & Pac.*	M.
19. *aratus, *Gthr.*	Chiapam, Panama	M. & B.
20. vivanus, *C. & V.*	Atlant.	M.
APOGON, *Lacép.*		
21. *dovii, *Gthr.*	Pacific Coast	M.

Fam. PRISTIPOMATIDÆ.

PRISTIPOMA, *Cuv.*		
22. *melanopterum, *C. & V.*	*Atl. & Pac.*	M.
23. *virginicum, *L.*	*Atl. & Pac.*	M.
24. *dovii, *Gthr.*	Panama	M.
25. *chalceum, *Gthr.*	Panama	M.
26. **humile,* Kner & Steind.	Rio Bayano	F.
27. *macracanthum, *Gthr.*	Chiapam	B.
28. crocro, *C. & V.*	Rio Motagua (Trop. Amer., Atlant.)	F., B., & M.
29. *leuciscus, *Gthr.*	San José, Chiapam, Panama	B.
CONODON, *C. & V.*		
30. *pacifici, *Gthr.*	Chiapam	B.
HÆMULON, *Cuv.*		
31. chromis, *Brouss.*	Atlant.	M.
32. canna, *C. & V.*	Atlant.	M.
33. xanthopterum, *C. & V.*	Atlant.	M.
34. *brevirostrum, *Gthr.*	*Panama, Puerto Cabello*	M.
35. *margaritiferum, *Gthr.*	Panama	M.
LOBOTES, *Cuv.*		
36. auctorum, *Gthr.*	*Atlant.* (*India*)	B.

Fam. SQUAMIPINNES.

CHÆTODON, *Cuv.*		
37. striatus, *L.*	Atlant.	M.
38. capistratus, *L.*	Atlant.	M.
39. *humeralis, *Gthr.*	Panama (Sandwich Isl.)	M.
POMACANTHUS, *Lacép.*		
40. paru, *Gthr.*	Atlant. (Colon)	M.
41. **zonipectus,* Gill	Pac.	M.
EPHIPPUS, *Cuv.*		
42. faber, *Bl.*	Atlant. (Belize)	M.

Fam. MULLIDÆ.

UPENEUS, *C. & V.*		
43. *tetraspilus, *Gthr.*	Panama	M.
44. **grandisquamis,* Gill	Panama	M.

Fam. SPARIDÆ.

SARGUS, *Cuv.*		
45. unimaculatus, *Bl.*	Atlant. (Belize)	M.
46. aries, *C. & V.*	Atlant. (Belize)	M.
CHRYSOPHRYS, *Cuv.*		
47. *calamus, *C. & V.*	*Atl. & Pac.* (Panama)	M.
PIMELEPTERUS, *Cuv.*		
48. boscii, *Lacép.*	*Atl. & Pac.* (Chiapam & Panama)	M.

Fam. CIRRHITIDÆ.

CIRRHITICHTHYS, *Blkr.*		
49. *rivulatus, *Val.*	Galapagos Islands, Panama	M.

Fam. SCORPÆNIDÆ.

SCORPÆNA, *Art.*		
50. plumieri, *Bl., Schn.*	*Atl. & Pac.* (Panama)	M.

Fam. POLYNEMIDÆ.

POLYNEMUS, *L.*		
51. *melanopoma, *Gthr.*	San José	M.
52. *approximans, *Lay & Benn.*	Pacif., Chiapam, Panama	M.
53. **opercularis,* Gill	Pacif.	M.

Fam. SCLÆNIDÆ.

LARIMUS, *C. & V.*		
54. *breviceps, *C. & V.*	*Atl. & Pac.* (Panama)	M.
MICROPOGON, *Cuv. & Val.*		
55. undulatus, *L.*	Atlant.	M. & F.
56. *altipinnis, *Gthr.*	Chiapam, San José, Panama	M. & B.
UMBRINA, *Cuv.*		
57. *elongata, *Gthr.*	Chiapam	B.
58. *nasus, *Gthr.*	Panama	M.
59. *analis, *Gthr.*	Panama	M.
CORVINA, *Cuv.*		
60. ronchus, *C. & V.*	Atlant.	M.
61. *chrysoleuca, *Gthr.*	Panama	M.
62. *vermicularis, *Gthr.*	Panama	M.
63. **armata,* Gill	Pacif.	
64. *ophioscion, *Gthr.*	Panama	M.
OTOLITHUS, *Cuv.*		
65. *squamipinnis, *Gthr.*	Panama	M.
66. *albus, *Gthr.*	Chiapam	B.
67. *reticulatus, *Gthr.*	San José, Chiapam	M. & B.

Fam. ACRONURIDÆ.

ACANTHURUS, *Schn.*		
68. chirurgus, *Bl.*	Atlant.	M.

Fam. CARANGIDÆ.

CARANX, *Gthr.*		
69. crumenophthalmus, *Bl.*	*Atl. & Pac.*	M.
70. amblyrhynchus, *C. & V.*	Atlant.	M.
71. *leucurus, *Gthr.*	Panama	M.
72. *speciosus, *Forsk.*	From Panama to East Africa	M.

73. carangus, *Bl.*	*Atlant. & Ind. Occ.* (Chiapam & Belize)	M.
74. *hippos, *L.*	*Tropics generally*	M.
75. *caballus, *Gthr.*	Panama	M.
76. *caninus, *Gthr.*	Panama	M.
77. *dorsalis, *Gill*	San Diego (Cal.), Panama	M.
ARGYRIOSUS, *Lac.*		
78. vomer, *L.*	*Atl. & Pac.* (Belize, Chiapam, Panama)	B. & M.
79. setipinnis, *Mitch.*	*Atl. & Pac.* (Panama)	M.
CHORINEMUS, *C. & V.*		
80. occidentalis, *L.*	Atlant.	M.
81. saliens, *Bl.*	*Atlant. & Pac.* (Chiapam, Isabel)	B. & F.
82. *altus, *Gthr.*	Panama	M.
83. **inornatus,* Gill	Panama	M.
TRACHYNOTUS, *C. & V.*		
84. ovatus, *L.*	*Atl., Pac., & Ind. Oc.* (Panama)	M.
85. *fasciatus, *Gill*	Panama, San José	M.

Fam. SCOMBRIDÆ.

PELAMYS, *C. & V.*		
86. *sarda, *Bl.*	*Atl. & Pac.*	M.
CYBIUM, *Cuv.*		
87. maculatum, *Mitch.*	Atlant. (Belize)	M.
ECHENEIS, *Art.*		
88. remora, *L.*	*Atl., Pac., & Ind. Oc.*	M.
89. naucrates, *L.*	*Atl., Pac., & Ind. Oc.*	M.

Fam. BATRACHIDÆ.

BATRACHUS, *Gthr.*		
90. *pacifici, *Gthr.*	*Panama, West Coast of Africa*	M.
91. surinamensis, *Bl. Schn.*	*Atl. & Pacif.* (Panama)	M.
*THALASSOPHRYNE, *Gthr.*		
92. *maculosa, *Gthr.*	Puerto Cabello	M.
93. *reticulata, *Gthr.*	Panama	M.
PORICHTHYS, *Girard.*		
94. porosissimus, *C. & V.*	*Atl. & Pac.*	M.

Fam. PEDICULATI.

ANTENNARIUS, *Commers.*		
95. *leopardinus, *Gthr.*	Panama	M.
96. *tenuifilis, *Gthr.*	Panama	M.

Fam. GOBIIDÆ.

GOBIUS, *Art.*		
97. soporator, *C. & V.*	*Atl. & Pac.* (Panama)	M. & B.
98. paradoxus, *Gthr.*	Panama	M.

99. mexicanus, *Gthr.*	Mexico, Rio Motagua	F.
100. seminudus, *Gthr.*	Panama	M.
EUCTENOGOBIUS, *Gill.*		
101. sagittula, *Gthr.*	Panama	M.
SICYDIUM, *C. & V.*		
102. plumieri, *Bl.*	*Atl. & Pac.* (Panama)	M.
ELEOTRIS, *Cuv.*		
103. *maculata, *Bl.*	*Atl. & Pac.* (Huamuchal)	B.
104. somnolenta, *Girard*	*Atl. & Pac.* (Cardon)	M.
105. dormitatrix, *Bl.*	Atl. (Rio Motagua, Yzabal)	F. & B.
106. *longiceps, *Gthr.*	Lake of Nicaragua	F.
107. **picta*, Kner	Rio Bayano	F.
108. *seminuda, *Gthr.*	Panama	M.
AMBLYOPUS, *C. & V.*		
109. *brevis, *Gthr.*	Panama	M.

Fam. BLENNIIDÆ.

BLENNIUS, *Artedi.*		
110. brevipinnis, *Gthr.*	Pacif.	M.
SALARIAS, *Cuv.*		
111. atlanticus, *C. & V.*	*Atl. & Pac.*	M.
CLINUS, *Gthr.*		
112. nuchipinnis, *Q. & G.*	*Atl. & Pac.*	M.
113. delalandii, *C. & V.*	*Atl. & Pac.*	M.
114. *macrocephalus, *Gthr.*	Panama	M.
CREMNOBATES, *Gthr.*		
115. *monophthalmus, *Gthr.*	Panama	M.

Fam. SPHYRÆNIDÆ.

SPHYRÆNA, *Artedi.*		
116. picuda, *Bl.*	Atl.	M.
117. forsteri, *C. & V.*	Ind. Oc. & Pac. (Chiapam)	M. & B.

Fam. ATHERINIDÆ.

ATHERINICHTHYS, *Gthr.*		
118. *pachylepis, *Gthr.*	Panama	M.
119. *guatemalensis, *Gthr.*	Huamuchal	B.

Fam. MUGILIDÆ.

MUGIL, *Artedi.*		
120. *brasiliensis, *Agass.*	*Atl. & Pac.*	M. & F.
121. *incilis, *Hancock*	Atl. (Chagres)	M. & F.
122. proboscideus, *Gthr.*	*Atl. & Pac.* (Cardon)	M. & F.
AGONOSTOMA, *Benn.*		
123. *microps, *Gthr.*	Rio Guacalate	F.

124. *nasutum, *Gthr.*	*Rivers of both sides of C. America* (R. San Geronimo, R. Motagua, Panama)	F.
125. *monticola, *Bancroft*	*W. Indies and rivers of both sides of C. America*	F.
Myxus, *Gthr.*		
126. harengus, *Gthr.*	Panama	M.

Fam. FISTULARIIDÆ.

Fistularia, *Lacép.*		
127. tabaccaria, *L.*	*Atl. & Pac.*	M.

Fam. GOBIESOCIDÆ.

Sicyases, *Müll. & Trosch.*		
128. *fasciatus*, Ptrs.	Puerto Cabello	M.
Gobiesox, *Lacép.*		
129. *rhodospilus, *Gthr.*	Panama	M.
130. *nigripinnis*, Ptrs.	Puerto Cabello	M.
131. nudus, *Bl.*	*Atl. & Pac.* (Cardon)	M.

PHARYNGOGNATHI ACANTHOPTERYGII.

Fam. POMACENTRIDÆ.

Pomacentrus, *C. & V.*		
132. *rectifrænum, *Gill*	*Pacif. & Atl.*	M.
133. leucostictus, *Müll. & Trosch.*	Atl.	M.
Glyphidodon, *Cuv.*		
134. saxatilis, *L.*	Atl.	M.
135. concolor, *Gill*	*Atl. & Pac.* (Cardon)	M.
136. declivifrons, *Gill*	Pac. (Cardon)	M.
Heliastes, *C. & V.*		
137. *marginatus, *Casteln.*	*Atl. & Pac.*	M.

Fam. LABRIDÆ.

Lachnolæmus, *C. & V.*		
138. falcatus, *L.*	Atl.	M.
Cossyphus, *Günth.*		
139. rufus, *L.*	Atl.	M.
140. diplotænia, *Gill*	Panama, Lower Calif.	M.
141. *pectoralis, *Gill*	*Panama, Lower Calif., St. Helena* (*? Cuba*)	M.
Platyglossus, *Gthr.*		
142. bivittatus, *Bl.*	Atl.	M.
143. *dispilus, *Gthr.*	Panama	M.
Pseudojulis, *Blkr.*		
144. *notospilus, *Gthr.*	Panama	M.

JULIS, *Gthr.*		
145. lucasana, *Gill*	Panama, Lower Calif.	M.
SCARUS, *Blkr.*		
146. abildgaardii, *Bl.*	Atl.	M.
PSEUDOSCARUS, *Blkr.*		
147. sanctæ crucis, *Bl.*	Atl.	M.
148. guacamaia, *C. & V.*	Atl.	M.

Fam. GERRIDÆ.

GERRES, *Cuv.*		
149. plumieri, *C. & V.*	Atl.	F., B., & M.
150. *axillaris, *Gthr.*	Chiapam	B.
151. *brevimanus, *Gthr.*	Chiapam	B.
152. rhombeus, *C. & V.*	*Atl. & Pac.* (Chiapam)	B. & M.
153. squamipinnis, *Gthr.*	(Jamaica) *Atl. & Pac.* (Chiap. & Panama)	B. & M.
154. aprion, *C. & V.*	*Atl. & Pac.* (Panama)	M.
155. **dovii*, Gill	Pac.	

Fam. CHROMIDES.

ACARA, *Gthr.*		
156. *cæruleopunctata, *Kner & Steind.*	Chagres River	F.
HEROS, *Gthr.*		
157. *parma, *Gthr.*	Mexico, R. Chagres & R. Motagua	F.
158. *margaritifer, *Gthr.*	Lake Peten	F.
159. **melanopogon*, Steindachner	? Lake Peten	F.
160. *melanurus, *Gthr.*	Lake Peten	F.
161. *macracanthus, *Gthr.*	Chiapam & Huamuchal	F. & B.
162. *spilurus, *Gthr.*	Rio Motagua, Yzabal	F.
163. *nigrofasciatus, *Gthr.*	Lakes of Amatitlan & Atitlan	F.
164. *multispinosus, *Gthr.*	Lake of Managua	F.
165. *longimanus, *Gthr.*	Lake of Nicaragua	F.
166. *urophthalmus, *Gthr.*	Lake Peten	F.
167. *aureus, *Gthr.*	Yzabal, Rio Motagua	F.
168. *affinis, *Gthr.*	Lake Peten	F.
169. *labiatus, *Gthr.*	Lakes of Managua & Nicaragua	F.
170. *erythræus, *Gthr.*	Lake of Managua	F.
171. *lobochilus, *Gthr.*	Lake of Managua	F.
172. *citrinellus, *Gthr.*	Lake of Nicaragua	F.
173. **altifrons*, Kner & Steind.	Western Veragua	F.
174. *friedrichsthalii, *Heck.*	Lake Peten	F.
175. *salvini, *Gthr.*	Santa Izabel, Lake Peten	F.
176. *trimaculatus, *Gthr.*	Chiapam, Huamuchal	F. & B.
177. *dovii, *Gthr.*	Lake of Nicaragua	F.
178. *motaguensis, *Gthr.*	Rio Motagua	F.

179. *managuensis, *Gthr.*	Lake of Managua	F.
180. *microphthalmus, *Gthr.*	Rio Motagua	F.
181. *oblongus, *Gthr.*	Rio Motagua	F.
182. *nicaraguensis, *Gthr.*	Lake of Nicaragua	F.
183. *godmanni, *Gthr.*	River of Cahabon	F.
184. **sieboldii,* Kner & Steindachner	New Granada	F.
185. *guttulatus, *Gthr.*	Lake of Amatitlan	F.
186. *irregularis, *Gthr.*	Rio Usumacinta, S. Geronimo	F.
187. *intermedius, *Gthr.*	Lake Peten	F.
188. *angulifer, *Gthr.*	Yzabal	F.
*PETENIA, *Gthr.*		
189. *splendida, *Gthr.*	Lake Peten	F.
*NEETROPLUS, *Gthr.*		
190. *nematopus, *Gthr.*	Lake of Managua	F.

ANACANTHINI.

Fam. LYCODIDÆ.

*MICRODESMUS, *Gthr.*		
191. *dipus, *Gthr.*	Panama	M.

Fam. OPHIDIIDÆ.

BROTULA, *Cuv.*		
192. *? multibarbata, *Schleg.*	Pac. coast	M.
DINEMATICHTHYS, *Blkr.*		
193. marginatus, *Ayres*	Panama	M.
OPHIDIUM, *Cuv.*		
194. brevibarbe, *Cuv.*	*Atl. & Pac.*	M.

Fam. PLEURONECTIDÆ.

CITHARICHTHYS, *Blkr.*		
195. *spilopterus, *Gthr.*	*Atl. & Pac.* (Chiapam)	M. & B.
196. **guatemalensis,* Blkr.	Guatemala	
HEMIRHOMBUS, *Blkr.*		
197. *ovalis, *Gthr.*	Pac.	M.
PSEUDORHOMBUS, *Blkr.*		
198. *brasiliensis, *Ranzani*	Atl.	M.
SOLEA, *Gthr.*		
199. scutum, *Gthr.*	Panama	M.
APHORISTIA, *Kaup.*		
200. *ornata, *Lacép.*	*Atl. & Pac.*	M.

PHYSOSTOMI.

Fam. SILURIDÆ.

AMIURUS, *Rafin.*		
201. *meridionalis, *Gthr.*	Rio Usumacinta	F.
PIMELODUS, *Gthr.*		
202. modestus, *Gthr.*	Rio Chagres, Esmeraldas	F.
203. guatemalensis, *Gthr.*	Huamuchal	F.
204. godmanni, *Gthr.*	Lower Vera Paz, Rio Motagua, Mexico	F.
205. **wagneri*, Gthr.	*Pacific & Atlantic rivers of Panama*	F.
206. *managuensis, *Gthr.*	Lake of Managua	F.
207. micropterus, *Gthr.*	Rio San Geronimo	F.
208. nicaraguensis, *Gthr.*	Lake of Nicaragua	F.
209. petenensis, *Gthr.*	Lake Peten	F.
210. motaguensis, *Gthr.*	Rio Motagua	F.
211. salvini, *Gthr.*	Rio San Geronimo	F.
212. polycaulus, *Gthr.*	Rio San Geronimo	F.
ARIUS, *Gthr.*		
213. guatemalensis, *Gthr.*	Chiapam, Panama	B.
214. *assimilis, *Gthr.*	Lake of Yzabal	F.
215. platypogon, *Gthr.*	San José	F.
216. seemanni, *Gthr.*	——?	
217. cærulescens, *Gthr.*	Huamuchal	F.
218. *troschelii*, Gill	Pac.	.
219. **dovii*, Gill	Pac.	.
220. melanopus, *Gthr.*	Rio Motagua	F.
221. *multiradiatus*, Gthr.	Rio Bayano	F.
ÆLURICHTHYS, *Baird & Gir.*		
222. *nuchalis, *Gthr.*	Panama	.
223. **panamensis*, Gill	Panama	.
PLECOSTOMUS, *Gthr.*		
224. *?*sp.*, Kner & Steindachner	Rio Chagres	F.
CHÆTOSTOMUS, *Heck.*		
225. *aspidolepis, *Gthr.*	Veragua	F.
226. *?*cirrhosus*, Val.	Rio Chagres	F.
LORICARIA, *Lacép.*		
227. **uracantha*, Kner & Steindachner	*Atlantic & Pacific rivers of Panama*	F.
228. *lima*, Kner	*Atlantic & Pacific rivers of Panama*	F.

Fam. CHARACINIDÆ.

MACRODON, *Müll. & Trosch.*		
229. *microlepis, *Gthr.*	*W. Ecuador, Rio Chagres*	F.
TETRAGONOPTERUS, *Cuv.*		
230. fasciatus, *Cuv.*	From Brazil to Mexico (Huamuchal, Rio Guacalate, Rio Motagua, Rio Chisoy)	F.

231. microphthalmus, *Gthr.*	Lake of Amatitlan, Pacif. Coast of Guatemala, Peru.	F.
232. panamensis, *Gthr.*	*Panama, Yzabal*	F.
233. brevimanus, *Gthr.*	Rio S. Geronimo, Yzabal	F.
234. petenensis, *Gthr.*	*Lake Peten, W. Ecuador*	F.
235. humilis, *Gthr.*	Lake of Amatitlan	F.
236. *æneus, *Gthr.*	Mexico, *Pacific & Atlantic rivers of Panama*	F.
CHALCINOPSIS, *Kner.*		
237. *dentex, *Gthr.*	*Rio Motagua and Usumacinta, Yzabal; Ecuador*	F.
238. striatulus, *Kner*	*Pacific & Atlantic rivers of Panama*	F.
239. chagrensis, *Kner*	Rio Chagres	F.
ANACYRTUS, *Gthr.*		
240. *guatemalensis, *Gthr.*	*Rio Chagres, Huamuchal*	F.

Fam. SCOPELIDÆ.

SAURUS, *C. & V.*		
241. fœtens, *L.*	*Atl. & Pac.*	M.
242. myops, *Bl.*	*Atl. & Pac.*	M.

Fam. SCOMBRESOCIDÆ.

HEMIRHAMPHUS, *Cuv.*		
243. unifasciatus, *Ranzani*	*Atlantic, Pacific, & Indian Oceans*	M.
EXOCŒTUS, *Artedi.*		
244. *callopterus, *Gthr.*	Pac.	M.
245. *albidactylus,* Gill (? = bahiensis, *Ranz.*)	Pac.	M.
246. *dovii,* Gill	Pac.	M.

Fam. CYPRINODONTIDÆ.

*CHARACODON, *Gthr.*		
247. *lateralis, *Gthr.*	—— ?	
HAPLOCHILUS, *M'Clell.*		
248. *dovii, *Gthr.*	Punta Arenas (Costa Rica)	F.
FUNDULUS, *C. & V.*		
249. *labialis, *Gthr.*	Rio S. Geronimo, Yzabal	F.
250. *punctatus, *Gthr.*	Chiapam	B.
251. *guatemalensis, *Gthr.*	Lakes of Dueñas & Amatitlan, Rio Guacalate, W. Ecuador	F.
252. *pachycephalus, *Gthr.*	Lake of Atitlan	F.
BELONESOX, *Kner.*		
253. belizanus, *Kner*	Lake Peten, Honduras, Mexico	F.
GAMBUSIA, *Poey.*		
254. *nicaraguensis, *Gthr.*	Lake of Nicaragua	F.
ANABLEPS, *Artedi.*		
255. dovii, *Gill*	Chiapam	B.

Pœcilia, *Gthr.*

256. mexicana, *Steindachner* . . . . *Chiapam, Dueñas, Rio Chisoy, Huamuchal, Lake of Amatitlan* . . . F. & B.
257. thermalis, *Steindachner* . . . . San Salvador, Mexico . . . F.
258. chisoyensis, *Gthr.* . . . . Rio Chisoy . . . F.
259. *elongata, *Gthr.* . . . . Panama . . . .
260. *petenensis, *Gthr.* . . . . Lake Peten . . . F.
261. dovii, *Gthr.* . . . . Lakes of Nicaragua & Amatitlan, Mexico . . . F.
262. **gillii*, Kner . . . . Rio Chagres . . . F.
263. spilurus, *Gthr.* . . . . ——?

Mollienesia, *Lesueur.*

264. *petenensis, *Gthr.* . . . . Lake Peten . . . F.

Xiphophorus, *Gthr.*

265. *hellerii, *Heck.* . . . . Rio Chisoy, Mexico . . . F.

Girardinus, *Poey.*

266. *pleurospilus, *Gthr.* . . . . Lake of Dueñas . . . F.

Fam. CYPRINIDÆ.

Sclerognathus, *Gthr.*

267. meridionalis, *Gthr.* . . . . Rio Usumacinta . . . F.

Fam. CLUPEIDÆ.

Chanos, *Lacép.*

268. salmoneus, *Forst.* . . . . Indian & Pacific Oceans (Chiapam) . . . M. & B.

Albula, *Gronov.*

269. conorhynchus, *Bl.* . . . . *Tropical & Subtropical seas* (Panama) . . . M.

Megalops, *Lacép.*

270. thrissoides, *Schn.* . . . . Atlantic . . . M.

Pristigaster, *Cuv.*

271. *macrops, *Gthr.* . . . . Panama . . . M.
272. *dovii, *Gthr.* . . . . Panama . . . M.

Clupea, *Artedi.*

273. *libertatis, *Gthr.* . . . . Libertad . . . M.

Chatoëssus, *C. & V.*

274. *petenensis, *Gthr.* . . . . Lake Peten . . . F.

Engraulis, *C. & V.*

275. brownii, *C. & V.* . . . . *Atlantic & Pacific* (Libertad) . . . M. & B.
276. **poeyi*, Kner & Steindachner . . Rio Bayano . . . F.
277. **macrolepidota*, Kner & Steind. . Rio Bayano . . . F.

Cetengraulis, *Gthr.*

278. *mysticetus, *Gthr.* . . . . Pacific coast of Panama . . . M.

Fam. GYMNOTIDÆ.

Carapus, *Müll. & Trosch.*

279. *fasciatus, *Pall.* . . . . Rio Motagua . . . F.

Fam. MURÆNIDÆ.

OPHIURUS, *Lac.*

280. triserialis, *Kaup.* . . . . *Atlantic & Pacific* . . . . M.
281. boro, *Ham. Buch.* . . . . *Indian Ocean, West Indies* . . . . . M., B., & F.
282. breviceps, *Richards.* . . . . . . Pacific coast . . . .

MURÆNA, *Cuv.*

283. lineopinnis, *Richards.* . . . . . *Atlantic & Pacific* (Panama) . . . . M.

Fam. SYMBRANCHIDÆ.

SYMBRANCHUS, *Bl.*

284. marmoratus, *Bl.* . . . . Atlantic (Rio Chisoy, Huamuchal, Lake Peten), M., B., & F.
285. immaculatus, *Bl.* . . . . Pacific Coast of Guatemala . . . . M.

PLECTOGNATHI.

DIODON, *Kaup.*

286. sex-maculatus, *Cuv.* . . . . . . Indian & Pacific Oceans (Panama) . . . . . . M.

TETRODON, *L.*

287. *politus, *Girard* . . . . San José . . . . M.
288. *geometricus, *Gthr.* . . . . . . Panama & Galapagos Isls. . . . . M.

OSTRACION, *L.*

289. cornutus, *L.* . . . . *Tropics* . . . . M.
290. bicaudalis, *L.* . . . . Atlantic . . . . M.

BALISTES, *Hollard.*

291. vetula, *L.* . . . . *Tropics* . . . . M.
292. *frenatus, *Lacép.* . . . . Indian & Pacific Oceans (Gonzalez Isl.) . . . . M.
293. niger, *Osbeck* . . . . *Ind., Pac., & Atlant. Oceans* . . . . M.

ALEUTERES, *Cuv.*

294. monoceros, *Osbeck* . . . . . . *Ind., Pac., & Atlant. Oceans* . . . . M.

GANOIDEI.

LEPIDOSTEUS

295. *tropicus, *Gill* . . . . Huamuchal . . . . B.

ELASMOBRANCHII.

MUSTELUS, *Bonap.*

296. *dorsalis, *Gill* . . . . Panama . . . . M.

ACANTHIAS

297. vulgaris, *Risso* . . . . *Atl., Ind., & Pac. Oceans* (Panama) . . . . . . M.

CARCHARIAS

298. *maculipinnis, *Poey* . . . . . *Cuba, Chiapam* . . . . M.

ZYGÆNA, *Cuv.*

299. tiburo, *L.* . . . . Atl. M.

RHINOBATUS, *Müll. & Henle.*

300. *leucorhynchus, *Gthr.* . . . . . Panama . . . . M.

PRISTIS, *Lath.*
301. antiquorum, *Lath.* . . . . . . *Atl. & Pac. Oceans* (Chiapam) . . . . M.
UROLOPHUS, *Müll. & Henle.*
302. **mundus*, Gill . . . . Pac. . . . . M.
AËTOBATIS, *Müll. & Henle.*
303. *latirostris, *A. Dum.* . . . . . . *Gaboon, Panama* . . . . M.

§ 6. *Partial Identity of the Fish-faunas of the Atlantic and Pacific Coasts of Central America.*

It will be seen that, as far as our present knowledge reaches, of these 303 species,

173 are truly marine forms, 57 being found on both sides of the Isthmus.

25 have been found in brackish water, of which 3 are found on both sides of the Isthmus.

101 are freshwater fishes, 17 being found in rivers of the Atlantic and Pacific sides.

There will be but very few species which are entirely limited to brackish water, and which may not be with equal propriety added either to the marine or freshwater fauna. Thus, five of the 25 species hitherto known from lagoons with brackish water belong to freshwater genera; and, admitting two groups only, we have

193 marine fish, 59 of which are found on both sides of Central America$=30\frac{1}{2}$ per cent.

106 freshwater fish, 19 being found in rivers of the Atlantic and Pacific sides$=18$ per cent.

From the circumstance that our collectors paid more attention to the freshwater than to the marine fauna (at least of the Atlantic coast), we may assume that the proportion between the two groups will be increased by future researches in favour of the marine fauna, but that the proportion between species peculiar to one side and those common to both will be lessened, inasmuch as every collector will discover other Atlantic forms on the Pacific side, and *vice versâ*.

The very curious fact of the partial identity of the species of both coasts of Central America was first distinctly stated by myself in the Society's 'Proceedings' for 1861 (p. 370), when, out of fourteen species collected by Capt. Dow on the Pacific side, five were found to be Atlantic forms. To these various others were added by me in the 'Catalogue of Fishes;' and Mr. Gill confirmed this observation in Proc. Ac. Nat. Sc. Philad. 1862, pp. 140, 249. Professor Wagner, in his memoir quoted above (p. 384)[1], has made the same observation; but the species enumerated by him, fourteen in number, are, with one exception, freshwater forms, the geographical distribution of which must have been brought about at periods and in ways different from those of the diffusion of marine species.

Knowing now that at least 30 per cent. of the *marine* fish are found on both sides of

[1] See also 'Record, Zool. Literat.' ii. p. 177.

Central America[1], we cannot account for this fact by resorting to such occasional means of dispersal as the accidental transmission of spawn from one shore to the other by birds or water-spouts, or even the close proximity of the sources of rivers flowing in opposite directions. If we do not adopt the view that species were created at the spot where we find them now, similar creations being produced under similar physical conditions, we have but one way of explaining the partial similarity of these marine fish-faunas, namely, by assuming that the Isthmus did not form a continuous barrier between the two oceans at a former period, but that one or more open channels existed. I am not aware that geology has, up to this time, furnished us with proof positive that this is really the fact; but considering the volcanic nature of Central America, and the absence of all fossiliferous strata, it does not appear too bold an hypothesis to assume that North and South America were formerly connected by a chain of islands similar to that of the Antilles, and that subsequently an elevation (as in other parts of the globe) took place, resulting in the final continuity of dry land: the long-continued activity of the numerous volcanoes may have been another, though secondary cause in filling up the channels on the Pacific side. If such a bodily elevation of Central America has taken place, it is easy to show where some of the broadest channels existed, namely, where we find the greatest depressions running from one ocean to the other. The northernmost of these depressions exists between Tehuantepec and the river Coatzalco; the second is indicated between Puerto Cabello and the Gulf of Fonseca; the third by the Lake of Nicaragua (the remnant and deepest part of a very broad channel); a fourth between Chagres and Panama. (See map, Pl. LXIII., where these supposed former depressions are coloured green.) As far as I have been able to ascertain, the greatest elevation of the first of these lines of depression would be 1500, of the fourth 287 feet only[2]. If we presume that only one of the channels was open at a period when the present marine fauna was already in existence, it will fully explain the existence of identical species on both sides of the isthmus, especially if the difference of the tides was as great as it is now[3], causing strong currents from one ocean to the other.

Such an instance of a disconnexion of a marine fauna by elevation of land as I am inclined to assume in the case of Central America does not stand quite alone. We owe to the researches of Prof. S. Lovén and Dr. Malmgren[4] the knowledge of the fact that marine animals (Crustacea, Annelids, and Fishes) inhabiting the glacial ocean are found in the great freshwater lakes of Sweden and in the Bothnian Gulf, and that this is to be explained only by the former continuity of the Baltic with the Glacial Ocean. During the second half of the glacial period the greater part of Finland and of the

[1] Mr. Darwin ('Origin of Species,' 3rd edit. p. 378) was not acquainted with this fact, which by no means militates against his argument, but merely modifies it.

[2] M. Wagner, *l. c.* p. 87.

[3] At Chagres the mean elevation is 1·16 foot, while at Panama the highest flow is 22 feet. (Seemann, Voy. of H.M.S. 'Herald,' i. p. 236.)

[4] Lovén, Skand. Naturforsk.-Sällskap. först. offentl. möte d. 9 Juli 1863: Stockholm, 1864. Malmgren, 'Kritisk Öfversigt af Finlands Fiskfauna,' see 'Zool. Record,' i. pp. 136–138.

middle of Sweden was submerged, and the Baltic was a great gulf of the Glacial Ocean, and not connected with the German Ocean. By the gradual elevation of the Scandinavian continent, the Baltic became disconnected from the Glacial Ocean, and the great lakes separated from the Baltic.

The Isthmus of Suez appears to have been a much more permanent barrier between the faunas of the Mediterranean and the Red Sea. R. A. Philippi has drawn up a list of species of shells common to both faunas; but it was founded on a collection made by Ehrenberg, in which the shells from both seas had been mixed[1]; and P. Fischer[2] has lately shown that the two faunas are quite distinct. As regards the fishes, I have mentioned (on former occasions) a few occurring in both seas (*Sargus noct*, *Sargus rondeletii*); but the number is so small that one might be tempted to account for it by the temporary existence of an artificial communication between the two seas.

Looking at the results of the separation of the Baltic from the Glacial Ocean on the one hand, and of that of the Pacific from the Atlantic on the other, we find them very different. As soon as the continuity of the Baltic with the Glacial Ocean was interrupted, the amount of fresh water carried into the former by rivers exceeded the quantity lost by evaporation of its surface, and the salt water gradually changed into brackish, and in the northern parts into fresh water. By far the greater part of the animals became extinct; but a few survived[3], *however, in spite of the greatly altered physical conditions, without altering their specific characters, still agreeing with the typical forms in every point, except in size, remaining smaller, leaner, almost starved.* The same thing might happen if by a rising of the chain of the West-Indian islands the Gulf of Mexico or the Caribbean Sea were at a future time converted into inland seas with narrow outlets into the open ocean.

The separation of the Atlantic and Pacific Oceans was, of course, not accompanied by a change of the water; and any difference that existed in the physical conditions of both seas, as, for instance, the formation of corals on the Atlantic side, and their total absence on the Pacific, existed already before the communication between the oceans was closed; so that the life of species was not in any way affected by the discontinuance of this communication. Let us for argument's sake assume that the part of the isthmus between the Lake of Nicaragua and Panama was once an island, *à peu près* of the form of Cuba, inhabited, like Cuba, on its northern and southern coasts by a certain species of fish. The only effect of a gradual rise of the land on the life of this species would be to force it to retreat further and further from the original coast, and to accommodate itself to the new one—an effect to which, if felt at all, the individuals on the northern and southern coasts would be equally exposed. Thus there is in this case no apparent external cause for an alteration of the species; *and, indeed, the specimens examined by me from opposite coasts of the isthmus are absolutely identical, and there is not the slightest indication that one of them has been modified or degenerated into a climatic or local variety.* I trust that

[1] Martens, in 'Zoolog. Record,' ii. p. 237.
[2] Journ. Conchyl. xiii. 1865, pp. 241–248.
[3] Seven or eight species of the northern part of the Baltic are believed to be of Arctic origin.

geology will furnish us with the proof of the former partial submergence of a part of Central America, as it has done with respect to the northern part of Scandinavia. We should then be able to speak with more confidence of the permanence, or rather endurance, of the characters of a specific type, and arrive at a somewhat more definite idea of the age of species which must have existed before those geological changes were completed[1].

Sir CHARLES LYELL has directed my attention to collateral evidence from other classes of the animal kingdom, by which the partial identity of the faunas of the two coasts is shown, although not in an equally conclusive manner. The majority of malacologists appear to have presumed *à priori* their distinctness, and consequently described Pacific shells generally as distinct from Atlantic species. However, Dr. MÖRCH, in a paper in which he describes or enumerates about 360 Panama species, makes the following remarks (Pfeiff. Malakozool. Blätt. 1859, p. 107):—

"The tropical [molluscan] faunæ may be classed in two principal divisions, the Indian and the Atlantic. To the latter belong, 1, the Guinean (Senegalian); 2, the Antillian; and 3, the Panaman, which, although belonging to the Pacific, appears to be most analogous to the Guinean. A great number of species, especially of Bivalves, have been regarded as identical with those from the eastern (Brazilian) shore. I believe I can prove that they are different. Certain irregular mollusks cannot be separated diagnostically; but I can recognize them by their general habit. It is at all events a fact that no species stamped with definite characters (wohlausgeprägt) is identical on both sides of the isthmus. The Panama species may be divided into:—1, those analogous to West-Indian; 2, those analogous to species from Guinea and Senegal; 3, those very remotely analogous to East-Indian species."

[1] I may on this occasion recur to a remark made by me in Proc. Zool. Soc. 1858, p. 381, with regard to the sea-snakes observed in the Bay of Panama by M. Sallé, Capt. Dow, and Mr. Salvin. There is now not the least doubt that the snakes seen were *Pelamys bicolor*, and that they are, moreover, very common there. I find that Dr. Seemann (Voy. 'Herald,' i. p. 265) already mentions them. But I am much inclined to think that this most common Indian species has migrated eastwards, and that its arrival on the West-American coast is of very recent date. Dampier and the other bucaniers who have left us records of their adventures, and who passed weeks and months in the Bay of Panama, could not have failed to observe them, and to mention them in their notes, just as they did on other occasions. It is also probable that these snakes would have spread into the Atlantic Ocean, had they been so numerous on the Pacific side at the time when a communication existed between the two oceans.

Whilst this paper was passing through the press, I found two notices of the existence of water-snakes on the western coasts of South America, in seas considerably more southwards than the Bay of Panama. The notes are in Capt. Sharp's Voyage in "The History of the Bucaniers of America." London, 1699, 8vo, vol. ii. p. 50: "As we sailed" [near Cape St. Francisco, which is nearly under the equator] "we saw multitudes of *Grampusses* every day; as also *Water-snakes* of divers colours." And p. 72, when sailing in lat. 19° S., the author mentions "A huge shoal of fish, two or three *Water-snakes*, and several *Seals*." I find in another part of the same work a note which I believe to be the first description of *Tapirus bairdi*. The part has a separate title-page, "A Journal of a Voyage made into the South Sea by the Bucaniers or Freebooters of America from the year 1684 to 1689. Written by the Sieur Raveneau de Lussan." Lond. 1698, 8vo. The Indian name of the Tapir is given as *Manipourye*, page 16.

These remarks appear to me to convey very strong testimony in accordance with my own observation on the ichthyological fauna, inasmuch as the author refers the Panama Mollusks generally to the Atlantic fauna. He, indeed, denies the perfect identity of the species, admitting merely an "analogy" between them; but then it is a question whether malacologists do not go too far in making specific distinctions, when they are not even able to express those distinctions "diagnostically," recognizing the forms merely "by their general habit." Shells are, after all, that portion of a mollusk the formation and development of which is most influenced by the peculiarities (physical and chemical) of the surrounding medium and locality; and only too many specific forms have been distinguished on account of slight differences in the sculpture and shape of the shells, the importance of which disappears on comparing a large series of examples. However, as I am not prepared to form an opinion with regard to the shells of Central America from my own examination, I am bound to receive the testimony of so celebrated a malacologist as Dr. Mörch; and should his observations prove to be fully correct, they will give an additional interest to this fauna, as proving that the shells of Mollusks suffer change under circumstances in which the specific characters of fishes remain unaltered.

With regard to fossil shells, Mr. J. C. Moore, who has examined several collections from tertiary beds in San Domingo, has made the observation that "many bear a strong resemblance to shells now living in the Indian Seas and the Pacific, and that one or two appear to be identical" (Quart. Journ. Geol. Soc. 1853, p. 131), and "that a channel or sound may have existed in the equatorial parts during some portion of the tertiary period, by which some few of the tropical shells may have migrated from the one ocean to the other" (ibid. 1850, p. 43).

Of the other marine animals, the *Corals* have been made the object of elaborate researches, the various authors arriving at somewhat different conclusions. First, Mr. Duncan, in a paper "On the Fossil Corals of the West-Indian Islands" (Quart. Journ. Geol. Soc. xix. 1863, p. 455), has shown that "in all the calcareous formations which are coralliferous, and are considerably elevated above the level of the Caribbean Sea [being probably of miocene age], there is a very limited series of Corals with generic relation to those now existing and characteristic of the West-Indian Coral Fauna, but a predominance of forms resembling those of the present Coral-seas of the Pacific, South Sea, and the Indian Ocean." This identity of the Corals proves an identical condition of the physical circumstances, and evidently a wide continuity of the West-Indian and Western seas.

On the other hand, Prof. Verrill, when speaking of the living Polyp-faunæ of the Atlantic and Pacific *sides of Central America* (Proc. Bost. Soc. Nat. Hist. x. 1866, p. 323 *et seq.*), states that their differences of character are very remarkable; that at Panama none of the reef-building corals of Aspinwall, Florida, or the West Indies occur, nor even any of the genera of the families to which they belong, with the exception of a small *Porites* and *Stephanocora*; that these and other differences do not favour the theory entertained by some geologists, viz. that there has been a communication between the two oceans at this point, and that the Gulf-stream flowed across the isthmus into the Pacific, within comparatively recent geological times.

It is not within the scope of this paper further to discuss the point on which Messrs. Duncan and Verrill are at variance, as we cannot assume that the present fish-fauna existed at so early a period. From the observations made on the fishes and shells we are obliged to conclude that down to a very recent period a connexion between the two seas has been kept open by channels and straits wide enough to allow of the passage of these animals. Why corals, or at least a part of them, should not have been dispersed by their floating germs in a similar manner, is a circumstance which we cannot explain.

The occurrence of identical species of *freshwater fishes* in rivers running to the two opposite oceans is a matter of much less difficulty, and, besides, has been very generally observed in various parts of the globe. The same agencies which in other countries have effected a wider dispersion of one species than of another must have been at work here also. Prof. M. Wagner has, in his Memoir quoted above, so fully treated of this part of our subject, with particular reference to the hydrographical peculiarities of the isthmus, that we need not dwell further on it.

§ 7. *Definition of the Characteristics of the Fish-fauna of Central America.*

In defining the zoological characters of Central America, expressed in its fish-fauna, I confine myself to the freshwater fishes proper. Here the *nearctic* types become extinct, and are represented by five generic types, four of which, although with numerous species in the north, have but a single one here—*Lepidosteus*, *Amiurus*, *Sclerognathus*, and *Haplochilus*. *Fundulus*, extending a little further southwards (with one species in Western Ecuador), is represented by four species in Guatemala. Not one of these species is identical with a North-American.

Much greater is the affinity with *neotropical* types; and their representatives are much more numerous: there is one species of *Acara*, one of *Macrodon*, seven of *Tetragonopterus*, one of *Anacyrtus*, twelve of *Pimelodus*, one of *Plecostomus*, two of *Chætostomus*, two of *Loricaria*, one of *Anableps*, one of *Carapus*, the latter being identical with a species from Guiana. Types in common with the West-Indian Islands are—*Agonostoma* with three species (one of which is said to be identical with a Jamaican species), *Girardinus* and *Gambusia* with one, the two latter genera being also represented in the Southern States of North America. The Siluroid genus *Arius*, which extends over the tropics generally, is represented by nine species.

Finally, the following genera are peculiar to Central America, or at least have attained there to the greatest development:—*Heros* and the allied *Neetroplus* and *Petenia* with thirty-four species, *Ælurichthys* with two, *Chalcinopsis* with three, *Characodon* with one, *Xiphophorus* with one, *Mollienesia* with one, *Pœcilia* with eight, and *Belonesox* with one species.

The affinity of this freshwater fauna with that of Mexico, will be found to be greater than with that of any other country (I might mention about ten species common to Guatemala and Mexico); but until we are better acquainted with the habitats of species described as Mexican, a more detailed comparison of the two countries would be of but little advantage. The freshwater fish-fauna of Central America may be shortly thus characterized:—*A part of the Chromides* (Heros, *&c.*) *and the Cyprinodontes generally have attained to their greatest development; neotropical types extending northwards prevail over nearctic extending southwards, the latter being represented by a few extreme branches.*

§ 8. *An Attempt to Subdivide this Fauna into Provinces.*

We may subdivide this part of the freshwater fauna into the following provinces:—

A. *The fresh waters north of the Lakes of Managua and Nigaragua, emptying into the Pacific.*—To this province belong the fishes collected at Chiapam [Ch.], Huamuchal [H.], San José [J.], in the Rio Guacalate (Dueñas) [G.], San Salvador [S.], and Libertad [L.]; also the fishes from the Lakes of Amatitlan [Am.] and Atitlan [At.] may be referred to the same province.

[The species printed in italics in the following lists are found also in one or more other provinces, and in Atlantic rivers.]

Heros macracanthus	Ch.	H.	—	—	—	—	—
—— trimaculatus	Ch.	H.	—	—	—	—	—
—— nigrofasciatus	—	—	—	—	—	Am.	At.
—— guttulatus	—	—	—	—	—	Am.	—
Agonostoma microps	—	—	—	G.	—	—	—
Arius guatemalensis	Ch.	—	—	—	—	—	—
—— platypogon	—	—	—	J.	—	—	—
—— cærulescens	—	H.	—	—	—	—	—
Pimelodus guatemalensis	—	H.	—	—	—	—	—
Anacyrtus guatemalensis	—	H.	—	—	—	—	—
Tetragonopt. microphthalmus	—	—	—	—	—	Am.	—
—— humilis	—	—	—	—	—	Am.	—
Fundulus guatemalensis	—	—	—	G.	—	Am.	—
—— pachycephalus	—	—	—	—	—	—	At.
—— punctatus	Ch.	—	—	—	—	—	—
Anableps dovii	Ch.	—	—	—	—	—	—
Pœcilia mexicana	Ch.	H.	—	G.	—	Am.	—
—— *thermalis*	—	—	—	—	S.	—	—
—— dovii	—	—	—	—	—	Am.	—
Girardinus pleurospilus	—	—	—	G.	—	—	—
Clupea libertatis	—	—	—	—	L.	—	—
Lepidosteus tropicus	—	H.	—	—	—	—	—

B. *The fresh waters north of the Lakes of Managua and Nicaragua, emptying into the Atlantic.*—To this province belong the fishes collected in the Rio Usumacinta [U.] (and in its tributaries Rio de Santa Isabel, Rio Chisoy, and Rio San Geronimo), in the Rio Motagua [M.], and in the Rio Cahabon (Yzabal) [Y.].

Eleotris dormitatrix	—	M.	Y.
Agonostoma nasutum	U.	M.	—
Heros parma	—	M.	—
—— spilurus	—	M.	Y.
—— aureus	—	M.	Y.
—— motaguensis	—	M.	—
—— microphthalmus	—	M.	—
—— oblongus	—	M.	—
—— angulifer	—	—	Y.
—— salvini	U.	—	—
—— irregularis	U.	—	—
—— godmanni	—	—	Y.
Arius assimilis	—	—	Y.
—— melanopus	—	M.	—
Amiurus meridionalis	U.	—	—
Pimelodus godmanni	U.	M.	—
—— motaguensis	—	M.	—
—— salvini	U.	—	—
—— polycaulus	U.	—	—
Tetragonopterus panamensis	—	—	Y.
—— brevimanus	U.	—	Y.
Chalcinopsis dentex	U.	M.	Y.
Fundulus labialis	U.	—	Y.
Belonesox belizanus	Honduras, Belize.		
Pœcilia chisoyensis	U.	—	—
Xiphophorus helleri	U.	—	—
Sclerognathus meridionalis	U.	—	—
Carapus fasciatus	—	M.	—

C. *Lake Peten.*—The fish-fauna of this limited district is so peculiarly developed, that we cannot hesitate to describe it as a separate province.

Heros margaritifer.
—— melanurus.
—— urophthalmus.
—— affinis.
—— friedrichsthalii.
—— *salvini* (in common with province B).
—— intermedius.
Petenia splendida.
Pimelodus petenensis.
Tetragonopterus petenensis.
Belonesox (in common with province B).
Pœcilia petenensis.
Mollienesia petenensis.
Chætoëssus petenensis.

D. *Lake of Managua.*—Although the number of species known from this lake is small, the forms are quite peculiar; we find here those species of *Heros* which are distinguished by the extraordinary development of the lips, or by incisor-like teeth, which render the separation into a distinct genus necessary. The development of these Chromides is the more remarkable, as this lake occupies a space which is supposed to have been a portion of a marine channel.

Heros erythræus.
—— managuensis.
—— labiatus.
Heros lobochilus.
—— multispinis.
Neetroplus nematopus.

E. *Lake of Nicaragua.*—Also the fishes of this lake are, with two exceptions, peculiar; like Lake Managua, it appears to have been part of a marine channel.

Eleotris longiceps.
Heros longimanus.
—— citrinellus.
—— dovii.
—— nicaraguensis.
Heros labiatus (Lake of Managua).
Pimelodus nicaraguensis.
Gambusia nicaraguensis.
Pœcilia dovii (in common with Lake Amatitlan).

F. *The fresh waters south of the Lakes of Managua and Nicaragua to the Isthmus of Darien.*—We are obliged, at present, to unite into one province the fish-fauna of Costa Rica, Veragua, Panama, and Darien, as our knowledge of the fishes of Costa Rica and also of Veragua is too incomplete to admit of a comparison with those of the more southern part of the isthmus. This is the more to be regretted, as a former separation of these two parts and of their faunas is, as we have explained above, a matter of great probability. The fishes of the Chagres River show a decidedly South-American character. The identity of the freshwater fish-faunas of the Pacific and Atlantic sides is here easily explained by the narrowness of the isthmus.

Eleotris picta	—	—	R. Bayano.
Agonostoma nasutum	—	Panama.	—
—— *monticola*	—	Panama.	—
Heros parma	Chagres.	—	—
—— altifrons		Western Veragua.	
Acara cæruleomaculata	Chagres.	—	—
Arius multiradiatus	—	—	R. Bayano.
Ælurichthys dorsalis	—	Panama.	—
—— panamensis	—	Panama.	—
Pimelodus wagneri	—	Panama.	—
—— modestus	Chagres.	—	—
Plecostomus, sp.	Chagres.	—	—
Chætostomus aspidolepis	—	Veragua.	—
Chætostomus ? cirrhosus	Chagres.	—	—
Loricaria lima	Chagres.	—	—

Loricaria uracantha	Chagres.	—	—
Macrodon microlepis	Chagres.	—	—
Tetragonopterus panamensis	—	Panama.	—
—— æneus	—	Panama.	—
Chalcinopsis striatulus	—	Panama.	—
—— chagrensis	Chagres.	—	—
Anacyrtus guatemalensis	Chagres.	—	—
Haplochilus dovii	—	Costa Rica.	—
Pœcilia elongata	—	Panama.	—
—— gillii	Chagres.	—	—

§ 9. *Descriptive Part.*

In the following descriptive part of this Memoir I have admitted full descriptions of those species only which are not described elsewhere; secondly, descriptive diagnoses of those of which figures are given; and, finally, notes on some known species, if they appeared to contribute to their better knowledge. For the descriptions of all the other species (the insertion of which would be a repetition of matter already published), I must refer the student to my general work on Fishes.

1. Centropomus appendiculatus.

Pocy, Mem. Cub. ii. p. 119.

$$D.\ 8 \mid \frac{1}{10}.\quad A.\ \frac{3}{6}.\quad L.\ lat.\ 70\text{–}72.$$

Nine longitudinal series of scales between the origin of the second dorsal fin and the lateral line. The height of the body is contained four times in the total length (without caudal), the length of the head twice and two-thirds. Præorbital indistinctly serrated; suboperculum produced into a short flap, which extends to or nearly to the vertical from the origin of the dorsal fin. The intermaxillary extends to below the middle of the orbit. Dorsal spines of moderate strength; the third is the longest, and about half as long as the head. The second anal spine is generally longer than the third; but sometimes they are equal in length, and even shorter than the third dorsal spine. The length of the ventral fin is more than one-half of its distance from the anal. Air-bladder with a pair of appendages anteriorly. Silvery; dorsal fins blackish; lateral line black.

We have received this species (which was originally described from Cuban examples) from Surinam and Mexico. Mr. Salvin and Capt. Dow obtained a specimen from the Chagres River, 10 inches long.

2. Centropomus medius.

Günth. Proc. Zool. Soc. 1864, p. 144.

$$D.\ 8 \mid \frac{1}{10}.\quad A.\ \frac{3}{7}.\quad L.\ lat.\ 57.$$

Eight longitudinal series of scales between the origin of the second dorsal fin and the lateral line. The height of the body is contained thrice and three-fourths in the total length (without caudal), the length of the head twice and four-fifths. Præorbital finely serrated; suboperculum produced into a flap, which does not extend to the vertical from the origin of the dorsal fin. The intermaxillary extends somewhat beyond the anterior margin of the orbit. Dorsal spines strong; the third is longer than the fourth, and half as long as the head. The second anal spine long, but a little shorter than the third, and equal in length to the distance between the extremity of the upper jaw and the præopercular margin. The length of the ventral fin is much more than one-half of its distance from the anal fin. Lateral line black.

Two specimens, 13 inches long, from Chiapam.

3. Centropomus nigrescens.

Günth. Proc. Zool. Soc. 1864, p. 144.

$$\text{D. } 8 \,|\, \tfrac{1}{10}. \quad \text{A. } \tfrac{3}{6}. \quad \text{L. lat. } 70.$$

Ten longitudinal series of scales between the origin of the second dorsal fin and the lateral line. The height of the body is contained four times and a half in the total length (without caudal), the length of the head twice and four-fifths. Præorbital not serrated; suboperculum produced into a short flap, which does not extend to the vertical from the origin of the dorsal fin. The intermaxillary extends a little beyond the middle of the orbit. Dorsal spines rather feeble; the third and fourth are equal in length, two-fifths of the length of the head. The second and third anal spines also are equal in length, and not longer than the dorsal spines mentioned. The length of the ventral fin is scarcely more than one-half of the distance of its base from the anal. Air-bladder without appendages anteriorly. Silvery; upper parts and fins blackish; lateral line black.

One specimen, 14 inches long, from Chiapam.

This species is allied to *C. appendiculatus* (Poey), but differs externally in its considerably more feeble and shorter fin-spines.

4. Centropomus parallelus.

Poey, Mem. Cuba, ii. p. 120.

$$\text{D. } 8 \,|\, \tfrac{1}{10}. \quad \text{A. } \tfrac{3}{6}. \quad \text{L. lat. } 85\text{–}90.$$

Twelve longitudinal series of scales between the origin of the second dorsal fin and the lateral line. The height of the body is contained thrice and three-fourths in the total length (without caudal), the length of the head twice and a half. Præorbital distinctly serrated; suboperculum produced into a flap, which extends to the vertical from the origin of the dorsal fin. The intermaxillary extends a little beyond the middle of the orbit. Dorsal spines rather feeble; the third is the longest, half as long as the head. The second anal spine is exceedingly strong, longer than the third and the third dorsal spine. The length of the ventral fin is considerably more than one-half of the distance of its base from the anal. Air-bladder without appendages anteriorly. Silvery; upper parts and fins greenish; lateral line not black.

This species occurs in Cuba; we have received it from San Domingo, Jamaica, and Bahia. Messrs. Dow and Salvin collected a specimen in the Chagres River.

5. Centropomus armatus.

Gill, Proc. Ac. Nat. Sc. Philad. 1863, p. 163.

D. $8\,|\,\frac{1}{10}$. A. $\frac{3}{6}$. L. lat. 51. L. transv. 7/14.

Six longitudinal series of scales between the origin of the second dorsal fin and the lateral line. The height of the body is contained from thrice and two-fifths to thrice and three-fourths in the total length (without caudal); the length of the head twice and a half. Præorbital serrated in its hinder half; suboperculum produced into a long flap, which extends beyond the vertical from the origin of the dorsal fin. The intermaxillary extends scarcely to below the middle of the orbit. Dorsal spines of moderate strength; the third is the longest, and half as long as the head. The second anal spine is exceedingly strong, much stronger than the third, and longer than the third dorsal spine. The length of the ventral fin is scarcely more than one-half of the distance of its base from the anal. Silvery; dorsal fins, a blotch on the opercle, and the membrane between the anal spines blackish. Lateral line not black.

Several specimens, 12 inches long, were collected by Mr. Salvin at Chiapam.

6. Centropomus ensiferus.

Poey, Mem. Cub. ii. p. 122, pl. 12. fig. 1.

D. $8\,|\,\frac{1}{10}$. A. $\frac{3}{6}$. L. lat. 53.

Seven longitudinal series of scales between the origin of the second dorsal fin and the lateral line. The height of the body is one-fourth of the total length (without caudal), the length of the head two-fifths. Præorbital coarsely serrated; suboperculum produced into a flap, which extends to the vertical from the origin of the dorsal fin. The intermaxillary extends scarcely to below the middle of the orbit. Dorsal spines of moderate strength; the third and fourth are the longest, and two-fifths as long as the head. The second anal spine is exceedingly strong, much stronger than the third, and much longer than the dorsal spines. The length of the ventral fin is somewhat more than one-half of the distance of its base from the anal. Silvery; dorsal fin, a blotch on the opercle, and the membrane between the anal spines blackish. Lateral line not black.

This species occurs in Cuba; we have received it from Jamaica and from the Guyanas. Mr. Godman collected a specimen, 12 inches long, at Belize.

7. Centropristis macropoma. (Pl. LXV. fig. 1.)

Günth. Proc. Zool. Soc. 1864, p. 145.

D. $\frac{10}{12}$. A. $\frac{3}{7}$. L. lat. 52. L. transv. 6/16.

Closely allied to *C. radialis*, Q. & G.; but whilst that species has a notch above the spiniferous angle, the present has its præopercular margin not interrupted, the long spines of the angle gradually passing into the finer serrature. There are six series of scales between the eye and the angle of the præoperculum. The maxillary extends nearly to the vertical from the posterior margin of the orbit. Dorsal fin with a notch, the ninth spine being considerably shorter than the tenth. A series of rather small brownish spots above and below the lateral line.

Three specimens, 4½ inches long, were collected by Messrs. Dow and Salvin on the Pacific coast of Panama.

8. Serranus creolus, C. & V.

I have examined specimens from the Atlantic coasts only; but Mr. Gill has found it in a collection of fishes from Lower California, the specimens being undistinguishable from those of the West Indies and South America (Proc. Ac. Nat. Sc. Philad. 1862, p. 249).

12. Serranus sellicauda.

Epinephelus sellicauda, Gill, Proc. Acad. Nat. Sc. Philad. 1862, p. 250.

D. $\frac{11}{17}$. A. $\frac{3}{8}$. L. lat. 100.

Caudal fin with the posterior margin convex. The height of the body is rather more than three-fourths of the length of the head, and one-fourth of the total (caudal included). The diameter of the eye is one-fourth of the length of the head. Præoperculum finely serrated behind, with some coarser teeth at the angle, lower limb entire; sub- and interoperculum entire. Ventrals three-fourths of the length of pectorals, and reaching two-thirds of the distance between their insertion and the commencement of the anal. Brownish, with olive-coloured spots of larger and smaller size on the body and opercles. All the fins with a narrow white margin. A square black blotch across the back of the tail.

Description.—Body not very elevated; its greatest height is below the third spine of the dorsal fin, rather more than three-fourths of the length of the head, and one-fourth of the total. The distance between the end of the dorsal and the commencement of the caudal is nearly one-sixth of the length of the base of the dorsal, is contained once and two-thirds in the base of the anal, is one-fourth of the distance between the dorsal fin and the snout, and equals the least depth of the tail. The distance between the eyes is one-half of the diameter of the eye, and covered with very minute scales, which are found also on the præorbital around the nostrils. The length of the snout is two-thirds of the diameter of the eye. The maxillary bone reaches the vertical from the posterior margin of the eye. The mandibulary is one-half of the length of the head. The lips are not very thick. Posterior limb of præoperculum very convex, minutely serrated, with three coarser teeth at the angle; lower limb toothless. Sub- and interoperculum entire. Operculum terminating in three not very strong teeth, the upper of which is somewhat more remote than the others, the middle one being the more prominent. Suprascapular concealed by the scales.

The membrane of the dorsal fin is scaly for about half the height between the spines and rays; the spinous portion scarcely lower but longer than the soft, with its upper margin convex, and a small membranaceous appendage behind the tip of each spine. The first spine is the shortest, rather more than half the length of the second, which is one-fifth shorter than the third; from the third to the seventh the spines are equal, becoming slightly shorter at the eighth; the last two spines are of equal length. The rays increase slightly from the first to the sixth, after which the upper margin is straight, becoming again rounded posteriorly. The first ray is one-fifth longer than the preceding spine. Caudal with posterior margin convex. The commencement of the anal is on a line with that of the soft dorsal, and it ends before the termination of the dorsal; the first spine is short, not half the length of the second, which is long and strong, longer than any of the dorsal spines; the third is slenderer, and equal to the third dorsal spine: the margin of the soft part of the fin is nearly straight, sharply rounded off posteriorly. The pectoral consists of eighteen rays, is rounded, and longer than the ventral, and covered with very minute scales to one-third of the length. The ventrals reach the vent; the second ray is the longest, the spine being equal to the second of the dorsal. Canine teeth of moderate size, those of the lower jaw rather small. Coloration as described above.

A single specimen, 4 inches long, was sent by Capt. Dow from the Pacific coast of Panama. The specimen in the collection of the Smithsonian Institution is from the coast of Lower California; a statement of its size, which would have been of some importance, is omitted.

13. Serranus analogus.

Epinephelus analogus, Gill, Proc. Acad. Nat. Sc. Philad. 1863, p. 163.

D. $\frac{10}{17}$. A. $\frac{3}{8}$. L. lat. ca. 100.

Adult.—The height is contained thrice in the total length (without caudal), the length of the head twice and two-thirds. The præoperculum is finely serrated behind, and towards the angle armed with three or four strong teeth. The diameter of the eye equals a sixth of the head's length, and equals the interorbital space as well as the snout behind the intermaxillaries. The third, fourth, and fifth spines are equal, and contained twice and two-thirds in the length of the head; the tenth thrice and a half. The caudal fin enters five times and a half in the length, the height of the dorsal twice and three-fourths in the head. The anal is deeper; its third spine is longest, and enters four times and three-fourths in the head's length; the pectoral is at least half as long as the head; the ventral shorter, but coterminal with it.

The colour is purplish grey, with numerous dark spots about as large as the pupil; those of the pectoral and caudal fins are smaller and more crowded, of the dorsal, anal, and ventral more like those of the body.

The specimens are from 11 to 15 inches long, and were found by Capt. Dow at Panama.

We have received also a *smaller* example, 5 inches long, from the same gentleman. It differs from those described above in being provided with five cross bands, paler in colour than the spots, which are one-third the size of the eye. The dorsal fin is scarcely notched, the tenth spine being but little shorter than the third or fourth, the length of which is contained twice and two-thirds in that of the head. The example being young, its eye is comparatively larger.

14. Plectropoma afrum. (Pl. LXVII. fig. 3.)

Epinephelus afer, Bloch, Taf. 327 (fide Peters, Monatsber. Ak. Wiss. Berlin, 1865, p. 105).
Alphestes afer, Bl. Schn. p. 236.
Plectropoma chloropterum, Cuv. & Val. ii. p. 398. Poey, Mem. Cub. i. p. 73, lam. 9. fig. 3.
—— *monacanthus,* Müll. & Trosch. in Schomb. Hist. Barb. p. 605. Günth. Fish. i. p. 164.
—— *multiguttatum,* Günth. Proc. Zool. Soc. 1866, p. 600.

D. $\frac{11}{18-20}$. A. $\frac{3}{9}$. L. lat. 75.

Caudal rounded. The height of the body is equal to the length of the head, and contained twice and three-fourths in the total (without caudal). The diameter of the eye is one-fifth of the length of the head, and a little less than that of the snout. Præoperculum with a strong spinous tooth below the angle, pointing forwards. Olive-brown, head and body with numerous spots.

Description.—Body somewhat elevated; its greatest height is below the fourth spine of the dorsal, and equal to the length of the head, which is contained thrice and one-third in the total (the caudal included). The distance between the dorsal and the caudal is contained seven times and one-third in the length of the base of the dorsal fin, twice in that of the base of the anal, four times in the distance between the dorsal fin and the snout, and is considerably less than the least depth of the tail. The distance between the eyes is about two-thirds of the diameter of the eye, and covered with scales which extend forward beyond the nostrils on the præorbital, and in a narrow band on the upper maxillary. The length of the snout equals the diameter of the eye, which is one-fifth of the length of the head. The maxillary reaches a little beyond the level of the posterior margin of the eye. The mandibulary is covered with minute scales, and is equal to one-half the length of the head. The lips are thick and fleshy. The posterior limb of the præoperculum slants obliquely backwards, and is minutely serrated, the denticulations becoming coarser at the angle; and beneath on the lower limb at some distance from the other teeth there is a single strong tooth pointing downwards, and nearly concealed by the skin; sub- and interoperculum not serrated.

The operculum terminates in three, flat, triangular teeth, the upper of which is the more distant and somewhat more obtuse than the others, the middle one being the longest, but not very prominent, and the lower one the shortest and weakest. The suprascapula is concealed by the scales.

Base of dorsal fin covered with very small scales, a tapering band of scales runs up between each pair of the spines and rays to about half the height of the fin. Spinous portion rather lower but longer than the soft, its upper margin convex; the membrane between each spine is deeply notched, and there is a small membranaceous appendage behind the top of each spine. The first spine is the shortest, half the size of the second; the second is five-sixths of the length of the third; the third, fourth, and fifth are the longest, and of nearly equal length; the spines then become gradually shorter to the last one, which is scarcely longer than the preceding. The soft portion exhibits an entirely rounded upper margin, the rays becoming longer from the first to the sixth or seventh, and shorter from the fourteenth to the last; the first ray is one-fourth longer than the preceding spine. Caudal with the posterior margin convex. Anal commencing a little behind the commencement of the soft dorsal, and terminating in advance of the end of the same; the first spine is not very strong, and short; the second long, thick, and strong; the third more slender and shorter, being but little longer than the second dorsal spine; the margin of the fin is rounded throughout, the third ray being the longest, and the subsequent ones becoming progressively shorter. The pectoral is composed of eighteen rays, rounded, one-fourth longer than the ventral, and covered with minute scales for about one-third of its length. The ventral reaches to the vertical from the origin of the eighth spine of the dorsal, but not to the vent; the spine is a little less than two-thirds the length of the first ray; the first and second rays are the longest, the others diminishing gradually in length; the length of the spine is somewhat less than that of the second dorsal spine. Canine teeth small in both jaws.

This species varies somewhat in coloration, as most of its congeners; the spots are numerous and small, either of a uniform dark-brown colour, or of a light colour and mixed with large brown spots. Pectoral fins with narrow blackish cross bands.

One example, 10 inches long, and three smaller ones have been collected by Capt. Dow on the Pacific coast of Panama. The latter have the spots somewhat larger and less conspicuous than the adult. This species occurs also in the West Indies and at the Falkland Islands.

15. Rhypticus decoratus.

Rhypticus nigripinnis, Gill, Proc. Ac. Nat. Sc. Philad. 1861, p. 53.
Promicropterus decoratus, Gill, *l. c.* 1863, p. 164.

D. $\frac{2}{26}$. A. 16.

The two dorsal spines are continuous with the soft portion. Body generally with more or less numerous round whitish spots, many of which have a brown centre.

Messrs. Dow and Salvin have collected several examples, from 3 to 8 inches long, on the Pacific coast of Panama.

The species described by Holbrook as *R. maculatus*, and said to have the dorsal spines separated from the soft portion, may eventually prove to be identical with the Pacific fish.

19. Mesoprion aratus.

Günth. Proc. Zool. Soc. 1864, p. 145.

D. $\frac{11}{13-14}$. A. $\frac{3}{8}$. L. lat. 45. L. transv. $4\frac{1}{2}/12$.

The height of the body equals the length of the head, and is contained thrice and two-fifths, or thrice and one-fifth in the total (without caudal). The maxillary does not extend backwards to the vertical from the centre of the eye. Præoperculum finely serrated, with scarcely a trace of a posterior notch. Dorsal spines of moderate strength; the third and fourth are the longest, two-fifths of the length of the head; the eleventh is scarcely longer than the tenth, which is rather more than half as long as the fourth. Caudal fin emarginate, two-thirds scaly; anal spines short, rather feeble, the third longer than the second, and equal in length to the last dorsal spine. Upper and lateral parts brownish-olive, each scale with a pearl-coloured spot, the spots forming together very distinct longitudinal stripes; no black lateral spot; hind part of the root of the pectoral brown. Lower parts salmon-coloured.

We have six examples: two, 15 inches long, were collected by Mr. Salvin at Chiapam; and four others were sent by Capt. Dow from the Pacific coast of Panama.

21. Apogon dovii.

Günth. Proc. Zool. Soc. 1861, p. 371.

D. $6 \mid \frac{1}{9}$. A. $\frac{2}{8}$. L. lat. 25. L. transv. 3/9.

A roundish black spot on each side of the root of the caudal; the spinous dorsal colourless, transparent; uniform olive (in spirits). Head densely punctulated with brown. Only the hind margin of the posterior præopercular ridge is serrated. Dorsal fins nearly equal in height.

The height of the body is one-third of the total length (without caudal); the length of the head two-fifths; eye large, its diameter being more than one-third of the length of the head. Palatine and vomerine teeth present. The upper jaw overlaps slightly the lower; maxillary extending backwards to below the posterior third of the orbit. Operculum with an upper flexible point, and with a lower stiff spine. The third dorsal spine is a little longer than the second, one-half the length of the head. Caudal fin slightly emarginate, with the angles rounded.

Total length 26 lines.

This species is so closely allied to *A. inermis* from the Mediterranean, that perhaps it would be better not to separate it; the only difference which I can find is the form of the soft dorsal fin, which is considerably higher than the spinous in the Mediterranean species.

22. Pristipoma melanopterum.

Pristipoma melanopterum, Cuv. & Val. v. 1830, p. 273.
—— *bilineatum,* Cuv. & Val. v. 1830, p. 271, pl. 122.
Hæmulon melanopterum, Ranzani, Comm. Bonon. v. 1842, p. 343, tab. 30.
Pristipoma melanopterum, Günth. Fish. i. 1859, p. 287.
Var. *Genytremus interruptus,* Gill, Proc. Acad. Nat. Sc. Philad. 1862, p. 256.
Pristipoma melanopterum, Günth. Proc. Zool. Soc. 1864, pp. 23 & 27.

This species occurs on both sides of Central America, Capt. Dow having collected specimens at Panama and Colon. Mr. Gill has found it also in a collection of fishes from Lower California. He describes his Pacific specimen as a distinct species; but the distinctive characters are, according to my views, not of specific value. He mentions it in the following terms:—

"The species is so closely allied to *bilineatus*, that it might be even considered as a variety, but it appears to differ by the steel-blue colour of the back, and the discontinuance of the lateral band a short distance before the spot on the tail[1]; at its end the band is bounded below by the lateral line. In other respects, the two species are so similar, that a detailed description would be only a repetition of that of *bilineatus*."

23. Pristipoma virginicum.

We have examined specimens of this species from the West Indies, from the Atlantic coasts of Central America, and from Bahia. Mr. Gill has described an example from Panama under the denomination of *Anisotremus tæniatus*, Proc. Ac. Nat. Sc. 1861, p. 107. Although six or seven is the normal number of longitudinal bands, it is sometimes increased by a more or less complete division of one or several bands. It appears to be more natural to consider the golden colour the ground-colour than the blue, as after death it fades into the same colour as that of the space between the black vertical bands. In *all* specimens, I have found the bluish bands edged with purplish. Mr. Gill, in describing his *A. tæniatus*, has taken the blue colour as ornamental, whilst in his description of *A. virginicus* the character assigned to the colours is reversed, and the blue colour regarded as ground-colour. There is no specific difference between these fishes.

24. Pristipoma dovii.

Günth. Proc. Zool. Soc. 1864, p. 23, pl. 3. fig. 1.

D. $\frac{12}{16}$. A. $\frac{3}{9}$. L. lat. 48. L. transv. 8/15.

The height of the body is one-half of the total length (without caudal); the length of the head one-third. Snout obtuse, not much longer than the eye; cleft of the

[1] This is also the case in some Atlantic specimens.

mouth small, the maxillary extending to the vertical from the anterior margin of the orbit. Lips thick; a pair of pores on the symphysis of the lower jaw, a central groove behind it. Snout naked, the remainder of the head being scaly. The width of the interorbital space is much less than that of the orbit. Dorsal and anal spines exceedingly strong; the third of the dorsal fin is the longest, and nearly two-thirds as long as the head. The second anal spine is much longer than the third, and a little shorter (but stronger) than the third of the dorsal fin. Each ray of the soft fins is accompanied by a series of minute scales, but only on the caudal fin are these scales dense enough to cover the rays. Caudal fin slightly emarginate. Silvery, with four black cross bands; the first runs from the occiput, through the eye, to behind the angle of the mouth, the second from before the dorsal fin to below the base of the pectoral, the third from the base of the sixth, seventh, and eighth dorsal spines to the vent; the fourth descends from the origin of the soft dorsal to that of the soft anal. Fins blackish. The cross bands appear to become fainter in old age.

Two specimens, $8\frac{1}{2}$ and 9 inches long, in the collection from Panama.

25. Pristipoma chalceum.

Günth. Proc. Zool. Soc. 1864, p. 146.

D. $\frac{12}{15}$. A. $\frac{3}{12}$. L. lat. 56. L. transv. 11/19.

The height of the body is contained twice and two-thirds in the total length (without caudal), the length of the head thrice and a third. The diameter of the eye is nearly equal to the width of the interorbital space, and two-thirds of the extent of the snout. The maxillary does not extend backwards to the vertical from the anterior margin of the orbit. Præoperculum minutely serrated behind, with the angle rounded, but not produced. There is no notch between the spinous and soft portions of the dorsal fin, the hinder spines being only a little shorter than the anterior rays; dorsal spines of moderate strength, the fourth being the longest, not quite half as long as the head; anal spines short, the second being only a little longer than the third, two-sevenths of the length of the head. Caudal fin subtruncated, scarcely emarginate. Dorsal and anal perfectly scaleless. The pectoral fin extends to the vertical from the vent. Bronze-coloured, shining silvery, perfectly immaculate; vertical fins blackish, with an indistinct light band along the base.

One specimen, 8 inches long, was discovered by Messrs. Dow and Salvin on the Pacific coast of Panama.

26. Pristipoma humile.

Kner & Steindachner, Sitzgsber. Ak. Wiss. Münch. 1863, p. 222; and Abhandl. bayer. Ak. Wiss. x. p. 3, tab. 1. fig. 1.

D. $\frac{12}{12}$. A. $\frac{3}{7}$. L. lat. 56. L. transv. $\frac{8}{19-20}$. Cæc. pyl. 3.

The height of the body is contained thrice and two-thirds in the total length (without caudal), the length of the head thrice. The diameter of the eye equals the width of the interorbital space, is one-fifth of the length of the head, and two-thirds of the extent of the snout. Snout produced; cleft of the mouth wide; the maxillary extending beyond the front margin of the eye. Præoperculum with the hind margin vertical and finely serrated. The spinous and soft portions of the dorsal fin are separated by a notch; dorsal spines moderately strong, the fourth being the longest, its length being contained twice and three-fourths in that of the head. Second anal spine exceedingly strong, more than half as long as the head. Caudal fin slightly emarginate; pectorals terminating at some distance before the vent. Scales ctenoid. Coloration uniform.

This species is known from a single example (size not stated) from the Rio Bayano (Panama).

27. Pristipoma macracanthum. (Pl. LXIV. fig. 1.)

Günth. Proc. Zool. Soc. 1864, p. 146.

D. $11 \mid \frac{1}{13}$. A. 3/8. L. lat. 47. L. transv. 6/13.

The height of the body equals the length of the head, and is one-third of the total (without caudal). The diameter of the eye equals the width of the interorbital space, and is two-thirds, or somewhat less than two-thirds, of the extent of the snout. Hind margin of the anterior nostril with a broad flap. Snout somewhat produced; the maxillary does not extend to below the anterior margin of the eye. Præoperculum with the hind margin rather concave, and with stronger teeth at the angle, which is rounded. The spinous and soft portions of the dorsal fin are separated by a deep notch, the spine of the soft portion being much longer than the preceding, which is somewhat longer than the second. Dorsal and anal spines exceedingly strong; the fourth dorsal spine is the longest, its length being contained twice and a third in that of the head. The second anal spine much longer and stronger than the third, and even than the fourth dorsal spine. Caudal fin truncated. Each soft ray of the vertical fins is accompanied by a series of minute scales. The pectoral fin extends to the vent. Scales smooth. Silvery, with several very indistinct dark cross bands on the back, which appear to be arranged as in *P. leuciscus*.

Two specimens, 11 and 14 inches long, were collected by Mr. Salvin at Chiapam.

29. Pristipoma leuciscus. (Pl. LXVI. fig. 3.)

Günth. Proc. Zool. Soc. 1864, p. 147.

D. $11 \mid \frac{1}{15}$. A. 3/7–8. L. lat. 51. L. transv. $\frac{5\text{-}6}{10}$.

The height of the body is contained thrice or thrice and a third in the total length (without caudal), the length of the head thrice and a fourth. The diameter of the eye is equal to, or more than, the width of the interorbital space, but is less than the extent of the snout. The maxillary does not quite extend backwards to the vertical from the anterior margin of the orbit. Præoperculum finely serrated behind, with the angle rounded, and with the hind margin slightly concave. The spinous and soft portions of the dorsal fin are separated by a deep notch, the spine of the soft portion being nearly twice as long as the preceding. Dorsal spines long, of moderate strength: the third is the longest, and one-half, or more than one-half, as long as the head. Anal spines rather strong: the third is a little longer than the second, equal to the seventh dorsal spine, and more than one-third of the length of the head. Caudal fin emarginate. Each soft ray of the vertical fins is accompanied by a series of minute scales. The pectoral fin extends to the vertical from the origin of the anal in the younger example, but is shorter in adult ones. Scales smooth, bright silvery; young specimens with several very indistinct dark cross bands on the back, the first from the nape of the neck to the gill-opening, the second below the seventh dorsal spine, the third below the last dorsal spine; old specimens with the marginal membrane of the operculum black.

One specimen, 7½ inches long, was found by Mr. Salvin at San José. Three others, from 11 to 12 inches long, are from Chiapam; and Capt. Dow found it also at Panama, where it does not appear to be rare.

30. Conodon pacifici. (Pl. LXIV. fig. 3.)

Günth. Proc. Zool. Soc. 1864, p. 147.

D. $11 \left| \frac{1}{13} \right.$. A. $\frac{3}{10}$. L. lat. 47. L. transv. 7/13.

Diagnosis.—The spinous teeth at the angle of the præoperculum are not much stronger than the others. The height of the body is contained twice and two-fifths in the total length (without caudal).

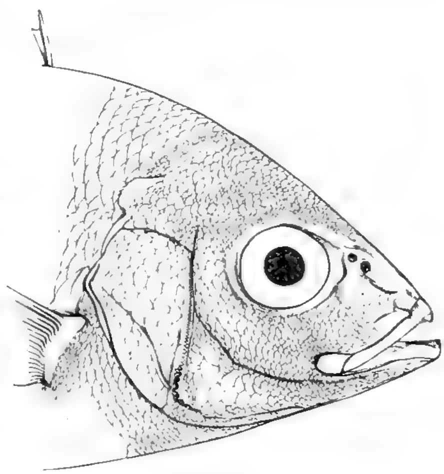
One specimen, 12½ inches long, was collected by Mr. Salvin at Chiapam.

Description.—The body is compressed, and considerably elevated; its greatest height, which is below the fifth dorsal spine, is contained twice and three-fourths in the total length. Upper profile rounded from the first dorsal spine to the nape, concave over the eyes, whence it descends abruptly over the snout. The upper surface of the head is very broad, the space between the eyes being nearly twice the width of the orbit. The snout is thick and obtuse; the lips thick and fleshy. Teeth in a villiform band in both jaws, with an outer series of conical teeth. Chin with a median groove and a pair of pores. Posterior limb of præoperculum straight, regularly and distinctly serrated, the teeth becoming gradually a little larger at the angle, and continued on the lower limb; the entire surface of the præoperculum is covered with scales, which are smaller than those of the operculum, and reach to the margin of the bone. The operculum has a notch behind, between two obtuse and feeble points. Suprascapular margin indistinctly toothed or roughened. The origin of the dorsal is in the vertical from the root of the pectoral, and its termination is vertically opposite to that of the anal; the base of the spinous portion is nearly twice as long as that of the soft. The spines are strong, broader alternately on one side than on the other; the first is small, not quite one-half the length of the second, which is rather more than half that of the third; the third spine is three-fourths the length of the fourth; the fifth is the longest, its length being contained twice and two-thirds in the height of the body; the sixth and fourth spines are equal in height, and the subsequent spines decrease gradually in length; the twelfth, which must be considered part of the soft dorsal, is slightly longer than the preceding spine, and equal to the tenth. The soft portion has a rounded margin; the third or highest ray is not quite equal to the fifth spine, and is twice as long as the last. The spinous portion as well as the soft can be received into a scaly sheath. The caudal fin is very slightly emarginate, scaly to within a short distance from its tip, and one of its longest rays is nearly one-fifth of the total length. The distance between the caudal and anal fins is less than the base of the latter; the first anal spine is opposite to the third ray of the dorsal, it is strong, broader on the right side, and excavated posteriorly, and is one-half the length of the second, which is very long and strong, equal in length to the fifth dorsal spine, and broader on the left side; the third anal spine is equal to the third of the dorsal, and little more than half the height of the first ray; the first and second rays are the longest, and the margin of the soft portion is vertical. The pectoral is moderately long, its length being contained four times and a half in the total. Root of ventral immediately behind that of pectoral; the spine is of moderate size and strength, a little more than half the length of the first ray, which is produced about one-eighth of an inch at its tip; the other rays decrease gradually in height. The scales are of moderate size, very finely crenated, with the margin convex. The lateral line is parallel with the curve of the back. Scales silvery, with purple reflexions; membrane between the scales brown; fins blackish.

34. Hæmulon brevirostrum.

D. $\frac{12}{15-16}$. A. $\frac{3}{8-9}$. L. lat. 50. L. transv. 5/14.

This species is closely allied to *H. chromis* and *H. canna*, differing from both by its much shorter and more convex snout.



The height of the body is contained twice and two-thirds in the total length (without caudal), the length of the head thrice and one-fourth. The snout is short, not much longer than the diameter of the eye, which is more than one-fourth of the length of the head. Cleft of the mouth rather wide, the maxillary extending beyond the vertical from the front margin of the eye. Hind margin of the præoperculum slightly emarginate, its angle with more conspicuous denticulations. Dorsal fin notched, with strong spines; the fourth is the longest, half as long as the head. Caudal fin forked.

The second anal spine is strong, and somewhat longer than the third, but not quite as long as the fourth of the dorsal fin. Scales above the pectoral fin not conspicuously larger than the others. More or less conspicuous oblique brown streaks run along the series of scales, and are broken up into series of spots in larger examples. A vertical black spot covered by the angle of the præoperculum.

We possess four examples of this species: three were collected by Capt. Dow at Panama; and the fourth is from Puerto Cabello. The largest is 8 inches long.

35. Hæmulon margaritiferum. (Pl. LXV. fig. 2.)

Günth. Proc. Zool. Soc. 1864, p. 147.

D. $\frac{12}{17}$. A. $\frac{3}{11}$. L. lat. 55. L. transv. 6/15.

The height of the body is one-third of the total length (without caudal), the length of the head two-sevenths. The diameter of the eye is two-sevenths of the latter, and equal to the extent of the snout and to the width of the interorbital space, which is very convex. The maxillary extends beyond the vertical from the anterior margin of the eye. Præoperculum emarginate behind. Dorsal fin scarcely notched, with the soft portion very low; its spines are moderately strong, the fourth is the longest, not quite half as long as the head. Anal spines strong; the second is longer and stronger than the third, and equal to the eighth of the dorsal. The soft vertical fins enveloped in scales; caudal forked, with the upper lobe longest. The pectoral fin does not extend to the vent. Greenish olive above, each scale with a pearl-coloured centre; sides silvery; a blackish spot above the axil.

One specimen, 12 inches long, was obtained by Messrs. Dow and Salvin on the Pacific coast of Panama.

39. Chætodon humeralis. (Pl. LXV. fig. 3.)

Günth. Fish. ii. p. 19.

I have given a full description of this species (*l. c.*). The Pacific coast of Central America appears to be its true home. Messrs. Salvin and Dow collected three specimens at Panama; and our other specimens, which we received from the Haslar Collection, are probably from Guatemala, from which country Sir J. Richardson, as we know, obtained a collection of fishes. I have no doubt that the statement of this species extending to the Sandwich Islands is correct. The Panama examples differ from the typical specimens only in having an additional black cross band near the hind margin of the caudal fin.

41. Pomacanthus zonipectus.

Pomacanthodes zonipectus, Gill, Proc. Ac. Nat. Sc. Philad. 1862, p. 244.

D. $\frac{11}{23-24}$. A. $\frac{3}{20}$.

"The form much resembles that of *Pomacanthus.* The greatest height equals three-fifths of the length. The head forms about a quarter, and the caudal fin about a sixth of the total length. . . . The dorsal is considerably produced at the sixth ray, which passes behind the rounded posterior margin. . . . Brownish, margined with light on each scale. A very dark brown band girdles the breast behind the pectoral and ventral fins." . . .

Obtained by Capt. Dow at San Salvador.

43. Upeneus tetraspilus. (Pl. LXVI. fig. 1.)

Günth. Proc. Zool. Soc. 1864, p. 148.

D. 8|9. A. 7. L. lat. 33. L. transv. 2/6.

The height of the body equals the length of the head, and is contained thrice and two-fifths in the total (without caudal); the width of the interorbital space is two-thirds of the length of the snout. Teeth in both jaws in two series, the outer series of the upper jaw being formed by very obtuse and partly confluent teeth. The maxillary is dilated and rounded behind, and bent upwards into a sort of hook; the barbels extend to the vertical from the root of the pectoral. The third and fourth dorsal spines are subequal in length, longer than the second, and nearly three-fourths of the length of the head. Greenish olive above, each scale above and below the lateral line with a large pearl-coloured spot; sides yellow; a rose-coloured band on each side of the belly. A large blackish blotch on the lateral line, behind the hind part of the spinous dorsal fin. A second smaller blackish spot behind the orbit; the latter is sometimes very indistinct.

Two specimens, $8\frac{1}{2}$ inches long, were collected by Messrs. Dow and Salvin on the Pacific coast of Panama.

This species would belong to the division which has been called *Mulloïdes*.

44. Upeneus grandisquamis.

Gill, Proc. Acad. Nat. Sc. Philad. 1863, p. 168.

This species, which belongs to Bleeker's division *Upeneus*, is described thus:—

D. $8|\frac{1}{8}$. A. 7. L. lat. 30. L. transv. $2\frac{1}{2}/5$.

The greatest height is contained four times in the length to the end of the median caudal rays, and four times and a half in the total. The head equals the height, and is itself longer than high, the profile in front of the eyes rapidly declines downwards, and is nearly rectilinear. The diameter of the eye enters thrice and a half in the head's length, and the height of the preorbitar twice and three-fourths. The supramaxillar ends at the vertical from the front of the eye. The teeth in front of the upper jaw are biserial; below uniserial. The first dorsal fin is highest at the third spine, and there equals the head in front of the præopercular margin; the first is exceedingly short, and the second and fourth nearly equal, little shorter than the third; all the spines are very slender towards the ends. The distance of the second from the first dorsal enters once and three-fourths in the base of the former, and in that interval are three scales; its length is less than that of the first. The ventral equals the distance of the hinder margin of the orbit from the snout. The tubes of the lateral line have slender branches diverging from them, generally directed obliquely upwards. The larger scales have six radiating striæ. The colour is light greenish brown above, with an indistinct silvery spot at the centre of each scale. Below the lateral line, especially between it and the anal fin, the colour is rose. The dorsal fins covered with spots of the colour of the back. The others are immaculate.

Two specimens, the longest of which is 7½ inches long, were collected by Capt. Dow on the Pacific coast of Central America.

47. Chrysophrys calamus.

A fine example, 16 inches long, has lately been sent by Capt. Dow from Panama.

49. Cirrhitichthys rivulatus. (Plate LXXXVI. fig. 4.)

Cirrhites rivulatus, Valenc. Voy. Vénus, Poiss. p. 309, pl. 3. fig. 1 (bad).

D. $\frac{10}{11}$. A. $\frac{3}{6}$. L. lat. 47. L. transv. 6/14.

The height of the body is contained thrice in the total length (without caudal), the length of the head twice and two-thirds. The snout is of moderate extent, compressed and rather elevated; the maxillary extends beyond the front margin of the eye. Inter-orbital space deeply concave, and half as wide as the orbit; a low longitudinal median crest on the crown of the head. Præoperculum finely serrated behind. The fourth, fifth, and sixth dorsal spines are the longest, two-sevenths of the length of the head, all are of moderate strength. Seven simple pectoral rays, none of which extend so far backwards as the ventral fin. The second anal spine is longer, but scarcely stronger, than the third. Brownish, with transverse dark brown bands and spots, all of which are edged with light blue. There are two of these bands on the head crossing the præoperculum; five on the body and tail, composed of large, more or less confluent, round spots; especially the third and fourth terminate above each in a pair of large spots, the first pair occupying the end of the spinous and commencement of the soft dorsal, the second the basal portion of the end of the soft dorsal. Caudal and anal fins with similar ocellated spots; a brown band across the inner side of the root of the pectoral.

A single example of this beautiful species, 5 inches long, was obtained by Capt. Dow at Panama. The typical specimen was obtained at the Galapagos Islands.

51. Polynemus melanopoma.

Günth. Proc. Zool. Soc. 1864, p. 148.

D. $7 \mid \frac{1}{12}$. A. $\frac{2}{13}$. L. lat. 73.

Nine free pectoral appendages, the longest of which extends to the vent. Præoperculum finely serrated, with a small spine above the angle. The vomerine teeth form a rounded patch; the band of the palatine teeth is as broad anteriorly as the front part of the intermaxillary band. Operculum black.

A single specimen, 15 inches long, was obtained by Mr. Salvin at San José.

Description.—This fish is elongated in form, its greatest height being contained five times and a half in the total length, with the caudal, and four times and one-sixth without it. The tail is compressed, its height above the end of the anal fin being half the length of the head. The head is much longer than high, and is contained four times and two-thirds in the total length with the caudal, and thrice and one-third without it; its width between the eyes is two-ninths of its length. Snout produced beyond the mouth, obtusely conical, and shorter than the diameter of the eye, which is contained five times and a half in the length of the head. The cleft of the mouth is situated on the inferior side of the head, it is extremely wide, the maxillary being more than half the length of the head. The posterior margin of the præoperculum is finely serrated; the angle is produced, forming a rounded membranaceous lobe. The posterior margin of the opercular apparatus is membranaceous, rounded, and formed by the operculum and suboperculum. The origin of the first dorsal is in the vertical from the ninth scale of the lateral line, or from a point about midway between the pectoral and ventral fins. The first spine is minute, the second is the strongest, all the others being flexible; the third is the longest, contained once and two-thirds in the length of the head; the fourth is longer than the second, and the following rapidly decrease in length. A series of scales ascends behind the second, third, and fourth spines, but disappears at the fifth; the distance between the two dorsals equals the length of the base of the second, which is entirely covered with scales and has the upper edge strongly emarginate; the second ray is the longest, nearly as high as the spinous dorsal, and twice the height of the last ray. The distance between this fin and the caudal is one-fourth of the total length (without caudal). The caudal fin is completely covered with scales, deeply forked, with the lobes pointed, the upper one being slightly the longer, and one-fourth of the total length. The distance between the anal and caudal fins is less than that between the caudal and dorsal, as the termination of the anal falls behind that of the dorsal, and in the vertical from the 52nd scale of the lateral line. It is entirely covered with scales; and its origin corresponds to that of the seventh ray of the dorsal; its lower edge is emarginate; the first spine is very small, the second being only one-third the length of the first ray; the first and second rays are the longest, and about thrice the length of the thirteenth or final ray, which, however, is rather longer than the one which precedes it. The pectoral is nearly one-sixth of the total length; its root is covered with minute transparent scales. The free pectoral appendages are long, the third and fourth being the longest, considerably longer than the pectoral fin, and reaching to the vent; the fourth is one-eighth of an inch longer than the head. The root of the ventral fin falls behind that of the pectoral, and in a vertical from the twelfth scale of the lateral line; it is short, one-eighth of the total length, and does not quite reach the vent; its spine is about one-half the length of the adjacent ray. The *scales* are of moderate size, longer than high, and have the posterior margin minutely crenulated. Lateral line straight, very slightly bifurcated between the lobes of the caudal. The teeth are minute and villiform, those of the vomer form a rounded or nearly square patch; the band on the palatines cuneiform and elongated, broadest anteriorly. The body is uniform silvery, greenish grey, darker on the back; the fins are minutely dotted with black, the dorsals becoming blackish at their margins. Operculum black.

52. Polynemus approximans.

Polynemus approximans, Lay & Benn. in Beechey's Voy. Zool. Fish. p. 57.
Trichidion approximans, Gill, Proc. Ac. Nat. Sc. Philad. 1863, p. 169.

D. $7 \mid \frac{1}{13}$. A. $\frac{3}{15}$. L. lat. 60.

Six pectoral appendages, the longest of which reaches to the commencement of the anal fin. The length of the caudal lobes is rather more than one-fourth of the total length. Pectoral fins blackish.

Description.—This fish is moderately elongate in form; its greatest height, which is between the root of the second dorsal and anal fins, is contained four times and one-third in the total length with the caudal, and thrice and one-fourth in the same without caudal. The tail is compressed, its height above the end of the anal being contained seven times and one-third in the total length. The head is much longer than high; its length is about four times and a half in the total with, and thrice and a half without caudal; its width between the eyes is nearly one fourth of its length. The snout is produced, obtusely conical, and shorter than the diameter of the eye, which is one-fifth of the length of the head. The cleft of the mouth is situated at the inferior side of the head, as usual; it is wide; the maxillary reaching considerably behind the orbit, but the length of the bone is only two-fifths of that of the head. The posterior margin of the præoperculum is armed with a distinct serrature, and one or two more distinct teeth above the projecting membranaceous lobe of the angle. The posterior extremity of the opercular apparatus is angular, membranaceous, and formed by the operculum and suboperculum. The origin of the first dorsal is opposite to the eighth scale of the lateral line, and in the vertical between the roots of the pectoral and ventral fins. The first spine is minute, the second shorter than the third, which is the longest, and contained about once and one-third in the length of the head; the fourth is longer than the second; and the subsequent spines rapidly decrease in length, rendering the upper margin almost vertical. There is a series of scales behind each spine almost to the top. The distance between the two dorsals is more than the length of the base of the second, which is entirely covered with scales and has the upper margin emarginate; the first and second rays are the longest, not so high as the spinous dorsal, more than twice as long as the hindmost rays. The distance between this fin and the caudal is one-fifth of the total length. The caudal fin is completely covered with scales, deeply forked, with the lobes pointed, the upper one being rather the longer. The distance between the caudal and anal fins is less than that between the dorsal and caudal, as the extremity of the anal falls behind that of the dorsal, or in the vertical from the forty-third scale of the lateral line. Its origin corresponds to that of the dorsal; and it has the lower edge straight or very slightly emarginate; it is entirely covered with scales. The first two spines are very small, and the third not half the length of the first ray; the first and second rays are the longest, but not twice as long as the fifteeenth or terminal ray. The length of the pectoral is not one-fourth of the total; it has minute scales towards the base. The free pectoral appendages are six in number; the upper one is the longest, reaching to the anal fin, and is not quite one-third of the total length. The root of the ventral falls a little behind the middle of the pectoral, and in the vertical from the eleventh scale of the lateral line; it is short, one-eighth of the total length, reaching to the vent; its spine is more than half the length of the adjacent ray. The scales are of moderate size, scarcely higher than long, and minutely ciliated on the posterior margin. The lateral line is straight, bifurcating between the lobes of the caudal. Teeth on the vomer in a narrow transverse patch.

Two specimens, 12 inches long, are in the Collection, one found by Mr. Salvin at Chiapam, the other by Capt. Dow at Panama.

Mr. Gill first recognized this species, which is not identical with *P. xanthonemus*, as suggested in the 'Catal. of Fishes.'

53. Polynemus opercularis.

Trichidion opercularis, Gill, Proc. Acad. Nat. Sc. Philad. 1863, p. 169.

This fish is described thus:—

$$D.\ 8 \mid \frac{8}{12}.\quad A.\ \frac{2}{13}.\quad L.\ lat.\ 69\text{–}70.\quad L.\ transv.\ 8/14.$$

The greatest height equals a fourth of the length to the fork of the caudal fin, and more than a fifth of the extreme, while the head enters four times and a half in the latter. The outline from the dorsal to the snout is nearly rectilinear and little declined. The distance of the anal from the outer axil of the ventral equals that of the posterior nostril from the margin of operculum. The first dorsal, when bent backwards, rests on the fourth scale, in front of the second. The second commences nearly above the twentieth scale of the lateral line. The pectoral is as long as the head behind the pupil. There are eight pectoral filaments, the longest of which extends rather beyond the front of the second dorsal. The colour is greenish brown above and yellowish green below. The operculum is blackish. The first dorsal and the pectorals, except below, are also blackish, as is likewise the margin of the caudal. The anal is tinged with orange.

A single specimen, 11 inches long, was collected by Capt. Dow at Panama.

54. Larimus breviceps.

Larimus breviceps, Cuv. & Val. v. p. 146, pl. 111. Günth. Fish. ii. p. 268.
Amblyscion argenteus, Gill, Proc. Ac. Nat. Sc. Philad. 1864, p. 165.

Having recently received a fine example of this fish from Panama through Capt. Dow, I have convinced myself that the Pacific examples are not specifically, much less generically, distinct from West-Indian ones.

56. Micropogon altipinnis.

Günth. Proc. Zool. Soc. 1864, p. 149.

D. $10 \mid \frac{1}{22}$. A. 2/7. L. lat. 48–50. L. transv. 7/15.

The height of the body is contained thrice and two-thirds in the total length (without caudal), the length of the head thrice and a half. The maxillary extends scarcely beyond the vertical from the anterior margin of the eye. A series of five minute barbels along each side of the mental groove. Two short, strong, divergent spines at the angle of the præoperculum. The third and fourth dorsal spines are long, their length being three-fifths of that of the head; anal spine of moderate strength, not quite one-fourth of the length of the head. Nearly uniform silvery.

Two specimens were procured by Mr. Salvin—one, 17 inches long, at Chiapam, and another, 14 inches long, at San José; a third specimen, $4\frac{1}{2}$ inches long, was found by Capt. Dow at Panama: this agrees in every other respect with the older examples, but of the minute barbels only a trace of the anterior (longest) pair is visible; so that it appears that this generic (!) character is developed with age.

57. Umbrina elongata. (Pl. LXIV. fig. 2.)

Günth. Proc. Zool. Soc. 1864, p. 148.

D. $10 \mid \frac{1}{24}$. A. 1/7. L. lat. 70. L. transv. 7/22.

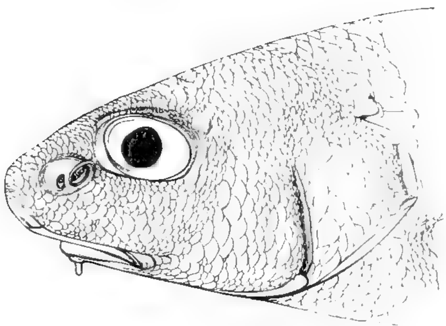
The height of the body is contained four times and a third in the total length (without caudal), and five times if the caudal is included; the length of the head is two-sevenths of the total, or one-fourth if the caudal is included. The depth of the head is contained once and three-fourths in its length. Snout long; the diameter of the eye is two-fifths of the length of the snout, and one-fourth of the postorbital part of the head. Symphysial barbel very short, as long as the posterior nostril. Præoperculum without distinct serrature. The length of the second dorsal spine is one-half of that of the head. Posterior margin of the caudal *f*-shaped, the upper lobe being pointed, the lower rounded; anal spine very feeble. The maxillary extends to the vertical from the anterior margin of the orbit. Upper parts blackish, shining silvery, the lower white.

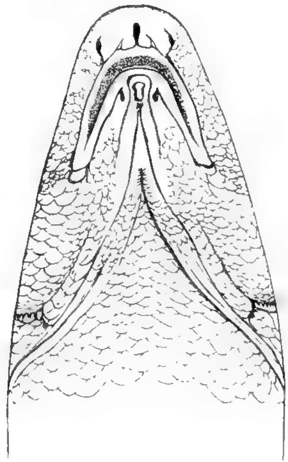
One specimen, 17 inches long, was found by Mr. Salvin at Chiapam.

58. Umbrina nasus.

D. 10 | $\frac{1}{22}$. A. 1/8. L. lat. 54. L. transv. 6/14.

The height of the body is contained four times in the total length (without caudal), the length of the head thrice and one-fourth. Snout much produced beyond the





mouth, which is quite at the lower side of the snout. The diameter of the eye is two-thirds of the length of the snout, and two-fifths of that of the postorbital portion of the head. Symphysial barbel very short, scarcely as long as the posterior nostril. Præoperculum distinctly serrated. The second and third dorsal spines are as long as the head, without snout. Posterior margin of the caudal fin *f*-shaped, the upper lobe being pointed, the lower rounded; anal spine very feeble. The maxillary extends to below the centre of the orbit. Silvery, fins blackish.

One specimen, 10 inches long, was found by Capt. Dow at Panama.

59. Umbrina analis.

D. 10 | $\frac{1}{26}$. A. 2/6. L. lat. 46–48. L. transv. 6/15.

The height of the body is one-third of the total length (without caudal), the length of the head two-sevenths. Snout compressed, rather deep, of moderate extent, longer than the eye, which is two-ninths of the length of the head, and equal to the width of the interorbital space. Snout overlapping the mouth, but not much protruding beyond it. Barbel very short, scarcely as long as the posterior nostril. Præoperculum distinctly serrated. The second and third dorsal spines are not quite as long as the head without snout. Caudal fin subtruncate. Anal spine very strong, more than half as long as the head. The maxillary extends beyond the front margin of the eye. An oblique dark streak runs along each series of scales. The spinous dorsal fin blackish.

One specimen, 11 inches long, was found by Capt. Dow at Panama.

I thought it possible for some time that this fish might be identical with *Umbrina undulata* of Girard; however, as this writer states that the anal spines of *U. undulata* are feeble, and gives 1/9 for the number of anal rays, we are not justified in identifying these two species.

61. Corvina chrysoleuca. (Pl. LXVII. fig. 1.)

Allied to *C. ronchus*.

D. $10 \Big| \frac{1}{22-23}$. A. $\frac{2}{9}$. L. lat. 55–56. L. transv. $\frac{5-8}{13}$.

The height of the body is contained thrice in the total length (without caudal), the length of the head thrice and one-third. Head thick; snout obtuse, with the upper jaw slightly overlapping the lower, as long as the diameter of the eye, which is contained four times and two-thirds in the length of the head. The maxillary is nearly entirely hidden by the præorbital, and extends beyond the vertical from the centre of the orbit. Teeth of the outer series of the upper jaw rather stronger than the others. Interorbital space slightly convex, only one-third wider than the orbit, its width being two-sevenths of the length of the head. Præoperculum with spinous teeth round its margin, three on and below the angle being much stronger than the others. Suprascapular denticulated. The second dorsal spine is the strongest, and the third the longest, being as long as the postorbital portion of the head. The second anal spine is very strong, as long as the longest of the spinous dorsal, and not much shorter than the first anal ray. Caudal fin irregularly rounded. Silvery, irregularly mottled with large brownish patches shining golden. A young specimen (5 inches long) is more uniform silvery.

Two specimens, 9 inches long, were collected by Capt. Dow at Panama.

I have observed in this species a most extraordinary variation in the size of the scales above the lateral line, such as I do not recollect having seen in other Acanthopterygian fishes. The two larger specimens are of nearly the same size; yet the dorsal scales of one are only half the size of those of the other. The lateral line is composed of nearly the same number of scales in both, and also the scales below the lateral are of nearly the same size.

62. Corvina vermicularis. (Pl. LXVII. fig. 2.)

D. $10 \Big| \frac{1}{25}$. A. $\frac{2}{8}$. L. transv. $\frac{6}{15}$.

The height of the body is a little more than one-third of the total length (without caudal); the length of the head two-sevenths. Head moderately compressed, snout obtuse, with the upper jaw overlapping the lower, a little longer than the diameter of the eye, which is one-fifth of the length of the head. The maxillary is entirely hidden by the præorbital, and extends somewhat beyond the vertical from the centre of the orbit. Teeth of the outer series of the upper jaw rather stronger than the others. Interorbital space convex, only one-fourth wider than the orbit, its width being one-fourth of the length of the head. Præoperculum with spinous teeth round its margin; they are rather widely set and of equally small size. Suprascapular scarcely denticulated. The second dorsal spine is scarcely stronger than, and but half as long as, the third, the length of which exceeds somewhat that of the postorbital portion of the head. The second anal spine is very strong, rather shorter than the succeeding ray, and equal in length to the postorbital portion of the head. Caudal fin rounded, with the upper lobe slightly produced. Scales irregularly arranged. Purplish shining silvery; a purplish brown streak, obliquely ascending backwards, follows the middle of each series of scales. Fins brown.

A single specimen, 8 inches long, was found by Capt. Dow at Panama.

63. Corvina armata.

Bairdiella armata, Gill, Proc. Acad. Nat. Sc. Philad. 1863, p. 164.

This species, which is evidently allied to *C. ronchus*, is described thus:—

$$\text{D. } 10 \,\Big|\, \tfrac{1}{23}. \quad \text{A. } \tfrac{2}{8}. \quad \text{L. lat. } 51. \quad \text{L. transv. } 7/10.$$

The height equals a fourth of the total length, of which the head forms a fourth. The caudal fin equals the head behind the front margin of the eye. The diameter of the eye enters four times and a half in the head's length, somewhat exceeds the interorbital area, which is scarcely convex, and equals the snout. The fourth dorsal spine is longest, and nearly equals half the head's length; all are stout and robust. The second dorsal commences nearly above the twentieth scale of the lateral line, or tip of pectoral. The second anal spine is very strong, longer than the first ray, and nearly equals the interval between the front of orbit and opercular flap; the soft fin behind is incurved. The pectoral equals the interval between the middle of the pupil and the opercular flap, and the ventral that between the front of the pupil and the same. The colour is hoary above, silvery below; the fins yellowish; the vertical, especially the first dorsal, clouded with darker.

Found by Capt. Dow at Panama.

64. Corvina ophioscion.

Ophioscion typicus, Gill, Proc. Acad. Nat. Sc. Philad. 1863, p. 164.

$$\text{D. } 10 \,\Big|\, \tfrac{1}{22\text{–}23}. \quad \text{A. } \tfrac{2}{7}. \quad \text{L. lat. } 49. \quad \text{L. transv. } \tfrac{4\frac{1}{2}}{10\frac{1}{2}}.$$

The height of the body is nearly equal to the length of the head, and two-sevenths of the total (without caudal). Head rather low, snout obtuse, but prominent, with the upper jaw projecting beyond the lower, the cleft of the mouth being quite at the lower side of the snout. The diameter of the eye equals the extent of the snout, and is two-ninths of the length of the head. The maxillary is entirely hidden by the præorbital, and extends to below the middle of the orbit. Teeth of the outer series of the upper jaw rather stronger than the others. Interorbital space scarcely convex, only one-third wider than the orbit, its width being two-sevenths of the length of the head. Præoperculum with straight, widely-set, spinous teeth round its margin, those on or near the angle being slightly the strongest. The second dorsal spine is the strongest, the third the longest, its length being more than that of the postorbital portion of the head. The second anal spine is exceedingly strong, about as long as the third dorsal spine, or as the first anal ray. Caudal fin irregularly rounded. Uniform silvery; top of the spinous dorsal blackish.

This species appears to be scarce at Panama, Capt. Dow having collected only two examples, of 8 and 6 inches in length.

65. Otolithus squamipinnis.

D. $8 \mid \frac{1}{21-22}$. A. $\frac{2}{10}$. L. lat. 85.

Scales rather irregularly arranged; there are nine longitudinal series between the origin of the first dorsal fin and the lateral line, and five or six between the end of the second dorsal fin and the lateral line. The height of the body is contained four times and one-sixth in the total length (without caudal), the length of the head thrice and one-fourth. Lower jaw very prominent, the extent of the snout being contained thrice and one-third in the length of the head. The width of the interorbital space is more than the diameter of the eye, and equals the extent of the upper jaw from the orbit. The maxillary extends to the vertical from the hind margin of the orbit. Præopercular angle slightly produced, dilated into a membranaceous margin which is faintly striated. The spinous dorsal is longer than high; the spines are feeble, the length of the third being two-fifths of that of the head. Caudal fin rounded, the middle rays being the longest. The membrane of the soft dorsal and anal fins is covered with small, transparent scales, which form a thickish cover on the base of these fins. The length of the pectoral is three-fifths of that of the head. Body uniformly coloured, scales on the sides minutely punctulated with brown; hinder side of the axil of the pectoral brown. Inner membrane of the gill-cover black. Ventral yellowish.

Two specimens, 10 & 11 inches long, were collected by Capt. Dow at Panama.

66. Otolithus albus.

Günth. Proc. Zool. Soc. 1864, p. 149.

D. $10 \mid \frac{1}{21}$. A. 2/9.

Scales rather irregularly arranged; there are seven series between the origin of the dorsal fin and the lateral line. The height of the body is one-fourth of the total length (without caudal), the length of the head two-sevenths. The extent of the snout is one-fourth of the length of the head; the maxillary extends somewhat beyond the vertical from the posterior margin of the eye. Præopercular angle not produced behind. The spinous dorsal is much longer than high; its spines are feeble, the length of the fourth being two-fifths of that of the head. Caudal fin rounded, with the middle rays produced. The second anal spine is truly spinous, not flexible, two-fifths of the length of the first soft ray. Membrane of the dorsal and anal fins not scaly. The pectoral fin extends as far backwards as the ventral, being more than half as long as the head. Immaculate, silvery, back greenish. (Pseudobranchiæ present.)

One specimen, $14\frac{1}{2}$ inches long, was obtained by Mr. Salvin at Chiapam.

67. Otolithus reticulatus.

Günth. Proc. Zool. Soc. 1864, p. 149.

$$\text{D. } 10 \left| \frac{1}{26\text{–}27} \right. . \quad \text{A. } 11\,(2/9).$$

Closely allied to *O. carolinensis*. Scales rather irregularly arranged; there are nine series between the origin of the dorsal fin and the lateral line. The height of the body is contained four times and a third in the total length (without caudal); the length of the head thrice and a third. The extent of the snout is two-sevenths of the length of the head; the maxillary does not extend backwards to the vertical from the posterior margin of the eye; præopercular angle somewhat produced behind, membranaceous, striated; the posterior margin of the præoperculum obliquely descending backwards. The spinous dorsal is much longer than high; its spines are feeble, the fourth being the longest, two-fifths of the length of the head. Caudal fin subtruncated, the middle rays somewhat produced. The first anal ray is quite rudimentary; the second as long as the eye, flexible, scarcely spinous. The pectoral fin extends as far backwards as the ventral, being more than half as long as the head. Back and sides with an irregular network of brown undulated streaks; fins immaculate.

Two specimens were collected by Mr. Salvin—one, 15 inches long, at San José, the other, 13 inches long, at Chiapam.

71. Caranx leucurus.

Günth. Proc. Zool. Soc. 1864, p. 24.

Very closely allied to *C. bicolor*.

$$\text{D. } 8 \left| \frac{1}{28} \right. . \quad \text{A. } 2 \left| \frac{1}{24\text{–}26} \right. .$$

The first dorsal fin is composed of short, stoutish spines, the fourth of which is the longest, but scarcely longer than the eye. The soft dorsal and anal are rather elevated; the caudal is emarginate, and has the lobes rounded. Teeth very small, forming a single series in both jaws; palate smooth. The height of the body is one-half of the total length (without caudal), the length of the head one-third. Snout rather obtuse, the jaws being equal in front when the mouth is closed; the maxillary extends to below the anterior margin of the orbit. The lateral line makes anteriorly a subsemicircular curve, the width of which is contained from once and two-thirds to once and four-fifths in the length of the straight portion; it becomes straight behind the vertical from the origin of the second dorsal, and is armed with about fifty small and low shields, only a few of which terminate in a depressed spine. The pectoral fin extends to the anal spines. Brownish grey, body with six dark brown vertical bands; the first crosses the body behind the base of the pectoral, and the fourth descends from the middle of the soft dorsal fin. Operculum with a large black spot. Dorsal, anal, and ventral black; pectoral and caudal whitish.

Only two examples, three inches long, were found by Capt. Dow at Panama.

72. Caranx speciosus (Forsk.).

Having examined specimens from Panama, collected by Mr. Salvin, and compared them with others from Borneo, Madras, Zanzibar, &c., I have convinced myself that *C. panamensis*, Gill, Proc. Acad. Nat. Sc. Philad. 1863, p. 166, is identical with *C. speciosus*.

74. Caranx hippos, L.

We have received two examples from the Pacific coast of Panama from Capt. Dow. The younger one, which is 5 inches long, agrees in every point, especially in the height of the body, with Atlantic examples of this species, whilst the older, 10 inches, is identical with that remarkable form described by Mr. Gill as *Carangus marginatus* (Proc. Acad. Nat. Sc. Philad. 1863, p. 166). This is considerably lower in form than the type, the height of the body being only two-sevenths of the total length; but having had an opportunity of comparing the example first mentioned, I do not think it entitled to specific rank, but regard it merely as a variety. The formula of fin rays in our example is D. $7 \left| \frac{1}{20} \right.$. A. $2 \left| \frac{1}{16} \right.$.

75. Caranx caballus.

Trachurus boops, Girard, U. S. Pac. R. R. Exped. Fish. p. 108; Günth. Fish. ii. p. 422 (not *C. boops*, C. & V.).

D. $7 \left| \frac{1}{23-24} \right.$. A. $2 \left| \frac{1}{20-21} \right.$. L. lat. 37.

The teeth of the upper jaw form a villiform band, those of the outer series being a little the larger; those of the lower are in a single series; teeth on the vomer, the palatines, and the tongue. The height of the body is two-sevenths of the total length (without caudal), the length of the head rather more than one-fourth. Eye with a broad adipose membrane in front and behind. Breast scaly. The lateral line is curved, the width of the arch being one-half of the length of the straight portion; the latter commences in the vertical from the third dorsal ray; the plates commence from the beginning of the straight portion of the lateral line, and are well developed. Lower jaw projecting beyond the upper; maxillary extending to below the anterior rim of the pupil. Pectoral reaching beyond the anterior anal rays. A black opercular spot.

Two specimens were collected by Capt. Dow at Panama; the species extends northwards to the coast of California.

76. Caranx caninus.

D. $8 \mid \frac{1}{20}$. A. $2 \mid \frac{1}{17}$. L. lat. 24.

The teeth in the upper jaw form a villiform band, those of the outer series being much the stronger, and widely set. Lower jaw with a single series of rather strong, closely set teeth, and with the two anterior ones somewhat enlarged, canine-like; teeth on the vomer, the palatines, and the tongue. The height of the body is a little more than the length of the head, and one-third of the total (without caudal). Snout obtuse, as long as the diameter of the eye; eye with an adipose eyelid in front and behind. Præorbital much narrower than the orbit. The maxillary extends beyond the vertical from the centre of the eye. Breast naked; lateral line slightly bent, the width of the arch being contained once and one-third in the length of the straight portion; the latter commences in the vertical from the fifth dorsal ray; the plates do not reach forward to the end of the arched portion, and are well developed. Lower jaw scarcely projecting beyond the upper. Dorsal spines rather stout and short; the fourth is the longest, and one-third of the length of the head. The pectoral extends to the fifth anal ray. A black opercular spot. Membrane of the soft dorsal and anal blackish.

One specimen, 7½ inches long, was discovered by Capt. Dow at Panama.

77. Caranx dorsalis.

Carangoides dorsalis, Gill, Proc. Acad. Nat. Sc. Philad. 1863, p. 166.

D. $4\text{–}5 \mid \frac{1}{18}$. A. $2 \mid \frac{1}{16}$. L. lat. 25*.

The teeth in both jaws form villiform bands; teeth on the vomer, the palatine bones, and on the tongue. The height of the body is contained once and four-fifths in the total length (without caudal), the length of the head thrice and one-fourth. The first dorsal fin is but little developed, the spines being short, feeble, and flexible. Anterior rays of the dorsal and anal fins prolonged into a very long filament, sometimes longer than the whole body. Jaws equal in length, the maxillary extends to the vertical from the front margin of the orbit. Lateral line bent, the width of its arch being as long as the straight portion; the latter commences below the middle of the second dorsal fin. The plates are moderately developed, and commence at some distance from the bend of the lateral line. Gill-membrane above the pectoral blackish; posterior half of the ventrals black.

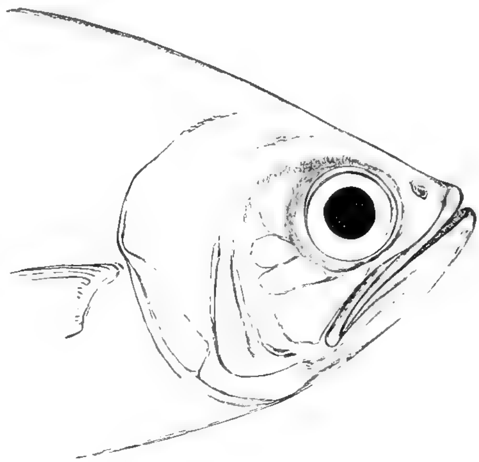
Panama. We have received two examples from Capt. Dow, one 19 inches long.

* Mr. Gill counted 44; this is either a mistake, or he has counted small scales not deserving the name of plates.

82. Chorinemus altus.

D. 5 | $\frac{1}{19}$. A. 2 | $\frac{1}{19}$.

The height of the body is contained thrice in the total length (without caudal), the length of the head four times and one-fourth. Eye rather large, its diameter being equal to the length of the snout, and one-fourth of that of the head. Lower jaw projecting beyond the upper. Maxillary very narrow posteriorly, scarcely extending to the vertical from the hind margin of the eye; the length of the intermaxillary is contained once and three-fourths in the length of the head. The infraorbital, situated above the maxillary, is as broad as the bone next above it; none of these bones reach to the anterior præopercular ridge. Pectoral fin longer than the ventral, nearly as long as the head (without snout). Coloration uniform.



One example, 11 inches long, has been recently sent by Capt. Dow from Panama.

83. Chorinemus inornatus.

Oligoplites inornatus, Gill, Proc. Acad. Nat. Sc. Philad. 1863, p. 166.

D. 5 | $\frac{1}{20}$. A. 2 | $\frac{1}{20}$.

"The height of the body enters four times and two-thirds in the total length; the length of the head five times and two-thirds. The upper maxillary reaches nearly to the vertical from the hinder margin of the orbit; the intermaxillary enters twice and one-third in the head's length. The snout is a little longer than the diameter of the eye; the latter equals a quarter of the head's length. The infraorbital bones do not extend to the præoperculum; the one above the maxillary bones is wider than the one above itself, and as wide as that behind the eye. The opercular apparatus is vertical in front of the pectoral, and for an equal space above. The præoperculum is nearly vertical, and its angle obliquely rounded. The width of the operculum and suboperculum in front of the lower axilla of the pectoral equals the diameter of the eye and the interval between suboperculum and axil. The pectoral equals the interval between its axis and the hinder border of the pupil; the ventral is rather shorter, but its end almost or quite reaches to the anus. The colour is uniform, tinged with blue above."

One adult specimen was collected by Capt. Dow on the Pacific coast of Central America.

85. Trachynotus fasciatus. (Plate LXIX. fig. 4.)

Trachynotus fasciatus, Gill, Proc. Ac. Nat. Sc. Philad. 1863, p. 86.
—— *glaucoides,* Günth. Proc. Zool. Soc. 1864, p. 150.

D. $6 \mid \frac{1}{20}$. A. $2 \mid \frac{1}{18}$.

Closely allied to *T. glaucus*, but with the body more elevated. The height of the body is one-half of the total length (without caudal); the length of the head two-sevenths. The maxillary extends to below the middle of the eye. Anterior dorsal and anterior anal rays, and the caudal lobes, much prolonged, the length of the latter being two-sevenths of the total. The *ventral* fin *does not extend to the vent.* Five narrow blackish vertical bars across the lateral line.

One specimen, 7 inches long, was obtained by Mr. Salvin at San José; two others, 11 inches long, were obtained by Capt. Dow at Panama.

Description.—This species has the body (without caudal) of a rhomboidal form, its greatest height being between the last spine of the dorsal and the vent, and one-half of the total length (without caudal); the upper profile between the dorsal and the snout is oblique, feebly convex over the eye. The length of the head is contained thrice and one-half in the total (without caudal). The diameter of the eye is rather more than the length of the snout, and contained thrice and two-thirds in that of the head. The cleft of the mouth is narrow; the maxillary reaches nearly to the level of the centre of the diameter of the eye; its length is a little more than one-third of that of the head. The width of the space between the eyes is more than one-third of the length of the head, or equal to the distance from the tip of the snout to the centre of the eye. Præoperculum with the hinder margin straight, and at a right angle with the lower border, which is also straight and parallel with the axis of the body. Operculum small, narrow, about two-thirds as long as high; the hinder border of the opercular apparatus is formed almost entirely of the sub- and interoperculum; it is rounded and membranaceous: the line of the separation between the operculum and suboperculum is at right angles with that between the sub- and interoperculum. There is a recumbent spine before the commencement of the first dorsal, and in a line with the posterior part of the axil of the pectoral; the dorsal spines, seven in number, are short; the first is minute, but erect, and not attached by any apparent membrane to the second; the others show a slight progression in dimensions, and are united by a low membrane. The base of the soft dorsal is not twice as long as that of the spinous; the first two rays, which are the longest, project considerably beyond any of the others, and are equal to half the length of the body (without the caudal); the following rays diminish very rapidly in length, and from the eighth ray to the last the fin is scarcely higher than the spinous dorsal, and its upper edge almost straight. The distance between the dorsal fin and the caudal is equal to that between the anal and caudal. The anal fin is preceded by three short spines about equal to the fourth, fifth, and sixth of the dorsal. The base of the soft portion of the anal is about as long as that of the soft dorsal: it consists of eighteen rays, and perfectly resembles the soft dorsal in shape, having the first two rays much longer than the others, equal to the corresponding rays in the dorsal, and the following rays rapidly decreasing in length to the sixth, from which the margin of the fin is almost straight. The pectoral fin is pointed, of moderate size, its length being three-fourths that of the head. The ventrals are short, more than half the length of the pectoral, and not reaching to the vent. The tail behind the dorsal and anal is compressed and narrow. The caudal is deeply forked; the lobes are equal, and contained thrice and a half in the total length; it is covered with small scales.

The body is covered with very minute scales; those at the base of the vertical fins and near the lateral line are a little larger. The head and opercular bones are entirely naked. The lateral line shows a somewhat irregular sinuosity slightly above the median axis of the body for the first half of its length, after which it is perfectly straight, terminating between the two lobes of the caudal. Teeth small, villiform; a small central patch on the vomer, and a narrow one on each of the palatines.

Bluish green above, silvery beneath. Five vertical brown stripes down the sides of the body across the lateral line, the first two being nearer together than the others, which are at almost equal distances: the first behind the axil of the pectoral, the second below the third dorsal spine, the third below the sixth, the fourth below the seventh dorsal ray, and the fifth below the seventeenth. However, the second and third of these bands are placed sometimes more backwards, which is evidently the case in the example described by Mr. Gill, and named by him *T. fasciatus*. Having recently obtained two examples from Capt. Dow, one of which shows the arrangement of the bands as in *T. glaucoides*, on one side, and that of *T. fasciatus* on the other, I cannot entertain any doubt as to the specific identity of these fishes.

86. Pelamys sarda, Bl.

We may mention this species here, although it is not contained in any of the collections forming the material for this Memoir, because Dr. Ayres alludes to it in the following manner:—" A species of *Pelamys* brought to the markets of San Francisco is without question the *P. sarda*. The closest examination fails to distinguish it from the Atlantic form. Previous to this time we had no positive knowledge of any fish in the low latitudes which inhabits Californian waters and those of the Atlantic."—Proc. Calif. Acad. 1855, p. 74.

90. Batrachus pacifici (Gthr.).

In other specimens recently collected by Capt. Dow at Panama, I find the membrane at the bottom of the pouch of the axil of the pectoral fin (described in Fish. iii. p. 173) folded and wrinkled, with a great quantity of coagulated mucus between the folds. The same species appears to occur also on the coast of West Africa, a specimen having been lately obtained by Dr. Steindachner, who describes it as *B. liberiensis* (Sitzgsber. Ak. Wiss. Wien, 1867, lv. p. 525, Taf. 1. figs. 2 & 3).

THALASSOPHRYNE[1].

Thalassophryne, Günth. Fish. iii. p. 174.

Head broad, depressed; body subcylindrical anteriorly, and compressed posteriorly; skin naked. Canine teeth none. Operculum with a single spine. The spinous dorsal formed by two spines of moderate length. The opercular and dorsal spines with a canal conducting a poisonous fluid from a sac situated at their base. Gill-opening not very narrow, not extending to the isthmus.

Atlantic coasts of Tropical America.

92. THALASSOPHRYNE MACULOSA. (Plate LXVIII. fig. 1.)

Günth. Fish. iii. p. 175.

D. 2|19. A. 18. V. 1/2.

Brown, marbled with darker; some round black spots on the pectoral and the side of the body.

The general habitus is that of a *Batrachus.* The head is somewhat longer than broad, its length being contained thrice and one-third in the total; it is moderately depressed. The snout is short, obtuse, with the cleft of the mouth ascending obliquely upwards, and with the chin prominent. The maxillary extends to the vertical from the posterior margin of the orbit. The teeth are obtusely conical, standing in single series, except anteriorly in the lower jaw, where they form two series, and in the upper, where they are cardiform, in a narrow band. The eyes are directed upwards and very small, their width being one-half of that of the bony bridge between the orbits. Gill-covers with a single spine; it is long, slender, cylindrical, like one of the dorsal spines, and has the operculum for its base. Gill-opening not very narrow; it extends from the upper base of the pectoral obliquely downwards and forwards to the level of the inferior base of the pectoral. The two dorsal spines are slender, pungent, about one-third of the length of the head. Dorsal and anal fins terminate immediately before the root of the caudal, the length of which is one-seventh of the total. Pectoral obliquely rounded, extending to the origin of the anal; ventral rather short, not quite one-half the length of the head, extending to the base of the pectoral. Skin perfectly smooth, with some very short tentacles at the lower jaw. Two short horizontal muciferous channels on the cheek and the lateral line are very distinct; they are not, as usually, composed of a series of distant pores, but the pores are confluent, forming one continuous groove of a white colour. Other muciferous channels, as for instance along the base of the anal, are composed of separate indistinct pores. Colour brown, marbled with darker; pectoral fins and sides of the body with some round black spots; chin and ventrals brownish; belly white.

A single specimen from Puerto Cabello is known.

[1] Greek denomination for Sea-toad.

	lines.
Total length	54
Length of the head	16
Width of the head	14
Depth of the head	10
Diameter of the eye	1
Length of the caudal fin	8
——— of the ventral fin	7

93. Thalassophryne reticulata. (Plate LXVIII. fig. 2.)

Günth. Proc. Zool. Soc. 1864, pp. 150, 155.

D. 2|24. A. 24. V. 1/2. P. 16.

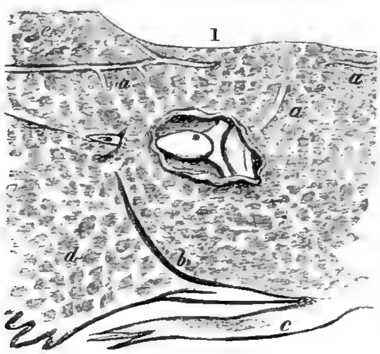
The length of the head is two-sevenths of the total length (without caudal). The teeth on the palate are in a single series, very short, obtuse, incisor-like. Pectoral very large, extending backwards to the sixth anal ray. Head, body, and fins brown, with a network of yellowish lines; vertical and pectoral fins with a white margin.

In other respects this species agrees with *T. maculosa*; so that we may refer to the description of that species given above.

Three specimens were found by Messrs. Dow and Salvin on the Pacific coast of Panama; the largest is 13 inches long.

In this species I first observed and closely examined the poison-organ with which the fishes of this genus are provided. Its structure is as follows:—

1. *The opercular part.*—The operculum is very narrow, vertically styliform, and very mobile; it is armed behind with a spine, 8 lines long in a specimen of $10\frac{1}{2}$ inches, and of the same form as the venom-fang of a snake; it is, however, somewhat less curved, being only slightly bent upwards; it has a longish slit at the outer side of its extremity, which leads into a canal perfectly closed, and running along the whole length of its



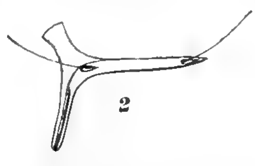


Fig. 1. Hinder half of the head, with the venom-sac of the opercular apparatus *in situ*. * Place where the small opening in the sac has been observed. *a*. Lateral line and its branches. *b*. Gill-opening. *c*. Ventral fin. *d*. Base of pectoral fin. *e*. Base of dorsal fin.

Fig. 2. Operculum, with the perforated spine.

interior; a bristle introduced into the canal reappears through another opening at the base of the spine, entering into a sac situated on the opercle and along the basal half of the spine; the sac is of an oblong-ovate shape, and about double the size of an oat-grain. Though the specimen had been preserved in spirits for about nine months, it still contained a whitish substance of the consistency of thick cream, which on the slightest pressure freely flowed from the opening in the extremity of the spine. On the other hand, the sac could be easily filled with air or fluid from the foramen of the spine.

No gland could be discovered in the immediate neighbourhood of the sac; but on a more careful inspection I found a minute tube floating free in the sac, whilst on the left-hand side there is only a small opening instead of the tube. The attempts to introduce a bristle into this opening for any distance failed, as it appears to lead into the interior of the basal portion of the operculum, to which the sac firmly adheres at this spot.

2. The *dorsal part* is composed of the two dorsal spines, each of which is 10 lines long. The whole arrangement is the same as in the opercular spines; their slit is at the front side of the point; each has a separate sac, which occupies the front of the basal portion; the contents were the same as in the opercular sacs, but in somewhat greater quantity. A strong branch of the lateral line ascends to the immediate neighbourhood of their base.

Thus we have four poison-spines, each with a sac at its base; the walls of the sacs are thin, composed of a fibrous membrane, the interior of which is coated over with mucosa. There are no secretory glands imbedded between these membranes, and these sacs are probably merely the reservoirs in which the fluid secreted accumulates. The absence of a secretory organ in the immediate neighbourhood of the reservoirs (an organ the size of which would be in accordance with the quantity of the fluid secreted), the diversity of the osseous spines which have been modified into poison-organs, and the actual communication indicated by the foramen in the sac, lead me to the opinion that the organ of secretion is either that system of muciferous channels which is found in nearly the whole class of fishes, and the secretion of which has poisonous qualities in a few of them, or at least an independent portion of it.

This description was made from the first example; through the kindness of Capt. Dow I received two other specimens; and in the hope of proving the connexion of the poison-bags with the lateral-line system, I asked Dr. Pettigrew, of the Royal College of Surgeons, a gentleman whose great skill has enriched that collection with a series of the most admirable anatomical preparations, to lend me his assistance in injecting the canals. The injection of the bags through the opening of the spine was easily accomplished; but we failed to drive the fluid beyond the bag, or to fill with it any other part of the system of muciferous channels. This, however, does not disprove the connexion of the poison-bags with that system, inasmuch as it became apparent that, if there be minute openings, they are so contracted by the action of the spirit in which the specimens were preserved, as to be impassable to the fluid of injection. A great part of the lateral-line system consists of *open* canals; however, on some parts of the body, these canals are entirely covered by the skin: thus, for instance, the open lateral line ceases apparently in the suprascapular region, being continued again in the parietal region. We could not discover any trace of an opening by which the open canal leads to below the skin; yet we could distinctly trace the existence of the continuation of the canal by a depressed line, so that it is quite evident that such openings do exist, although they may be passable only in fresh specimens. Thus, likewise, the existence of openings in the bags, as I believe to have found in the first specimen dissected, may be proved by examination of fresh examples.

The sacs are without an external muscular layer, and situated immediately below the loose thick skin which envelopes their spines to their extremity; the ejection of the poison into a living animal, therefore, can only be effected by the pressure to which the sac is subjected the moment the spine enters another body.

Nobody will suppose that a complicated apparatus like the one described can be intended for conveying an innocuous substance; and therefore I have not hesitated to designate it as poisonous; and, Capt. Dow informs me in a letter lately received, "the natives of Panama seemed quite familiar with the existence of the spines and of the emission from them of a poison which, when introduced into a wound, caused fever, an effect somewhat similar to that produced by the sting of a Scorpion; but in no case was a wound caused by one of them known to result seriously. The slightest pressure of the finger at the base of the spine caused the poison to jet a foot or more from the opening of the spine." The greatest importance must be attached to this fact, inasmuch as it assists us in our inquiries into the nature of the functions of the muciferous system, the idea of its being a secretory organ having lately been superseded by the notion that it serves merely as a stratum for the distribution of peripheric nerves. Also the objection that the Sting-Rays and many Siluroid fishes are not poisonous, because they have no poison-organ, cannot be maintained, although the organs conveying their poison are neither so well adapted for this purpose nor in such a perfect connexion with the secretory mucous system as in *Thalassophryne*.

The poison-organ serves merely as a weapon of defence. All the Batrachoids with obtuse teeth on the palate and in the lower jaw feed on Mollusca and Crustaceans.

95. Antennarius leopardinus. (Plate LXIX. fig. 3.)

Günth. Proc. Zool. Soc. 1864, p. 151.

D. 3|13. A. 7. P. 11.

Skin very rough, covered with minute spines; anterior dorsal spine (tentacle) not longer than the second, terminating in a small, flat disk; the third is separate from the soft dorsal. Brownish grey, marbled with rose-colour, and with brown dots on the sides; a black ocellus edged with rosy in the middle of the side, another larger one on the base of the ninth and tenth dorsal rays, and one or two small ones on the side of the tail. Belly covered with round brown spots; caudal with ovate black spots, arranged in three transverse series; all the other fins with similar spots.

One specimen, $2\frac{1}{2}$ inches long, was found by Capt. Dow on the Pacific coast of Panama.

96. Antennarius tenuifilis.

D. 3/12. A. 7. P. 10.

Allied to *A. bigibbus.* Skin rough, the spines being exceedingly fine; anterior dorsal spine (tentacle) much longer than the second, and tapering into a fine point; second quite free, conical; third entirely covered by the skin, forming a slight protuberance. Rose-coloured, with black markings which are most crowded and confluent on the middle parts of the length of the fish, less so on the head and thorax, leaving the nape and back of the trunk nearly immaculate; the markings form irregular concentric streaks on the thorax, and larger patches on the body; a deep-black band across the caudal and anal fins.

One specimen, $2\frac{1}{2}$ inches long, was found by Dr. Seemann, walking on the reefs outside the city of Panama.

103. Eleotris maculata (Bl.).

This species attains to a large size; Mr. Salvin collected specimens 11 inches long at Huamuchal. Such large examples have, of course, the eye comparatively smaller than younger ones; and having also a deeper body, the number of series of scales between the origin of the second dorsal and the anal is increased by the addition of smaller scales. On such a large example Mr. Gill has founded his *Dormitator microphthalmus*, Proc. Ac. Nat. Sc. Philad. 1863, p. 170.

106. Eleotris longiceps.

Günth. Proc. Zool. Soc. 1864, p. 151.

D. $6 \mid \frac{1}{10}$. A. $\frac{1}{10}$. L. lat. 66.

Vomerine teeth in a broad subcrescentic band, which is more than half as broad as that of the intermaxillaries. Thirty-six series of scales between the occiput and the anterior dorsal fin; twenty between the origin of the posterior and the anal. The height of the body is nearly one-half of the length of the head, which is more than one-third of the total (without caudal). The maxillary extends to below the middle of the eye; teeth cardiform. Caudal fin obtusely rounded, one-sixth of the total length. Brownish black, marbled with brown and black; fins with roundish blackish spots.

This species differs from the others (which have been referred to the division of *Philypnus*) in having a comparatively longer head. One specimen, 8 inches long, was given to Mr. Salvin by Capt. Dow, who found it in the Lake of Nicaragua.

107. Eleotris picta.

Kner, Sitzgsber. bayer. Ak. Wiss. 1863, p. 223, and Abhandl. bayer. Ak. Wiss. 1865, p. 18, tab. 3. fig. 1.

D. $6 \left| \frac{1}{8-9} \right.$. A. $\frac{1}{9}$. L. lat. 60.

This fish is closely allied to *E. gyrinus*, but is said to be distinguished by having the height of the body only one-sixth or one-seventh of the total length[1]; lower parts of the body with numerous whitish spots and streaks.

From the Pacific side of the Isthmus.

108. Eleotris seminuda.

Günth. Proc. Zool. Soc. 1864, p. 24.

D. 7 | 11. A. 9.

The head and the trunk are naked; the tail is covered with small scales; head depressed, broader than high, flat above, its length being two-sevenths of the total. Snout rather obtuse, longer than the eye, with the lower jaw somewhat prominent; the cleft of the mouth extends to below the anterior margin of the orbit. Teeth in the upper jaw in a narrow band; the lower has four somewhat larger and recurved teeth in front; they appear to form a single series; palate toothless. None of the fin-rays are prolonged; the pectoral does not quite extend to the origin of the second dorsal; ventral much shorter than pectoral, its inner ray is the longest, the others gradually decreasing in length outwards; caudal fin rounded. Brown, with numerous well-defined white cross stripes on the head as well as on the body; vertical fins black.

Although there is only a single example, 20 lines long, in the collection, the characters of this species are so well marked that I have not hesitated to describe it.

109. Amblyopus brevis.

Günth. Proc. Zool. Soc. 1864, p. 151.

D. 6 | 15. A. 15.

The height of the body is one-eighth of the total length (without caudal); the length of the head two-ninths. Eyes minute. Jaws with a series of longish, widely set teeth. Caudal fin black.

One specimen, 3 inches long, was found on the Pacific coast of Panama by Messrs. Dow and Salvin.

The specimen being young, I abstain from giving a detailed description. In its dentition it agrees with *A. sagitta* from California, and therefore it would belong to the subgenus *Tyntlastes* (Proc. Zool. Soc. 1862, p. 194). The scales must have been very thin and deciduous, and do not appear to be very small, at least not on the hinder part of the body. The ventral is much longer than the pectoral, and the caudal longer than the head.

[1] According to the figure it is higher.

114. Clinus macrocephalus. (Plate LXIX. fig. 2.)

Günth. Fish. iii. p. 266.

D. $\frac{21-22}{12}$. A. $\frac{2}{24}$. C. 13. P. 13. V. 1/3.

The height of the body is contained seven times and a half in the total length, the length of the head five times. The head is depressed, rather short, nearly as broad as long; crown of the head broad and flat; interorbital space concave, narrower than the orbit. Snout very short, obtuse, rounded; the maxillary does not extend to behind the posterior margin of the orbit; lips thick. The teeth in the jaws form a band with an outer series of stronger ones; vomerine teeth in a narrow band; palatine teeth none. No orbital tentacles, those at the nostril and on the neck very small. Gill-openings wide, the gill-membranes being united at the throat. Head naked; scales on the body not very small, cycloid. The dorsal fin commences at the occiput, and terminates near the base of the caudal; the spines are flexible, and much lower than the soft rays; the three anterior ones are rather more remote from one another than the following: none of the rays of this or of the other fins are branched. Caudal rounded. The anal is higher posteriorly than anteriorly, about as high as the spinous dorsal. Pectoral rounded, with the middle rays longest, shorter than the head. Ventrals jugular, half as long as the pectoral, with the spine and the outer ray enveloped in a common thick membrane. Dark greyish olive; head and fins blackish; head, base of the pectoral, anterior part of the body, and dorsal dotted with white.

Several examples, of the size of the figure, were collected by Capt. Dow at Panama.

Cremnobates.

Cremnobates, Günth. Proc. Zool. Soc. 1861, p. 374.

Body moderately elongate, with the scales small or of moderate size. Snout rather short, with the cleft of the mouth of moderate width. A band of small teeth in the jaws; teeth on the vomer. Two separate dorsals, composed of spines only; the anterior short, formed of three spines. Ventrals jugular, composed of three rays. Head with tentacles; gill-opening wide.

115. Cremnobates monophthalmus. (Plate LXIX. fig. 1.)

Auchenopterus monophthalmus, Günth. Fish. iii. p. 275.
Cremnobates monophthalmus, Günth. Proc. Zool. Soc. 1861, p. 374.

D. 3|27. A. $\frac{2}{19}$. V. 3. L. lat. 38.

A fimbriated superciliary tentacle; a small one at the nostril and on each side of the nape, both multifid. A black ocellus, edged with white, on the posterior quarter of the dorsal fin.

Specimens, 2 inches long, were collected by Capt. Dow at Panama.

118. Atherinichthys pachylepis.

Günth. Proc. Zool. Soc. 1864, p. 25.

D. $4\left|\frac{1}{6-8}\right.$. A. $\frac{1}{20-21}$. L. lat. 41. L. transv. 7.

The height of the body is nearly equal to the length of the head, and contained five times and a half or five times and a third in the total length (without caudal). The snout is short, not longer than the diameter of the eye; and the cleft of the mouth does not extend backwards to below the anterior margin of the eye. The anterior dorsal is composed of short, feeble spines; and its origin is opposite to the fourth or fifth anal ray. The pectoral fin is much longer than the head. The silvery streak occupies the adjoining halves of the third and fourth series of scales.

Two specimens, 6 inches long, were collected by Capt. Dow at Panama.

119. Atherinichthys guatemalensis.

Günth. Proc. Zool. Soc. 1864, p. 151.

D. $4\left|\frac{1}{9}\right.$. A. $\frac{1}{22}$. L. lat. 36. L. transv. 7.

Anterior dorsal fin very small, inserted behind the vertical from the commencement of the anal fin. The height of the body is contained five times in the total length (without caudal), the length of the head four times and a fourth. The silvery band occupies the third upper series of scales. The lower caudal lobe rather longer than the upper.

Several examples, from 2 to $2\frac{1}{2}$ inches long, were collected by Mr. Salvin in the Lakes of Huamuchal.

120. Mugil brasiliensis (Agass.).

Messrs. Dow, Godman, and Salvin have collected numerous examples of all sizes at Belize, Chiapam, and Panama. I have no doubt that *M. güntheri*, Gill, Proc. Ac. Nat. Sc. Philad. 1863, p. 169, is founded on a specimen of this species; it is described as having all the fins scaleless; but, as all our specimens of *M. brasiliensis* and *M. incilis* have the dorsal and anal more or less covered with minute scales, I suppose that these scales have either been lost in the example of the Smithsonian Institution, or overlooked.

The first dorsal spine, in this species, is either longer than or as long as the second. L. lat. 36–38.

121. Mugil incilis.

Mugil incilis, Hancock in Lond. Quart. Journ. Sc. 1830, p. 127.

D. $4\left|\frac{1}{8}\right.$. A. $\frac{3}{9}$. L. lat. 42–44. L. transv. 15.

Closely allied to *M. brasiliensis*, but with smaller scales, and with the second dorsal spine rather longer than the first.

The height of the body equals the length of the head, which is two-ninths of the total (without caudal). The snout is moderately broad, scarcely convex, with the lower profile ascending in the same degree as the upper descends; the interorbital space is slightly convex, its width being contained twice and two-thirds in the length of the head. Upper lip rather thin. The angle made by the two mandibulary bones is a right one; the præorbital tapers posteriorly, has the anterior margin finely serrated, and covers the maxillary, so that only a very narrow portion of it is visible on the side of the snout. Eyes hidden anteriorly and posteriorly by a broad adipose membrane. Nostrils rather distant from each other, the posterior situated nearer to the orbit than to the extremity of the snout. The space of the chin, between the mandibles and the interopercula, is elongate cuneiform. The second dorsal and the anal are enveloped in small scales. There are twenty-three scales between the snout and the anterior dorsal. The second dorsal spine is longer than the first, and more than half as long as the head. The tenth, eleventh, and twenty-fifth scales of the lateral line correspond to the extremity of the pectoral fin and to the origins of the two dorsal fins. The root of the pectoral is above the middle of the body; and the ventral is inserted somewhat nearer to the pectoral than to the spinous dorsal; pectoral shorter than the head; caudal deeply emarginate. Silvery, axil of the pectoral blackish.

We have received examples of this species from Dutch and British Guiana; Mr. Salvin collected two fine examples in the Chagres River.

I formerly considered it possible that the fish described by Hancock might be identical with *M. brasiliensis*; but having now received examples, I have convinced myself that it is a distinct species.

123. Agonostoma microps. (Plate LXX. fig. 1.)

Günth. Fish. iii. p. 462.

D. $4 \mid \frac{1}{8}$. A. $\frac{3}{9}$. L. lat. 43. L. transv. 12.

Broad bands of villiform teeth in the jaws, on the vomer, and the palatine and pterygoid bones. The height of the body is contained five times in the total length, the length of the head four times and a half; the latter is more than the distance between the origins of the two dorsal fins; snout much longer than the eye. Upper lip thick, protruding anteriorly. The maxillary extends to, or beyond, the vertical from the anterior margin of the eye. The interorbital space is convex. The anterior dorsal commences midway between the snout and the base of the caudal fin.

Mr. Salvin has collected specimens of this species (of which we have given a detailed description, *l. c.*) in the Rio Guacalate.

124. Agonostoma nasutum. (Plate LXX. fig. 2.)[1]

Agonostoma nasutum, Günth. Fish. iii. p. 463.

Dajaus[1] *elongatus*, Kner & Steindachner, Sitzgsber. bayer. Ak. Wiss. 1863, p. 222; and Abhandl. bayer. Ak. Wiss. 1865, p. 6, Taf. 1. fig. 2.

—— *nasutus*, Kner & Steindachner, *l. c.* p. 8.

D. $4 \mid \frac{1}{8}$. A. $\frac{3}{9}$. L. lat. 42. L. transv. 12.

Rather narrow bands of villiform teeth in the jaws, on the vomer, and palatine bones. The height of the body equals the length of the head, and is one-fifth of the total.

[1] See Zool. Record, ii. p. 192.

Upper lip thick. The maxillary extends to the vertical from the anterior margin of the eye. The interorbital space is convex. The anterior dorsal commences nearer to the end of the snout than to the base of the caudal fin.

This species, of which we have given a full description (*l. c.*), occurs in rivers of both sides of the Isthmus and of Guatemala. The specimens named *Dajaus elongatus* are probably emaciated, caught after spawning-time.

125. Agonostoma monticola (Bancroft).

This species, which is indigenous in Jamaica and Barbadoes, has been found by M. Sallé in Mexico; and Messrs. Kner & Steindachner enumerate it in a collection from Panama, where it is found in rivers of both sides of the Isthmus. Abhandl. bayer. Ak. Wiss. 1865, p. 8.

129. Gobiesox rhodospilus.

Günth. Proc. Zool. Soc. 1864, p. 25.

D. 6. A. 5. C. 8–9. P. 17.

A vertical fold of the skin along the lower half of the base of the pectoral; the coracoid is scarcely below the level of the upper margin of the pectoral. The distance of the origin of the dorsal fin from the caudal is contained twice and two-thirds in its distance from the snout; the anal commences below the third dorsal ray. A very narrow band of short conical teeth in the upper jaw—one of the lateral teeth being somewhat larger than the others, recurved, canine-like. The lower jaw with a single series of teeth, the anterior being narrow incisors, whilst the outermost on each side is distinctly a canine tooth, corresponding to that in the upper jaw. Rose-coloured, with dark-rose transverse spots, each spot having an edge of deep-red dots.

Two specimens, 18 lines long, were collected by Capt. Dow at Panama.

132. Pomacentrus rectifrænum.

A species from California and the western coast of Central America was described by Mr. Gill under this name in the year 1862, and easily recognized by myself when I gave an account of this genus in the fourth volume of my 'Fishes,' having received, beside numerous examples from Panama and the Island of Cardon, a typical specimen from the collection of the Smithsonian Institution. At the same time a specimen was received from the same establishment, numbered as the other, but marked in the accompanying list as *Pomacentrus bairdii*, another name proposed by Mr. Gill in the same year (Proc. Ac. Nat. Sc. Philad. 1862, p. 149). It agreed perfectly with the description given there; but as a comparison with our other examples of *P. rectifrænum* did not reveal distinctive specific characters, I did not hesitate to regard it not only as a typical specimen of Mr. Gill's *P. bairdii*, but also as specifically identical with *rectifrænum*; about this I had no doubt.

However, during the publication of my account of the *Pomacentridæ*, Mr. Gill kindly sent me a MS. communication on the same subject, in which he pointed out the characters of these two and of three other allied species (see 'Fishes,' iv. p. 27); I had no faith whatever in these distinctions; but, to allow others interested in the subject to judge for themselves, I admitted into my account those MS. notes in the form in which they were sent to me.

I was rather surprised to find in an article written by Mr. Gill a short time afterwards (Proc. Ac. Nat. Sc. Philad. 1863, p. 218) the assertion that the specimen sent as "*P. bairdii*" is not this species, but the young of *P. rectifrænum*, "the name, under which the *P. bairdii* was sent, having doubtless by some accident been shifted to the young of *P. rectifrænum*, and the specimen of the former lost." If this be so, it is certainly curious that the "*P. bairdii*" sent agrees so well with the "*P. bairdii*" described; and the shifting must have happened to the sender, inasmuch as the number corresponding to "*P. rectifrænum* in the accompanying list" is still tied, by a thread drawn through the tail, to one of the specimens; and two specimens of *Pomacentrus* only having been then sent, it is fair to assume that the other example was meant for *P. bairdii*.

But in the same paper the author goes a step further: *P. bairdii* is not only mentioned as distinct, but it becomes one of the types of a new genus, *Pomataprion*, distinguished from *Pomacentrus* by its *entire*[1] præoperculum. In our series of examples, varying in size from 10 lines to 4½ inches, I find that the youngest have the præoperculum entire, without exception, that in specimens 2½ inches long the præoperculum is as frequently entire as but very slightly denticulated, and that the serrature even in the oldest examples is fine and thin. Therefore I continue to regard those specific and generic distinctions of Mr. Gill as utterly valueless, and the names of *P. rectifrænum*, *P. flavilatus*, *P. analigutta*, and *P. bairdii* as referring to specimens of one and the same species.

The synonymy stands now thus:—

Gill, 1862.	*Pomacentrus rectifrænum*, Gill, *l. c.* p. 148. —— *flavilatus*, Gill, ibid. —— *bairdii*, Gill, *l. c.* p. 149. —— *analigutta*, Gill, in Günth. Fish. iv. p. 27.
Günther, 1862.	*Pomacentrus rectifrænum*, Günth. Fish. iv. p. 26. *Heliastes insolatus*, young (10 inches long), Günth. ibid. p. 61.
Gill, 1863.	*Pomacentrus rectifrænum*, Gill, *l. c.* p. 214. —— *flavilatus*, Gill, ibid. *Pomataprion bairdii*, Gill, *l. c.* p. 217.

137. HELIASTES MARGINATUS (Castelnau).

Chromis atrilobata (Gill) is, as already stated in Fish. iv. p. 64, identical with this species. Mr. Gill thinks that it ought to be kept distinct on account of a "sulphur spot behind the dorsal fin," Proc. Ac. Nat. Sc. Philad. 1863, p. 220. In two specimens

[1] "The præopercular serrature is *almost obsolete*," Gill, 1862, p. 149.

from Bahia, which I have examined, the larger is without any trace of such a spot; whilst the smaller one shows one, of about the size of the scale, on each side of the base of the last dorsal ray.

141. Cossyphus pectoralis (Gill).

This species occurs also in the Atlantic, as I have lately received fine examples from St. Helena. *Cossyphus pulchellus* (Poey) is perhaps identical with it.

143. Platyglossus dispilus. (Plate LXXIV. fig. 1.)

Günth. Proc. Zool. Soc. 1864, p. 25.

D. $\frac{9}{11}$. A. $\frac{2}{12}$. L. lat. 28. L. transv. 2/9.

The height of the body equals the length of the head, and is contained four times and one-fourth in the total. Caudal fin rounded, with the lobes very slightly produced. Greenish olive, with a roundish black spot edged with silvery on the lateral line, below the fifth and sixth dorsal spines; the side of the head with five or six pearl-coloured streaks, a part of which are continued on the body, forming a series of round spots. An oblong variegated blotch behind the pectoral fin: it is composed of three pearl-coloured stripes, enclosing two yellow bands, each of which has an undulated purple edge. No spot in the axil of the pectoral. A short oblique yellowish streak behind the base of each soft dorsal ray; these streaks form a continuous band on the spinous portion. Anal fin with two or three whitish lines; caudal with several irregular reddish longitudinal bands, which are convergent behind.

Young specimens are much more plain-coloured; the black spot on the lateral line, however, is very distinct, and there is another at the root of the caudal.

Capt. Dow's Panama collection contains a single young specimen; but Mr. Salvin has brought others, one, apparently adult, being $5\frac{1}{2}$ inches long.

144. Pseudojulis notospilus. (Plate LXVI. fig. 2.)

Günth. Proc. Zool. Soc. 1864, p. 26.

D. $\frac{9}{11}$. A. $\frac{3}{12}$. L. lat. 25. L. transv. $\frac{2\frac{1}{2}}{8}$.

The height of the body is rather less than the length of the head, and contained four times and a quarter in the total. Dorsal spines pungent; caudal fin slightly rounded. Brownish or yellowish olive; young specimens with a silvery band along each side of the trunk, above the pectoral fin. Back with four or five indistinct broad brown cross bars; a series of blotches on the dorsal fin corresponds to these cross bands, one of them, on the first three dorsal rays, being the largest and most distinct; it is of a deep black colour, and of an ovate form. The corners of the caudal fin are white; ventral whitish, with a broad blackish outer margin.

One adult specimen, 4 inches long, and several young ones were collected by Capt. Dow at Panama.

150. Gerres axillaris.

Günth. Proc. Zool. Soc. 1864, p. 102.

D. 9|10. A. 3/8. L. lat. 34. L. transv. 5/10.

Allied to *G. plumieri*, but with considerably shorter fin-spines. The height of the body is contained twice and a fourth in the total length (without caudal). Præorbital finely serrated. Snout as long as the eye; the groove for the intermaxillary processes is very broad, scaleless, extending backwards to the vertical from the centre of the eye. Dorsal fin notched, the last spine being not much longer than the eye; dorsal spines strong, the second as long as the head without snout; the second anal spine stronger, but scarcely longer than the second of the dorsal fin. The pectoral extends to the vertical from the third anal spine. Caudal deeply forked, with the lobes equal in length to each other and to the pectoral. A blackish streak along each series of scales; the hinder side of the axil, and sometimes the anterior, blackish.

Three specimens, from 8 to 9 inches long, were collected by Mr. Salvin at Chiapam.

151. Gerres brevimanus.

Günth. Proc. Zool. Soc. 1864, p. 152.

D. 9|10. A. 3/8. L. lat. 39. L. transv. 6/11.

Præorbital minutely serrated. The height of the body is contained twice and two-fifths in the total length (without caudal), the length of the head twice and a half. Snout as long as the eye; the groove for the intermaxillary processes is broad, scaleless, not extending backwards to the vertical from the centre of the eye. Dorsal fin notched, the last spine being longer than the eye; dorsal spines strong, the length of the second equals the distance between the end of the operculum and the anterior nostril; the second anal spine stronger, but much shorter, than the second of the dorsal fin. The scaly sheath of the anal fin leaves the outer half of the last ray uncovered. The pectoral extends scarcely to the vertical from the vent. Caudal scaly, deeply forked, with the lobes equal in length, each being one-fourth of the total. Three or four blackish streaks along the series of scales below the lateral line; the spinous dorsal fin black.

One specimen, 10 inches long, was found by Mr. Salvin at Chiapam.

155. Gerres dovii.

Diapterus dowii, Gill, Proc. Ac. Nat. Sc. Philad. 1863, p. 162.

This species is characterized thus:—

D. $\frac{9}{10}$. A. $\frac{3}{7}$. L. lat. 47. L. transv. 5/10.

The greatest height is contained thrice and a half in the extreme length; the head four times and a quarter; the diameter of the eye twice and three-fourths in the head; the snout equals four-fifths of the eye. The profile is rectilinear, and the interorbital space nearly flat, but convex above the eyes, and nearly as wide as the eye. The maxillary groove is linear, and extends backwards to a vertical midway between the front of the orbit and pupil, while the scales on each side extend to the vertical from the front of the orbits. The exposed surface of the supermaxillary bones is at first triangular, and thence oblong, the whole twice and a half as long as wide. The height of the constricted portion of the caudal peduncle equals two-thirds of its length and the diameter of the eye. The lateral line is scarcely bent behind. The second and third dorsal spines are slender, and nearly equal half the height of the body beneath; the last is little more than half as long as the first branched ray. The third anal spine is as long as the snout, and longer and more slender than the second. The colour is silvery; the spinous dorsal blackish at margin; the axilla of pectoral blackish.

Discovered by Capt. Dow on the Pacific coast of Central America.

156. Acara cæruleopunctata.

Kner & Steindachner, Sitzgsber. bayer. Akad. 1863, p. 222; and Abhandl. bayer. Akad. Wiss. x. p. 16, tab. 2. fig. 3.

D. $\frac{15}{10}$. A. $\frac{3}{8}$. L. lat. 27. L. transv. $2\frac{1}{2}/9$.

Three series of scales on the cheek. Præorbital scarcely wider than the orbit. The greatest breadth of the head is two-thirds of its length. Cleft of the mouth oblique. Body with four or five indistinct cross bands. A large black blotch on the middle of the sides, and traces of a second on the root of the caudal. Each scale on the side of the head and chest with a bluish spot.

Two specimens, 5 inches long, were collected by Mr. Salvin in the Rio Chagres.

Description.—The height of the body is contained twice and a half in the total length (without caudal), the length of the head rather more than thrice. Nape curved, the profile of the snout straight. Width of the interorbital space two-fifths of the length of the head, and more than that of the snout. Snout broad, moderately elevated, the width of the præorbital being scarcely more than the diameter of the eye. Cleft of the mouth slightly oblique, not reaching the vertical from the orbit. The fold of the lower lip is interrupted in the middle. Lower limb of præoperculum more than half the length of the posterior limb. There are only eight series of scales between the throat and the root of the ventral. Dorsal spines of moderate strength, gradually increasing in length posteriorly; the length of the ninth is more than one-third of that of the head. The middle of the soft dorsal and anal produced, and extending beyond the middle of the caudal, which is rounded. Pectoral as long as the head, reaching only to the origin of the anal. Ventral filament rather long. Colours as described above.

157. Heros parma (Gthr.).

This species varies considerably in coloration and in form of the body. The cross bands may be entirely absent, and replaced by a large diffuse black blotch on the end of the tail; the height of the body is contained from once and three-fifths to twice and one-fifth in the total length. Guatemalan specimens have generally the black caudal blotch, but they vary much in the depth of the body. The numbers of the fin-rays (D. $\frac{17}{12-13}$. A. $\frac{6}{9-10}$) appear to be very constant.

158. Heros margaritifer. (Plate LXXI. fig. 2.)

Günth. Fish. iv. p. 287.

D. $\frac{17}{11}$. A. $\frac{7}{9}$. L. lat. 31. L. transv. 5/13.

The fold of the lower lip is slightly interrupted in the middle; five or six series of scales on the cheek. The height of the body is rather less than one-half of the total length (without caudal). Brownish olive, with seven black cross bands, each band with pearl-coloured spots.

One specimen, 6½ inches long, was found by Mr. Salvin at Lake Peten.

159. Heros melanopogon.

Steindachner, Denkschr. Ak. Wiss. Wien, xxiii. p. 72, Taf. 1. fig. 3.

D. $\frac{16-17}{12}$. A. $\frac{6}{9}$. L. lat. 30. L. transv. 6½/13.

The fold of the lower lip is interrupted in the middle; five or six series of scales on the cheek. The height of the body is four-ninths of the total length (without caudal). Body with five irregular blackish cross bands interrupted in the middle, so as to represent two series of irregular blotches; a large blackish blotch on the root of the caudal fin. Small pearl-coloured spots surround the lower blotches, and are scattered over the caudal blotch.

Known from a specimen 4½ inches long.

This fish may represent merely the younger state of *H. margaritifer*; it is stated to be from Central America. It formed part of a collection made by Friedrichsthal, who, to judge from other specimens collected by him, appears to have visited Lake Peten, which is inhabited by *H. margaritifer*.

160. Heros melanurus. (Plate LXXII. fig. 3.)

Günth. Fish. iv. p. 288.

D. $\frac{17}{11}$. A. $\frac{6}{8}$. L. lat. 33. L. transv. 5/13.

The fold of the lower lip is subinterrupted in the middle[1]; five series of scales on the cheek. The height of the body is contained twice and a third or twice and a half in the total length (without caudal). A deep-black band along the middle of the tail; the lower parts black in adult specimens.

Several examples, from 3 to 10 inches long, were collected by Mr. Salvin at Lake Peten.

[1] The fold is distinctly interrupted in specimens from 6 to 10 inches long, whilst it appears to be slightly continuous in young individuals of 3 to 4 inches long.

161. Heros macracanthus.

Günth. Proc. Zool. Soc. 1864, p. 153.

D. $\frac{14-15}{12-13}$. A. $\frac{5}{9-10}$. L. lat. 31. L. transv. $\frac{5\frac{1}{2}}{15}$.

The lower lip is interrupted in the middle. The height of the body is two-thirds of the total length (without caudal) in adult specimens, but only one-half in immature; the length of the head is one-third of the total. Upper profile of the head very steep, not concave. Scales on the cheek in five series. The first dorsal spine is a little before the vertical from the upper end of the gill-opening. Dorsal and anal spines strong, the tenth of the dorsal fin being two-fifths of the length of the head. Pectoral as long as the head. Dark greenish, many scales with a pearl-coloured spot in the upper or lower angle. Vertical and ventral fins black.

About a dozen specimens, from 3 to 9 inches long, were collected by Mr. Salvin at Chiapam and Huamuchal.

Description.—The height of the body is two-thirds of the total length (without caudal), and nearly one-half of the entire length of the fish. The length of the head is one-third, or slightly more than one-third of the total (without caudal). Head rather higher than long, the nape convex, but the upper profile showing a slight concavity above the snout. The snout is of rather considerable extent, the height of the præorbital being one-half more than the width of the orbit. The cleft of the mouth is slightly oblique; the præorbital almost covering the posterior end of the maxillary, which does not attain the line of the front margin of the eye. Jaws rather protractile, armed with a broad band of villiform teeth, those of the outer series being enlarged. Interorbital space convex, nearly twice the width of the orbit. Eye somewhat nearer to the end of the operculum than to that of the snout. Base of soft dorsal and anal with a few small scales. Dorsal spines strong; the twelfth is a little less than one-half of the length of the head in adult specimens; the fifteenth is the longest, and more than half the length of the head. Soft dorsal and anal much elevated; the middle rays produced; caudal rounded. Pectoral rounded, about as long as the head. First ventral ray slightly prolonged. The free portion of the tail is nearly twice as deep as long. Greenish or brownish olive; fins black; a more or less distinct black spot on the root of the caudal fin, above the lateral line. Immature specimens with six very indistinct dark cross bands, the third of which has a blackish blotch below the lateral line; an indistinct blackish spot at the root of the caudal fin.

162. Heros spilurus. (Plate LXXIII. fig. 1.)

Günth. Fish. iv. p. 289.

D. $\frac{18}{10}$. A. $\frac{8-9}{7-8}$. L. lat. 29. L. transv. $\frac{4\frac{1}{2}}{11}$.

The fold of the lower lip is interrupted in the middle; four series of scales on the cheek. The height of the body is one-half of the total length (without caudal), the length of the head nearly one-third. Head a little higher than long; snout of moderate extent, its length being two-fifths of that of the head. The diameter of the eye is two-sevenths of the length of the head, two-thirds of that of the snout, and less than the width of the interorbital space, which is convex; the eye is situated below the upper profile, a little nearer to the extremity of the operculum than to that of the snout. Præorbital as wide as the orbit. Dorsal spines of moderate length and strength, the length of the twelfth being contained twice and a third in that of the head. The distance between dorsal and caudal is less than the depth of the tail. Greenish olive, with nine dark vertical bands; a large, roundish black spot on the middle of the root of the caudal; no spot on the temple; caudal and the posterior part of the dorsal and anal with whitish spots.

Three examples were collected by Messrs. Salvin and Godman at Yzabal and in the Rio Motagua. Length $3\frac{1}{2}$ inches.

163. Heros nigrofasciatus. (Plate LXXIV. fig. 3.)

D. $\frac{18}{8}$. A. $\frac{10}{7}$. L. lat. 29. L. transv. 4/11.

The lower lip is interrupted in the middle. Scales on the cheek in four or five series. Dark blackish brown, with nine deep-black cross bands.

Numerous examples, from 2 to $3\frac{1}{2}$ inches long, were collected by Mr. Salvin in the Lakes of Amatitlan and Atitlan.

Description.—The height of the body is contained twice and one-sixth in the total length (without caudal), the length of the head thrice; the free portion of the tail is considerably deeper than long. Head as high as long, with the upper profile convex to the snout, where it is straight. Snout of moderate extent, the width of the præorbital being equal to that of the orbit. The eye is somewhat nearer to the end of the snout than to that of the operculum; its diameter is considerably less than the width of the interorbital space, and one-fourth of the length of the head. Jaws equal in length. The soft dorsal and anal fins have scarcely any scales on their base, and are more or less produced in the middle, the longest rays reaching to the middle of the caudal. The dorsal fin commences in the vertical from the humerus; its spines are of moderate strength, rather short, the length of the twelfth being somewhat less than one-third of that of the head. Anal spines as long as, but rather stronger than those of the dorsal fin. Caudal rounded, two-ninths of the total length. Pectoral as long as the head, without snout, extending to the second or third anal spine. Ventral but slightly produced.

This species is very dark-coloured. The ground-colour is a dark blackish purplish brown. An arched black band runs from the nape of the neck round the opercular margin to the interoperculum. A second is nearly concentric with the first, running from the nape to behind the pectoral and ventral. The third is short, like a spot, between the anterior dorsal spines and the lateral line. The following are subvertical, slightly inclined backwards, and broader than the interspaces between them. The penultimate connects the ends of the dorsal and anal fins; the last across the root of the caudal. Fins black.

This species appears to remain within small dimensions.

164. Heros multispinosus. (Plate LXXIV. fig. 2.)

D. $\frac{18}{9}$. A. $\frac{11}{7}$. L. lat. 29. L. transv. 4/12.

The lower lip is interrupted in the middle. Three series of scales on the cheek. A blackish band, interrupted on the tail, runs from the eye to the caudal; a round black spot in the middle of the length of the band.

A single specimen, $3\frac{1}{2}$ inches long, was obtained by Capt. Dow in the Lake of Managua.

Description.—The height of the body is contained twice and one-seventh in the total length (without caudal), the length of the head thrice. The free portion of the tail is twice as deep as long. Head as deep as long, with the upper profile nearly straight. Snout rather short; the width of the præorbital being considerably less than that of the orbit. The eye is situated immediately below the upper profile, nearer to the end of the snout than to that of the operculum; its diameter is a little less than one-third of the length of the head, and much less than the width of the interorbital space, which is flat. Mouth with the jaws equal in length, small, the maxillary not nearly reaching the vertical from the orbit. Suboperculum with two series of scales. The soft dorsal and anal fins are scaly at the base, they are scarcely prolonged, and not extending to the middle of the caudal. The dorsal fin commences above the humerus; its spines are of moderate strength, and rather long, the length of the eighth to the last spine being not much less than one-half of that of the head. Anal spines stronger, and even a little longer than those of the dorsal. Caudal fin rounded, two-ninths of the total length. Pectoral shorter than the head, extending to the fifth anal spine. The outer ventral ray produced into a short filament. Brownish olive, each scale somewhat darker at the base. A blackish band, as broad as a scale, runs from the eye to a round black spot situated before and below the termination of the upper part of the lateral line; thence it is continued to the root of the caudal as a series of four or five irregular spots. Fins blackish, apparently immaculate.

165. Heros longimanus. (Plate LXXII. fig. 2.)

D. $\frac{16}{10}$. A. $\frac{6}{8}$. L. lat. 28. L. transv. $4\frac{1}{2}$/12.

The fold of the lower lip is interrupted in the middle. Three or four series of scales on the cheek. Pectoral very long, extending nearly to the end of the anal. Greenish olive, with an indistinct blackish band running from the orbit to a large black spot on the middle of the side. Dorsal fin with numerous round whitish spots.

One specimen, $5\frac{1}{2}$ inches long, was found by Capt. Dow in the Lake of Nicaragua.

Description.—The height of the body is contained twice and one-sixth in the total length (without caudal), the length of the head twice and three-fifths. Upper profile of head straight. Head rather longer than high; cleft of the mouth slightly oblique, with the lower jaw rather prominent. Jaws moderately protractile; the maxillary does not extend to the vertical from the front margin of the eye. Præorbital as wide as the diameter of the eye, which is somewhat less than the width of the interorbital space, and more than one-fourth of the length of the head. The eye is situated immediately beneath the upper profile of the head, and a little nearer to the end of the operculum than to that of the snout. Scales on the cheek in three or four series; scales on the opercles large. The dorsal commences vertically above the scapula; the spinous portion has its upper margin convex; the spines are slender and long, the fifth and sixth being the longest, one-half of the length of the head. The soft dorsal and anal have the middle rays somewhat longer than the others, and reaching to about the middle of the caudal; the soft anal is slightly scaly at the base, the soft dorsal scarcely or not at all scaly. Anal spines shorter but somewhat stronger than those of the dorsal. Caudal slightly emarginate. Pectoral very long, slightly longer than the head, and extending nearly to the end of the anal. Ventral with the outer ray produced into a filament. The distance between the vent and the root of the ventrals is equal to one-third of the length of the head. Teeth in the jaws small, cardiform, forming a band, those of the outer series being somewhat larger than the others.

This species is similar to the Mexican *H. helleri*, but has a considerably longer pectoral fin, and also less anal rays.

166. Heros urophthalmus. (Plate LXXII. fig. 1.)

Günth. Fish. iv. p. 291.

D. $\frac{17}{11}$. A. $\frac{6}{9}$. L. lat. 28. L. transv. 5/12.

The fold of the lower lip is continuous in the middle. Scales on the cheek in six series. The height of the body is contained twice and a half or twice and a quarter in the total length (without caudal), the length of the head nearly three times. Head as high as long; snout rather elevated, with the cleft of the mouth oblique and with the lower jaw prominent. Præorbital as wide as the orbit; interorbital space flat, wider than the orbit. The eye is nearer to the extremity of the snout than to that of the operculum. Dorsal spines of moderate length and strength, the length of the twelfth being two-fifths of that of the head. The free portion of the tail is higher than long. Anal spines strong and long. The distance between the vent and the root of the ventral is three-fifths of the length of the head. Brownish- or greenish-olive, with seven blackish cross bands, as broad as the interspaces between: the first descending obliquely backwards across the nape; the second, third, and fourth below the dorsal spines; the seventh across the free portion of the tail. A large, black, white-edged ocellus on the root of the caudal. Fins blackish; pectoral yellowish towards the base.

Mr. Salvin obtained three examples, 7 inches long, at Lake Peten.

167. Heros aureus. (Plate LXXIII. fig. 2.)

Günth. Fish. iv. p. 292.

D. $\frac{16}{9-10}$. A. $\frac{7}{8}$. L. lat. 33. L. transv. 6/13.

The fold of the lower lip is continuous in the middle. Scales on the cheek in five series. Base of the dorsal scaleless. The height of the body is contained twice and a third in the total length (without caudal), the length of the head three times. Head as high as long; snout somewhat elevated, with the cleft of the mouth oblique and with the jaws equal anteriorly; præorbital as wide as the orbit. The eye is a little nearer to the extremity of the operculum than to that of the snout. Dorsal spines rather slender, the length of the twelfth being a little less than one-half of that of the head. The distance between the dorsal and caudal is somewhat less than the greatest depth of the free portion of the tail. Caudal slightly emarginate. The distance between the vent and the root of the ventral is one-third of the length of the head. Yellowish-olive, with six dark cross bands, extending downwards to a yellow longitudinal band running from above the pectoral to the lower half of the base of the caudal. The third cross band terminates in a large black lateral spot; sides of the head with several bluish dots, and with a blackish spot on the operculum and suboperculum, darkest on the latter bone. Fins light-coloured, immaculate.

Two specimens, 4 and 5 inches long, were collected by Messrs. Salvin and Godman at Yzabal and in the Rio Motagua.

168. Heros affinis. (Plate LXXIX. fig. 1.)

Günth. Fish. iv. p. 292.

D. $\frac{16}{8-9}$. A. $\frac{8-9}{8-7}$. L. lat. 29. L. transv. 5/12.

The fold of the lower lip is continuous in the middle. Scales on the cheek in four series. The height of the body is contained twice and two-fifths in the total length (without caudal), the length of the head twice and three-fourths. Head as high as long; snout compressed, elevated, with the cleft of the mouth oblique and with the lower jaw prominent. Præorbital wider than the orbit (in the larger individuals); the eye is considerably nearer to the extremity of the operculum than to that of the snout. Dorsal and anal fins entirely scaleless; dorsal spines rather strong and long, the length of the twelfth being two-fifths of that of the head. Anal spines very strong. The free portion of the tail is a little higher than long. Caudal slightly emarginate, two-ninths of the total length. The distance between the vent and the root of the ventral is one-third of the length of the head. Olive, with five or six dark cross bands, the middle one of which has a deep-black spot where it passes the lateral line; a more or less distinct black spot on the suboperculum; sides of the head and vertical fins with bluish dark-edged ocelli.

This species is very closely allied to *H. aureus*, but may be distinguished from it by larger scales, by a more backward position of the eyes, by stronger spines, &c.

Four examples, from $3\frac{1}{2}$ to $5\frac{1}{2}$ inches long, were obtained by Mr. Salvin at Lake Peten.

169. Heros labiatus.

Günth. Proc. Zool. Soc. 1864, p. 27, pl. 4. fig. 1.

D. $\frac{17}{11}$. A. $\frac{7-8}{8}$. L. lat. 32. L. transv. 6/13.

The anterior portions of the upper and lower lips are much enlarged, each forming a moveable subtriangular flap (probably in old males only). The height of the body is somewhat more than the length of the head, and two-fifths of the total (without caudal); the eye occupies the middle of the length of the head. Scales on the cheek in four series. Base of the dorsal fin almost scaleless. *The length of the eighth dorsal spine is less than one-third of that of the head. The depth of the free portion of the tail is scarcely more than its length.* Uniform red, or red irregularly marbled with black, or nearly entirely black.

Two specimens, $6\frac{1}{2}$ and 7 inches long, were collected by Capt. Dow in the Lake of Managua; three others were lately sent by the same gentleman from the Lake of Nicaragua. We do not yet know the female sex and the young state of this species.

Description.—Head rather longer than high; snout somewhat elevated; cleft of the mouth slightly oblique, with the lower jaw a little prominent. Teeth in narrow bands, those of the outer series enlarged, with brown tips. The maxillary does not nearly attain the vertical from the front of the eye. Præorbital as wide as the orbit, the diameter of which is less than the extent of the snout, and one-fourth of the length of the head. Interorbital space somewhat convex, wider than the orbit. The eye is situated not quite immediately beneath the upper profile of the head, and midway between the end of the snout and that of the operculum. Opercles scaly, the scales being larger than those on the cheek; suboperculum with two series of scales. Soft portions of dorsal and anal fins with minute scales between the rays at their base. Dorsal spines of moderate length and strength, the length of the eighth dorsal spine being less than one-third of the length of the head. Points of the produced middle rays of the soft dorsal and anal reaching to the middle of the caudal fin. Caudal rounded, its length being contained rather more than five times in the total. Anal spines of nearly the same length and strength as those of the dorsal fin. Pectoral rounded, reaching to the fourth or fifth spine of the anal; ventral filament produced.

The distance between the vent and the root of the ventral is less than one-half of the length of the head.

170. Heros erythræus. (Plate LXXV. fig. 2.)

D. $\frac{17}{12}$. A. $\frac{7}{8}$. L. lat. 31. L. transv. $6\frac{1}{2}$/14.

Lips thick, with broad free margin in their entire circumference. The height of the body is contained twice and a third in the total length (without caudal), the length of the head twice and two-thirds; the eyes occupy the middle of the length of the head. Scales on the cheek in four or five series. Base of the soft dorsal fin with very small scales. *The length of the eighth dorsal spine is less than one-third of that of the head. The depth of the free portion of the tail is conspicuously more than its length.* Of a deep orange-colour; many of the scales of the tail with a blackish spot on the base.

One specimen, 7 inches long, was collected by Capt. Dow in the Lake of Managua.

I was for some time inclined to regard this fish as a variety of sex or age of *H. labiatus.* This, however, is not the case, all the specimens being males, and the specimen of *H. erythræus* larger than one of the two of *H. labiatus.* Besides, it appears to be sufficiently distinguished by its much shorter and deeper tail.

Description.—Head as high as long; snout rather elevated, with the cleft of the mouth slightly oblique, and the lower jaw scarcely prominent. Teeth in narrow bands, those of the outer series enlarged, with brown tips. The maxillary does not reach the vertical from the front margin of the eye; præorbital wider than the orbit. The diameter of the eye is contained nearly five times in the length of the head. Interorbital space slightly convex, much wider than the orbit. Eye situated near the upper profile of the head, and equidistant from the end of the snout and that of the operculum. Opercles scaly, the scales being larger than those on the cheek; suboperculum with two series of scales. The soft dorsal and anal fins with a few minute scales running up between the bases of the rays; dorsal spines of moderate strength. Soft dorsal and anal slightly produced, not reaching to the middle of the caudal. Caudal rounded, one-fifth of the total length. Anal spines stronger but not longer than those of the dorsal fin. Pectoral rounded, extending to the fourth anal spine, somewhat shorter than the head. The outer ventral ray produced; the distance between the ventral and the vent is one-half of the length of the head.

171. Heros lobochilus. (Plate LXXV. fig. 1.)

D. $\frac{17}{11-12}$. A. $\frac{7}{8-9}$. L. lat. 32. L. transv. 6/14.

Old males with the anterior portions of the upper and lower lips much enlarged, each forming a moveable subtriangular flap; in young males the lips are simple, the fold of the lower being continuous. The height of the body is contained twice and a third in the total length (without caudal), the length of the head twice and three-fourths. The eye occupies the middle or nearly the middle of the length of the head. Scales on the cheek in four or five series. Base of the dorsal fin scaly. *The length of the eighth dorsal spine is more than one-third of that of the head. The depth of the free portion of the tail is scarcely more than its length.* Greenish or yellowish, with about six indistinct dark cross bands; that below the fourteenth dorsal spine with a large black blotch below the lateral line; sometimes a black spot on the upper half of the base of the caudal.

Two male specimens were collected by Capt. Dow in the Lake of Managua; the larger, 8 inches long, has the labial lobes and black caudal spot; the smaller is 7 inches long, and, without doubt, of the same species. The female sex is unknown.

Description.—Head as high as long; snout rather elevated, with the cleft of the mouth oblique, and the lower jaw rather prominent. Upper profile very concave. Teeth in narrow bands, those of the outer series enlarged, with brown tips. The maxillary does not reach nearly to the vertical from the front of the orbit; præorbital as wide as the orbit, being contained very slightly more than four times in the length of the head. Interorbital space flat, much wider than the orbit. The eye is situated immediately below the upper profile, slightly nearer to the extremity of the snout than to that of the operculum. Opercles scaly, the scales being larger than those on the cheeks; suboperculum with one series of scales. The soft portions of the anal and dorsal fins with a series of small scales between the rays at their base. Dorsal spines of moderate strength, the length of the eighth to twelfth being more than one-third of that of the head. Points of the soft anal and dorsal reaching to the middle of the caudal. The free portion of the tail is scarcely higher than long. Caudal rounded, its length being one-fifth of the total. Anal spines strong and long. Pectoral rounded, reaching to the fourth anal spine; outer ventral ray produced. The distance between the vent and the root of the ventral is three-sevenths of the length of the head. Coloration as described above.

172. HEROS CITRINELLUS. (Plate LXXI. fig. 1.)

Günth. Proc. Zool. Soc. 1864, p. 153.

D. $\frac{16-17}{12}$. A. $\frac{7}{8-9}$. L. lat. 30. L. transv. 6/13.

The fold of the lower lip is continuous in the middle. The height of the body is contained twice and a fifth in the total length (without caudal), the length of the head twice and seven-eighths; the free portion of the tail is conspicuously deeper than long; nape of the neck very convex; interorbital space broad, its width being two-fifths of the length of the head. Snout not obtuse; scales on the cheek in four series. The first dorsal spine is inserted above the upper end of the gill-opening. Dorsal and anal spines slender, the eighth or tenth of the dorsal fin being two-fifths of the length of the head. Pectoral nearly as long as the head. Lemon-coloured, either nearly uniform or with the back black, which colour sometimes forms irregular blotches on the vertical fins.

Three specimens, two males and one female, from 7 to 8 inches long, were collected by Capt. Dow in the Lake of Nicaragua.

Description.—Head as high as long; snout rather elevated, the cleft of the mouth almost horizontal, the lower jaw scarcely prominent. Teeth in narrow bands, those of the outer series enlarged, with brown tips. The maxillary does not reach the vertical from the front margin of the eye. Præorbital wider than the orbit. The eye is situated close to the upper profile, and a little nearer to the end of the snout than to the opercular margin; its diameter is one-fourth of the length of the head. Interorbital space flattish, twice the width of the orbit. Opercles scaly, the scales being larger than those on the cheeks; suboperculum with two series of scales. Soft anal and dorsal fins slightly scaly at the base. The points of the soft dorsal and anal considerably produced, and extending beyond the middle of the caudal fin, sometimes to its extremity. Caudal rounded, its length being contained four times and a half in the total. Pectoral long and rounded, extending to the fifth anal spine. Outer ventral ray produced. The distance between the vent and the root of the ventral is nearly one-third of the length of the head.

173. Heros altifrons.

Kner & Steindachner, Sitzgsber. bayer. Akad. 1863, p. 223; and Abhandl. bayer. Akad. x. p. 11, Taf. 2. fig. 1.

$$D. \frac{16}{11}. \quad A. \frac{5}{8-9}.$$

The lower lip is dilated into a lobe on each side, which is broadest behind. Scales on the cheek in four or five series. The height of the body is contained twice and two-fifths in the total length (without caudal), the length of the head twice and four-fifths. Snout rather high, the width of the præorbital being more than that of the orbit. Jaws equal in length. Eye considerably nearer to the end of the operculum than to that of the snout. Dorsal spines of moderate length and strength. Body with four or five dark vertical bands[1], each band with a darker blotch. Scattered pearl-coloured dots all over the body; a dark spot on the middle of the root of the caudal fin.

Southern (Pacific) rivers of the district Chiriqui (Western Veragua).

174. Heros friedrichsthalii.

Heckel, Flussfische Brasil. p. 381. Günth. Fish. iv. p. 294.

$$D. \frac{18}{9-10}. \quad A. \frac{8-9}{9-7}. \quad L. lat. 31. \quad L. transv. 4/12.$$

The fold of the lower lip continuous in the middle. Scales on the cheek in seven series. Antero-inferior margin of præorbital concave, the greatest width of this bone

[1] The authors describe them as "*tæniæ*," instead of "*fasciæ*."

being only two-thirds of that of the orbit. The length of the twelfth dorsal spine is two-sevenths of that of the head. Yellowish-olive, with six or seven blackish cross bands; a black band from the eye to the upper part of the root of the caudal, interrupted by the interspaces between the cross bands; the origin and end of this band are edged with yellow; suboperculum with a black ocellus; an oblique black streak from the eye towards the ocellus.

Lake Peten. Several examples, 5 inches long, were collected by Mr. Salvin.

175. Heros salvini. (Plate LXXIII. fig. 3.)

Heros salvini, Günth. Fish. iv. p. 294.

—— *triagramma*, Steindachner, Denkschr. Akad. Wiss. Wien, xxiii. p. 70, tab. 3. fig. 2.

D. $\frac{17}{10}$. A. $\frac{8-9}{7}$. L. lat. 29. L. transv. 5/10.

Fold of the lower lip continuous in the middle; scales of the cheek in five series. Præorbital a little narrower than the orbit, with the antero-inferior margin concave. Base of the soft dorsal scaly. The height of the body is contained twice and a fourth in the total length (without caudal), and the length of the head twice and three-fourths. Head somewhat longer than high; snout of moderate extent, longer than the eye, pointed, with the cleft of the mouth very oblique, and with the lower jaw projecting; the maxillary does not quite extend to the vertical from the anterior margin of the orbit. The eye is situated immediately below the upper profile, in the middle of the length of the head. Suboperculum of moderate width, with one series of scales. The length of the twelfth dorsal spine is two-fifths of that of the head in specimens from Lake Peten, and one-third in those from Santa Isabel. The distance between dorsal and caudal is considerably less than the depth of the free portion of the tail. The distance between the vent and the root of the ventrals is two-fifths of the length of the head. Dark greenish olive, with a black band, edged with yellow, running from the snout, through the eye, to the root of the caudal; it is most distinct on the head, but interrupted on the tail by lighter interspaces; it passes a black lateral spot, and, in young specimens, terminates in another black spot. An irregular black band along the back, below the base of the dorsal fin. Sometimes three bands across the upper surface of the head. A blue horizontal line below the orbit; a more or less distinct black ocellus on the suboperculum is sometimes entirely absent. Fins blackish, immaculate, or with faint dots only in small number. The sides below the black band are sanguineous in mature specimens.

The largest specimen is 4½ inches long.

This species occurs in Lake Peten as well as in the Rio Santa Isabel; specimens from the former locality are distinguished by somewhat longer dorsal spines. *H. triagramma* appears to have been founded on a Lake-Peten example.

176. Heros trimaculatus. (Plate LXXVI.)

D. $\frac{17}{11}$. A. $\frac{6-8}{9}$. L. lat. 31. L. transv. 5/14.

Allied to *H. salvini*. Fold of the lower lip continuous in the middle; scales of the cheek in five series. Lower jaw prominent. Præorbital as wide as the orbit, with the antero-inferior margin concave. The length of the twelfth dorsal spine is rather less than one-third of that of the head. Dark greenish olive, with three black spots; the first above the origin of the lateral line, the second in the middle of the side, and the third above the end of the lateral line. Fins black.

Three adult examples, from 8 to 11 inches long, and one of $2\frac{1}{2}$ inches, were collected by Mr. Salvin at Chiapam and Huamuchal.

Description.—The height of the body is contained twice in the total length (without caudal), the length of the head twice and two-thirds. Head nearly as high as long; snout rather pointed, much longer than the eye, with the cleft of the mouth very oblique, and the lower jaw prominent; the maxillary extends nearly to the vertical from the front margin of the orbit. Præorbital as wide as the orbit, with the antero-inferior margin concave. The width of the orbit is one-fifth of the length of the head, but only two-thirds of that of the interorbital space. The eye is situated immediately below the concavity of the upper profile of the head, and is very slightly nearer to the tip of the snout than to the opercular margin. Opercles scaly; suboperculum with two series of scales. The vertical fins are scaly at the base. Dorsal spines of moderate strength and length, the twelfth being rather less than one-third of the length of the head. The points of the soft dorsal and anal extend beyond the middle of the caudal. Caudal much rounded. The distance between the caudal and the dorsal is considerably less than the depth of the free portion of the tail. Pectoral much shorter than the head, extending only to the second anal spine; ventrals with the outer ray produced. The distance between the vent and the root of the ventrals is nearly half the length of the head. The coloration of the young example is exactly the same as that of the adult.

177. Heros dovii. (Plate LXXIII. fig. 4.)

Günth. Proc. Zool. Soc. 1864, p. 154.

D. $\frac{18}{11-12}$. A. $\frac{6}{9-10}$. L. lat. 35. L. transv. $\frac{5\frac{1}{2}}{13}$.

The fold of the lower lip is continuous in the middle. The height of the body is contained thrice in the total length (without caudal); the length of the head twice and three-fifths. Snout pointed, with the lower jaw very prominent. Præorbital with the antero-inferior margin but slightly concave, its greatest width being three-fourths of that of the orbit. Both jaws with a pair of fangs, those of the upper pair being close together in the middle of the jaw, whilst the lower are separate. Scales on the cheek small, rather irregularly arranged, in about eight series. The first dorsal spine is inserted behind the vertical from the upper end of the gill-opening. Dorsal and anal spines slender, the length of the twelfth of the dorsal fin being one-fourth of that of the head. Pectoral three-fifths as long as the head. Brown, irregularly marbled with darker; fins black; an indistinct black band along the operculum and the side of the trunk; an oblique blackish band descends from the eye towards the root of the pectoral; a black spot behind the angle of the mouth.

This species is allied to *H. friedrichsthalii*, *H. salvini*, &c. Two specimens, 6 inches long, were collected by Capt. Dow in the Lake of Nicaragua.

Description.—Head much longer than high. Snout rather elongate, much longer than the eye, pointed, with the cleft of the mouth oblique, and the lower jaw very prominent. The maxillary reaches the vertical from the anterior margin of the orbit. The width of the orbit is contained four times and a half in the length of the head, and equal to that of the interorbital space. The eye is situated immediately below the upper profile, but is considerably nearer to the end of the snout than to that of the operculum. Opercles scaly, the scales on the operculum larger than those on the cheek; suboperculum with two series of scales. The soft portions of the dorsal and anal fins are scaly at the base, and do not reach much beyond the origin of the caudal. Caudal rounded. The pectoral is about two-thirds as long as the head, and scarcely reaches the vertical from the origin of the anal. Ventral pointed, slightly produced, reaching only to the vent. The distance between the vent and the root of the ventral is two-fifths of the length of the head.

178. Heros motaguensis. (Plate LXXVII. fig. 2.)

D. $\frac{18}{10}$. A. $\frac{7}{8-9}$. L. lat. 32. L. transv. 5/13.

The fold of the lower lip is continuous in the middle. Snout pointed, with the lower jaw prominent. Præorbital with the antero-inferior margin but slightly concave, its greatest width being equal to that of the orbit. Dentition as in *H. dovii*. Scales on the cheek small, in eight series. The first dorsal spine is inserted behind the vertical from the upper end of the gill-opening. Dorsal and anal spines short, the length of the twelfth of the dorsal fin being two-ninths of that of the head. Brownish, a black interrupted band runs from the eye to a spot on the root of the caudal, this spot being situated above the lateral line. An oblique short black streak runs from the lower posterior angle of the orbit towards a spot situated on the suture between operculum and suboperculum, close to the interoperculum, the band being not continuous with the spot. Back with traces of irregular cross bands, more distinct in young than in old individuals. Vertical fins with numerous brown dots.

Five examples, from 4 to 10 inches long, were obtained by Mr. Godman from the Rio Motagua. This species is closely allied to *H. friedrichsthalii*.

Description of an example 10 inches long.—The height of the body is nearly equal to the length of the head, and is contained thrice in the total length (without caudal); the length of the head is contained twice and five-sixths in the same. Head longer than high; snout of moderate extent, much longer than the eye, pointed, with the cleft of the mouth very oblique, and the lower jaw very prominent. The maxillary reaches nearly to the vertical from the anterior margin of the orbit. The width of the orbit is not quite one-fifth of the length of the head, and less than the width of the interorbital space. The eye is situated near the upper profile of the head, nearer to the end of the snout than to that of the operculum. Opercles scaly; suboperculum with two series of scales. Vertical fins scaly at the base, their points do not reach the middle of the caudal. Caudal rounded. The distance between the dorsal and caudal is somewhat less than the depth of the free portion of the tail. Pectoral short, less than two-thirds of the length of the head, and scarcely reaching to the vent; ventral short, pointed, with the outer ray produced. The distance between the vent and the root of the ventral is more than half the length of the head.

179. Heros managuensis. (Plate LXXVII. fig. 3.)

D. $\frac{18}{10}$. A. $\frac{7}{8}$. L. lat. 32. L. transv. $4\frac{1}{2}/13$.

The fold of the lower lip is continuous in the middle. Snout somewhat pointed, with lower jaw prominent. *Præorbital* with the antero-inferior margin concave, *narrow, its greatest width being scarcely more than one-half of that of the orbit.* Dentition as in *H. dovii.* Scales on the cheek small, rather irregularly arranged, in eight or nine series. The first dorsal spine is inserted behind the vertical from the upper end of the gill-opening. Dorsal and anal spines of moderate length and strength, *the length of the twelfth of the dorsal fin being contained thrice and two-thirds in that of the head.* Greenish brown, shining golden, and irregularly marbled with dark brown. A series of quadrangular black spots (probably a band in young examples) runs from the eye to a black spot on the root of the caudal, this spot being situated above the lateral line; a brown band descends obliquely from the lower posterior angle of the orbit to the lower posterior angle of the operculum. Vertical fins with black spots, each spot being half as large as a scale.

This species is allied to *H. friedrichsthalii, salvini,* &c.; a single specimen, $7\frac{1}{2}$ inches long, was found by Capt. Dow in the Lake of Managua.

Description.—The height of the body is nearly equal to the length of the head, and two-fifths of the total length (without caudal). Head longer than high; snout of moderate length, somewhat pointed, with the lower jaw prominent, and the cleft of the mouth oblique. The maxillary reaches beyond the anterior margin of the eye. The width of the orbit is one-fifth of the length of the head, and three-fourths of the width of the interorbital space. The eye is situated immediately below the upper profile; its distance from the end of the snout is a little more than half of that from the hinder margin of the operculum. Opercles scaly, the scales on the operculum larger than those on the cheek; suboperculum with two series of scales. Vertical fins slightly scaly at the base. The soft dorsal and anal do not reach to the middle of the caudal. Caudal rounded. The distance between the dorsal and caudal is much less than the depth of the free portion of the tail. Pectoral short, more than half the length of the head, and extending only to the origin of the anal; ventral with the outer ray slightly produced, reaching beyond the vent. The distance between the vent and the root of the ventral is not quite half the length of the head.

180. Heros microphthalmus.

Günth. Fish. iv. p. 295.

D. $\frac{18}{13}$. A. $\frac{5-6}{10-9}$. L. lat. 34. L. transv. 5/14.

The fold of the lower lip is continuous in the middle; six series of scales on the cheek. The height of the body is contained twice and a third in the total length (without caudal), the length of the head thrice and a third. Head as high as long; snout of moderate extent; præorbital wider than the eye. Cleft of the mouth rather narrow, horizontal, with the jaws equal anteriorly. Interorbital space very convex, twice as broad as the orbit; the eye is a little nearer to the extremity of the snout than to that of the opercle. Vertical fins scaly at the base; the spinous dorsal is low, the length of the twelfth spine being one-third or rather less than one-third of that of the head. The free portion of the tail is rather higher than long. Pectoral much shorter than the head, equal in length to the ventral, which does not extend on to the vent. Brownish, with indistinct dark cross bands, and with a dark band along the sides and tail, terminating at a black spot in the middle of the root of the caudal. Each scale on the lateral and lower parts with a purple spot at the base. The soft portions of the vertical fins with series of blackish dots; axil of the pectoral orange-coloured.

Numerous examples, from 4 to 8 inches long, were collected by Mr. Godman in the Rio Motagua.

181. Heros oblongus.

D. $\frac{18}{12-13}$. A. $\frac{6}{8-9}$. L. lat. 33. L. transv. 5½/15.

Closely allied to *H. microphthalmus*, but with the body considerably more elongate.

The fold of the lower lip is continuous in the middle; five series of scales on the cheek. The height of the body is one-third of the total length (without caudal), the length of the head two-sevenths. Mouth small, horizontal, with the jaws equal in length. The length of the twelfth dorsal spine is less than one-third of that of the head. Coloration as in *H. microphthalmus*.

Two examples, 7 and 8 inches long, were obtained by Mr. Godman from the Rio Motagua.

Description.—Head a little longer than high; snout of moderate extent; præorbital wider than the eye, the diameter of which is one-fifth of the length of the head. Cleft of the mouth rather narrow, horizontal, with the jaws equal anteriorly, and the maxillary not extending backwards to the vertical from the front margin of the eye. Teeth in a band, those of the outer series much larger and stronger than the others, and with brown tips. Interorbital space convex, not quite twice as broad as the orbit. Eye about equidistant from the end of the snout and that of the opercle. Vertical fins scaly at the base. The spinous dorsal is rather low, the length of the twelfth spine being less than one-third of that of the head. Soft dorsal and anal somewhat produced, the former reaching to the middle of the caudal. The free portion of the tail is rather longer than high. Caudal subtruncated, its length being a little less than one-fifth of the total. Pectoral shorter than the head, about equal in length to the ventral, the outer ray of which reaches to the vent. Brownish, with about five very indistinct broad darker cross bands, descending from the back to a not less indistinct longitudinal band which runs from above the pectoral to a black spot in the middle of the root of the ventral. Vertical fins with transverse series of round whitish spots, separated by a network of dark lines. Pectoral yellowish.

182. Heros nicaraguensis. (Plate LXXVII. fig. 1.)

Günth. Proc. Zool. Soc. 1864, p. 153.

D. $\frac{18-19}{11}$. A. $\frac{7}{8-9}$. L. lat. 35. L. transv. 5/13.

The fold of lower lip is interrupted in the middle. The height of the body is contained twice and two-fifths in the total length (without caudal); the length of the head thrice and one-fifth. Head much higher than long, in consequence of an adipose swelling above the eye, which renders the shape of the head Coryphæna-like. Scales on the cheek in six series, rather irregularly arranged. The first dorsal spine is inserted above the upper end of the gill-opening. Dorsal and anal spines long, the sixteenth of the dorsal fin being one-half the length of the head. Pectoral not quite as long as the head. Brownish olive above, yellowish below; back with five or six blackish cross bands, not extending downwards to beyond the middle of the side; many scales with a brown vertical marginal streak. The soft vertical fins with brown spots, each half as large as a scale.

Two specimens, 6½ and 7 inches long, were collected by Capt. Dow in the Lake of Nicaragua.

Description.—Snout elevated; præorbital wider than the orbit, the diameter of which is more than one-fourth of the length of the head. Cleft of the mouth rather narrow, horizontal, the jaws equal in front, and the maxillary not extending back to the vertical from the front of the orbit. Teeth in a band, those of the outer series being somewhat enlarged, and with brown tips. Interorbital space very convex, not quite twice as broad as the orbit. The eye is about equally distant from the end of the snout and that of the opercle, and far below the upper profile of the head. Vertical fins scaly at the base. Spinous dorsal not very low, the sixteenth spine being half as long as the head;

the soft portions of the dorsal and anal slightly produced, the former extending nearly to the middle of the caudal. Free portion of the tail as high as long. Caudal slightly emarginate, its length being considerably more than one-fifth of the total. The ventral has the outer ray much produced, and reaches to the sixth anal spine.

183. Heros godmanni. (Plate LXXIV. fig. 5.)

Günth. Fish. iv. p. 296.

D. $\frac{16-17}{13-12}$. A. $\frac{5}{9}$. L. lat. 33. L. transv. 5/13.

The fold of the lower lip is interrupted in the middle; six or seven series of scales on the cheek. The height of the body is contained twice and three-fourths in the total length (without caudal), the length of the head thrice or thrice and a third. The profile of the nape is much curved. Head rather longer than high; snout rather elevated, the præorbital being wider than the orbit. Cleft of the mouth rather narrow, horizontal, with the jaws equal anteriorly, and with the maxillary not extending backwards to the vertical from the front margin of the eye. The nape is elevated, and the orbit considerably below the upper profile of the head. Dorsal and anal fins very slightly scaly at the base; the spinous dorsal is low, the length of the twelfth spine being one-fourth of that of the head. The free portion of the tail is a little longer than high. Head greyish olive; cheeks and body reddish olive; an irregular blackish band proceeds from above the pectoral to a black spot in the middle of the root of the caudal. A black spot above the origin of the lateral band. Opercles, back, and vertical fins with black dots.

Two specimens, 7 inches long, were collected by Mr. Salvin in the River of Cahabon.

184. Heros sieboldii.

Kner & Steindachner, Abhandl. bayer. Ak. Wiss. x. (1864) p. 13, Taf. 2. fig. 2.

This fish is probably not sufficiently distinct from *H. godmanni*; it is from New Granada, and the dark markings are arranged in irregular cross bands.

185. Heros guttulatus. (Plate LXXVIII. fig. 3.)

Günth. Proc. Zool. Soc. 1864, p. 152.

D. $\frac{17}{13}$. A. $\frac{6}{9}$. L. lat. 33. L. transv. $\frac{4\frac{1}{2}}{12}$.

Very closely allied to *H. godmanni*.

The fold of the lower lip is interrupted in the middle. The height of the body is contained twice and three-fifths in the total length (without caudal), the length of the head thrice and a fifth. Head as high as long. The upper profile of the head descending in a gentle curve. Scales on the cheek in four or five series. The first dorsal spine is inserted behind the vertical from the upper end of the gill-opening. Dorsal spines rather feeble, the length of the twelfth being two-sevenths of that of the head. Pectoral two-thirds as long as the head. Upper parts blackish, each scale with a black base; lower parts reddish, with a broad blackish band from behind the pectoral to the base of the caudal; many scales within or below the band with a black spot in the upper or lower angle; each scale on the side of the head with a black spot; chin and throat violet. The spinous dorsal black, with yellowish margin; the soft parts of the vertical fins with blackish spots.

This species inhabits the Lake of Amatitlan, where Mr. Salvin obtained numerous examples up to 7 inches in length.

Description.—The profile of the head and nape forms a curve. Head as high as long; snout rather elevated; præorbital wider than the eye, the diameter of which is a little more than one-fifth of the length of the head, and about three-fifths of the width of the interorbital space. Cleft of the mouth narrow, horizontal, the upper jaw slightly overlapping the lower, and the maxillary not extending backwards as far as the anterior margin of the orbit. The six front teeth of the outer series are the longest, deep brown. The orbit is considerably below the upper profile of the head, and somewhat nearer to the end of the opercle than to that of the snout. Opercles scaly, the scales on the cheek in four or five series, and smaller than those on the opercle. Vertical fins not scaly at the base; the soft dorsal and anal do not reach far beyond the root of the caudal. Free portion of tail a little higher than long. Caudal subtruncated, two-ninths of the total length. Pectoral three-fourths as long as the head; ventral with the outer ray slightly produced, rather longer than the pectoral, and reaching nearly to the vent.

186. Heros irregularis. (Plate LXXVIII. fig. 2.)

Theraps irregularis, Günth. Fish. iv. p. 284.

D. $\frac{16}{13}$. A. $\frac{(4)\,5}{9\text{–}10}$. L. lat. 35. L. transv. 4/14.

The fold of the lower lip is interrupted in the middle. The height of the body is nearly equal to the length of the head, which is two-sevenths of the total (the caudal fin not included). Head longer than high, with the snout compressed and prominent; the length of the snout is two-fifths of that of the head, and twice or more than twice the width of the orbit. The cleft of the mouth is small, extending backwards somewhat behind the vertical from the nostril; upper jaw slightly overlapping the lower; teeth in a narrow band, those of the outer series largest. Præorbital wider than the orbit, its width being equal to that of the interorbital space, which is rather convex. The eye is situated immediately below the upper profile, its centre being a little behind the middle of the length of the head. Scales on the cheek small, in six oblique series. Scales on the opercles as large as those on the neck; those near the base of the dorsal and on the abdomen very small. Scales finely serrated. The dorsal fin commences above the root of the ventral, and is not scaly. The spines are of moderate length and strength, the length of the fifteenth being two-sevenths, or in old examples one-third of that of the head. The soft portion does not extend to the caudal, if laid backwards. The free portion of the tail much longer than high. Caudal rounded. Pectoral shorter than the head. The ventral does not extend on to the vent. Reddish olive, marbled with blackish; the latter colour forming seven rather irregular transverse bands, some of which extend on the dorsal fin. Belly silvery, marbled with blackish; opercles and some scales on the body with blue dots. The inner half of the soft vertical fins blackish violet, the outer yellow; spinous dorsal with yellow margin. Lower side of head blackish violet.

I have now before me numerous examples of this species from the Rivers Chisoy, San Geronimo, and Santa Isabel; and finding that the anal spines are normally five in number, the number four of the typical specimen being merely accidental, I do not hesitate to reunite the genus *Theraps* with *Heros*. The largest example in the collection is 8 inches long.

187. Heros intermedius. (Plate LXXVIII. fig. 1.)

Günth. Fish. iv. p. 298.

D. $\frac{17\text{–}18}{11}$. A. $\frac{5\ 6}{10\text{–}8}$. L. lat. 32. L. transv. 5/13.

The fold of the lower lip is interrupted in the middle; five or six series of scales on the cheek. The height of the body is contained twice and three-fifths in the total length (without caudal), the length of the head thrice and a fourth. The eye is not very remote from the profile of the nape, which is curved. Head as high as long; præorbital rather wider than the orbit. Cleft of the mouth rather narrow, horizontal, with the jaws equal anteriorly. Base of the soft dorsal and anal with scarcely any scales; dorsal spines of moderate length and strength, the length of the twelfth being one-third or nearly one-third of that of the head[1]. The soft dorsal and anal extend slightly beyond the root of the caudal. The free portion of the tail is not quite so long as high. Caudal subtruncated, its length being one-fifth of the total. Pectoral shorter than the head, but rather longer than the ventral, which extends nearly to the vent. Brownish, lower parts red in adult specimens; a broad angular brown band on the trunk, its horizontal branch extending from the gill-opening to the vertical from the first anal spine, whilst its vertical branch ascends to the hinder dorsal spines. Each scale within this band with a black vertical streak. A rather narrow brown band runs from the angular band to a blackish spot at the root of the caudal. Vertical fins with whitish ocelli, enclosed by reddish streaks.

This species is closely allied to *H. nebulifer* and *H. angulifer*, from which it may be distinguished by its colours, and by the size of its scales. It inhabits Lake Peten, where specimens 5 and 6 inches long were collected by Mr. Salvin.

[1] These spines are represented a little too short in the figure.

188. HEROS ANGULIFER. (Plate LXXXV. fig. 1.)

Günth. Fish. iv. p. 298.

D. $\frac{17-18}{10}$. A. $\frac{5}{8}$. L. lat. 33. L. transv. 4/12.

The fold of the lower lip is interrupted in the middle; four series of scales on the cheek. The height of the body is two-fifths of the total length (without caudal), the length of the head three-tenths. The eye is not very remote from the profil of the nape, which is slightly curved. Head as high as long; præorbital scarcely wider than the orbit. Cleft of the mouth rather narrow, horizontal, with the jaws equal anteriorly, and with the maxillary not extending backwards to the vertical from the front margin of the eye. Dorsal and anal fins not scaly; dorsal spines of moderate length and strength, the length of the twelfth being one-third of that of the head; the soft dorsal and anal extend to the root of the caudal. The free portion of the tail is as long as high. Caudal subtruncated, its length being not quite one-fifth of the total. Pectoral shorter than the head, but longer than the ventral, which does not extend to the vent. Brownish olive, with a broad angular black band on the trunk, its horizontal branch extending from the eye to the vertical from the first anal spine, whilst its vertical branch ascends to the hinder dorsal spines. Some scales within the band and on the opercles with a black dot. A round blackish blotch on the root of the caudal fin.

Two examples, 4 inches long, were collected by Messrs. Godman and Salvin at Yzabal.

PETENIA.

Günth. Fish. iv. p. 301.

Body compressed, oblong, covered with ctenoid scales of moderate size. Dorsal spines numerous, anal spines more than four; the soft dorsal scaleless. Teeth in a band, small, conical. Anterior prominences of the first branchial arch short, compressed, distant. Cleft of the mouth wide; jaws very protractile. Scales on the cheeks small. The origin of the ventral falls vertically below that of the dorsal.

189. PETENIA SPLENDIDA. (Plate LXXIX. fig. 2.)

Günth. *l. c.*

B. 5. D. $\frac{15}{12}$. A. $\frac{5}{10}$. L. lat. 41. L. transv. 6/17.

Scales on the cheek in about seven series. Greenish shining golden; head, body, and vertical fins with black dots. A series of six or seven large round black spots along the middle of the side, the last spot being edged with white, and situated on the upper half of the root of the caudal.

Three examples were collected by Mr. Salvin in Lake Peten, the largest being 16 inches long.

NEETROPLUS.

This genus differs from *Heros* in having a front series of flat incisor-like teeth. It is also closely allied to *Etroplus*, which genus, however, has but a rudimentary lateral line, whilst in *Neetroplus* it is as much developed as in *Heros*.

190. NEETROPLUS NEMATOPUS. (Plate LXXIV. fig. 4.)

D. $\frac{19}{10}$. A. $\frac{8}{7}$. L. lat. 34. L. transv. $5\frac{1}{2}/12$.

The fold of the lower jaw interrupted in the middle; five series of scales on the cheek. Incisors $\frac{10}{8}$. The outer ventral ray produced into a filament as long as the fin.

One specimen, $4\frac{1}{2}$ inches long, was discovered by Capt. Dow in Lake Managua.

Description.—The height of the body is contained twice and three-fifths in the total length (without caudal), the length of the head thrice and two-fifths. Head as high as long, with an adipose prominence over the eye, which renders the profile of the forehead somewhat abrupt; snout rather compressed and prominent, the length of the snout is two-fifths of that of the head, and more than the width of the orbit, which is nearly one-third of the length of the head. Cleft of the mouth small, extending backwards somewhat behind the vertical from the nostril; jaws equal in front; teeth in a band, those of the outer series being genuine incisors, which appear to be replaced by smaller ones, standing behind in a band. Præorbital wider than the eye, equal in width to the interorbital space, which is convex. The eye is situated at some distance from the upper profile, nearer to the end of the opercle than to that of the snout. Scales on the cheek small, in about five oblique series. Posterior limb of præoperculum about twice as long as the inferior, and descending obliquely forwards. Scales on the opercles as large as those on the neck; those near the base of the dorsal and on the abdomen very small. The dorsal fin commences above the vertical from the hinder margin of the operculum. Dorsal and anal scaly at the base. Spines rather strong, the sixteenth dorsal spine being nearly one-half of the length of the head. The soft portions of both fins are produced, and reach beyond the middle of the caudal. Caudal truncated. Pectoral shorter than the head. Outer ray of ventral produced into a filament as long as the fin. Brownish-olive, with irregular darker clouds.

MICRODESMUS.

Günth. Proc. Zool. Soc. 1864, p. 26.

Body much elongate, eel-like, covered with rudimentary scales. Head rather short, with snout obtuse, cleft of the mouth narrow, and lower jaw prominent. Eyes minute. Teeth in both jaws minute; palate toothless. The gill-opening is reduced to a small slit in front of the pectoral fin. Vertical fins united by a membrane; but the caudal can be easily distinguished from the two other fins. Dorsal fin very long, composed of flexible, undivided rays, like the anal. Pectorals short; ventrals thoracic, each reduced to a single ray. Vent in the middle of the total length.

I am not able at present to add anything to the knowledge of this fish which would elucidate its natural affinities and indicate its systematic position.

191. Microdesmus dipus.

Günth. *l. c.*, pl. 3. fig. 2.

D 55. A. 34. C. 16. P. 12. V. 1.

The depth of the body is about one-eighteenth of the total length; the length of the head one-eleventh. The head is rather compressed, the snout short, the mouth very narrow, and the lower jaw very prominent. The minute eye is lateral, and in the anterior third of the length of the head. The dorsal fin commences at a distance from the occiput which is somewhat less than the length of the head; it is nearly even, and the rays are very distinct, the interradial membrane being thin and transparent. The anal fin commences immediately behind the vent. The caudal rays are much more slender and more closely set than those of the dorsal and anal; the caudal fin is rounded, two-thirds of the length of the head. Pectorals as long as the ventrals, and half as long as the head; the latter fins are close together, and inserted a little behind the root of the pectoral. Upper parts uniform brownish olive.

The single specimen is 4½ inches long, it was found by Capt. Dow at Panamá.

192. Brotula multibarbata (Schleg.).

Mr. Salvin has found on the Pacific coast of Guatemala a small fish, which I am unable to distinguish from the Indian or Japanese species. However, having only small examples for examination, I am not prepared to maintain the specific identity of these fishes.

195. Citharichthys spilopterus. (Plate LXXX. fig. 2[1].)

Günth. Fish. iv. p. 421.

D. 76–78. A. 60–63. L. lat. 47–50.

The height of the body is two-fifths of the total length (without caudal), the length of the head two-sevenths. Scales of the lateral line subquadrangular; lateral line nearly straight, gently descending anteriorly. Snout with the jaws equal in front, rather longer than the eye, the diameter of which is one-sixth of the length of the head. The maxillary, the length of which is contained twice and two-thirds in that of the head, extends beyond the middle of the orbit. Anterior teeth of the upper jaw widely set, much larger than the posterior, which are close together and very small; the lower jaw with seven or eight distant teeth of moderate size on each side. Eyes separated by a very narrow scaleless ridge, their front margins being nearly on the same level. Fin-rays scaly. The dorsal commences a little before the upper eye, and terminates close by the caudal; its longest rays are behind the middle, and one-half of the length of the head. Anal spine none. Caudal rounded; its length is one-sixth of the total. The pectoral is rather longer than half the length of the head; ventral much shorter, extending beyond the origin of the anal. Gill-rakers lanceolate, pointed.

[1] The artist has unfortunately omitted to reverse the view of this figure.

one-third as long as the eye. Greenish olive (in spirits); a series of distant blackish spots along the basal portions of the anal and dorsal fins.

This species occurs on the shores of the tropical parts of the Atlantic, and has been found by Mr. Salvin also on the Pacific coast, at Chiapam.

196. Citharichthys guatemalensis.

Bleeker, Nederl. Tydschr. Dierk. 1864, p. 73.

D. 77. A. 57. L. lat. ca. 45.

"*Citharichthys* corpore ovali, altitudine $2\frac{2}{3}$ circiter in ejus longitudine; capite $4\frac{3}{5}$ circiter in longitudine corporis, æque alto circiter ac longo; oculis sinistris, minus diametro $\frac{1}{5}$ distantibus, superiore quam inferiore vix majore 5 circiter in longitudine capitis, paulo ante inferiorem prominente; linea frontonuchali declivi rectiuscula; naribus non tubulatis, utroque latere approximatis; rictu curvato; maxillis subæqualibus, superiore usque ante oculi inferioris marginem superiorem adscendente, sub oculi inferioris partem posteriorem desinente, $2\frac{3}{5}$ circiter in longitudine capitis; dentibus maxillis conicis acutis parvis, caninis nullis, utroque latere maxilla superiore numerosis postrorsum magnitudine decrescentibus, maxilla inferiore parcioribus, intermaxillaribus majoribus subæqualibus; præoperculo obtusangulo angulo rotundato; squamis præoperculo in series verticales 8 circiter, operculo in series verticales 6 vel 7 dispositis, linea laterali corpore antice parum declivi; capite regione oculo-temporali conspicua obliqua; prima dorsali ante medium oculum superiorem incipiente et vix ante pinnam caudalem desinente radiis longissimis corpore plus triplo humilioribus; pinnis pectoralibus et ventralibus (ex parte abruptis); anali dorsali vix humiliore; caudali postice angulata $5\frac{2}{3}$ ad $5\frac{3}{4}$ in longitudine corporis; colore corpore latere oculari viridescente (?), latere anophthalmo albido, pinnis flavescente (?)."

The specimen, which is 145 mm. long, and in the Leyden Museum, is stated to be from Guatemala.

197. Hemirhombus ovalis. (Plate LXXX. fig. 1[1].)

Günth. Proc. Zool. Soc. 1864, p. 154.

D. 86. A. 69. L. lat. 58.

The dorsal commences before the eye. Teeth of the upper jaw in a double series, with one or two pairs of small canine teeth in front; those of the lower jaw closely set, conical, in a single series. Scales largest in the middle of the body, adherent, ciliated; lateral line ascending gently over the pectoral fin, straight for the rest of its length. The height of the body is contained twice and two-thirds in the total length; the length of the head four times and two-thirds. Snout rather shorter than the eye, the diameter of which is two-ninths of the length of the head. Jaws equal anteriorly; the length of

[1] The artist has unfortunately omitted to reverse the view of this figure.

the maxillary is a little more than one-third of the length of the head; maxillary scaly. Interorbital space very narrow, concave, one-third of the vertical width of the orbit; the concavity is produced by two ridges convergent posteriorly. Head nearly entirely covered with ciliated scales. Rays of the vertical fins scaly, the distance between the dorsal and caudal fins is one-half of the depth of the free portion of the tail. The longest dorsal rays are somewhat behind the middle of the fin, and four-ninths of the length of the head. Pectoral rays not prolonged. Body nearly uniform reddish olive; some of the dorsal, anal, and caudal rays with elongate dark-brown spots.

One specimen, 7 inches long, was collected by Messrs. Dow and Salvin on the Pacific coast of Panama.

198. Pseudorhombus brasiliensis.

Hippoglossus brasiliensis, Ranzani, Comm. Bonon. v. p. 10, tab. 3.
Rhombus aramaca, Casteln., not Cuv.
Pseudorhombus vorax, Günth. Fish. iv. p. 429.

This species is known to occur on the coast of Brazil; however, there is a specimen in the British Museum, which formed part of a collection containing numerous fishes from Guatemala; and I mention it, therefore, in this list to draw attention to this species.

200. Aphoristia ornata, var. elongata.

Two examples, 5 inches long, collected by Mr. Salvin on the Pacific coast of Panama, differ, from specimens from the West Indies, only in having the body more elongate, its depth being contained four times and two-thirds in the total length (with the caudal). The number of fin-rays is the same, viz. D. 97, A. 82; L. lat. 98.

201. Amiurus meridionalis. (Plate LXXXI. fig. 1.)

Günth. Fish. v. p. 102.

D. 1/6. A. 28–29. P. 1/9.

Head one-half or one-third longer than broad; the maxillary barbels extend to the end of the head. The length of the dorsal spine is somewhat less than that of the head without snout, and nearly equal to that of the pectoral spine. Adipose fin short. The height of the body is one-fifth of the total length (without caudal), the length of the head one-fourth or two-ninths. Snout obtusely rounded, with the upper jaw longer than the lower. The diameter of the eye is one-half or two-fifths of the extent of the snout, and one-third or two-sevenths of the length of the postorbital portion of the head. The band of maxillary teeth is five or six times as broad as long. The outer mandibulary barbels extend to the posterior margin of the gill-membrane. The distance of the dorsal spine from the snout is a little more than one-half of its distance from the caudal fin; it is finely serrated behind. The length of the base of the adipose fin equals that of the dorsal. Caudal fin deeply forked; the upper lobe is somewhat the longer, its length being equal to, or a little less than, that of the head. The anal fin terminates behind the adipose fin, and its last rays do not extend to the base of the caudal. Axil of the pectoral with a very distinct porus mucosus. The pectoral spine is serrated interiorly, sometimes a little longer, sometimes a little shorter, but always rather stronger than that of the dorsal fin. Pectoral fin longer than ventral, two-thirds or three-fifths of the length of the head. The ventral extends to the origin of the anal. Upper parts brownish, with steel-blue reflexions; lower parts silvery, with a reddish tinge.

Three examples were collected by Mr. Salvin in the Rio Usumacinta; the largest is 15 inches long.

205. Pimelodus wagneri.

Pimelodus cinerascens, Kner & Steindachner, Abhandl. bayer. Akad. x. p. 49 (not Gthr.).

D. 1/6. A. 11–12.

Head covered with soft skin above. Adipose fin one-third of the total length (without caudal). The maxillary barbels extend beyond the root of the ventrals; the outer ones of the mandible do not quite reach the base of the pectorals. The length of the head is contained from five times and two-fifths to five times and seven-eighths in the total (with the caudal), the height of the body seven times and one-third, or seven times and one-half. Upper jaw projecting beyond the lower. The eye is equidistant from the end of the snout and from that of the gill-cover; its diameter is one-seventh or one-eighth of the length of the head, and contained twice and two-thirds or twice and three-fourths in the width of the interorbital space. Dorsal fin with the spine very feeble, as high as long. Pectoral fin two-thirds as long as head. Porus axillaris small. Coloration uniform, a darker streak along the lateral line; dorsal fin with the usual whitish cross band, and sometimes with a large round black spot between the last two rays.

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The *complete* diagnosis of *P. cinerascens* (Gthr.), accompanied by a most accurate figure, proves at once that the species discovered by Hr. Wagner is distinct from it. It appears to be nearest to *P. godmanni*.

206. Pimelodus managuensis.

D. 1/6. A. 14–15. P. 1/9.

Head covered with soft skin above; occipital process styliform, not extending to the basal bone of the dorsal spine. Adipose fin very long, rather more than one-third of the total length (without caudal); its distance from the dorsal is equal to the length of the base of the latter. The maxillary barbels are rather short, extending nearly to the base of the dorsal fin, the outer ones of the mandibles reach beyond the root of the pectoral. The height of the body is contained six times in the total length (without caudal); the length of the head five times. The lower jaw is slightly shorter than the upper. Interorbital space flat, its width being less than twice the width of the eye. Dorsal fin with the spine very feeble, somewhat higher than long. Pectoral fin rather short, as long as the head, without snout; its spine about double the length of the humeral spine. Porus axillaris distinct. Ventral rather longer than the pectoral. Anal fin with the base longer than that of the dorsal; its rays do not extend nearly to the end of the adipose fin if laid backwards. Caudal cleft to the base; its upper lobe less rounded and narrower than the lower one, which is one-seventh of the total length. Coloration uniform, dorsal fin with a whitish cross band.

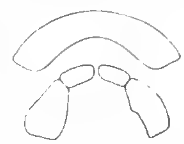
One specimen, 9 inches long, was obtained by Capt. Dow in the Lake of Managua.

214. Arius assimilis.

Günth. Fish. v. p. 146.

D. 1/7. A. 19. P. 1/10.

The height of the body is contained four times and two-thirds in the total length (without caudal), the length of the head thrice and three-fifths; head much broader than high, its greatest width being three-fourths of its length. Eyes rather small, situated nearer to the end of the snout than to that of the operculum; the length of the snout is three-fifths of the width of the interorbital space. *The median longitudinal fonticulus on the upper side of the head does not extend to the base of the occipital process.* Teeth on the vomer but slightly separated in the middle, forming a pair of oblong transverse patches, which are confluent with those on the palatine bones; the latter are short, club-shaped. The band of intermaxillary teeth is five times as broad as long. All the teeth villiform. The maxillary barbels extend nearly to the end of the head; the length of the outer ones of the mandible is one-half or two-thirds of that of the head. Crown of the head granular, the granulations being arranged in radiating streaks. Occipital process broader than long, triangular, with its hinder end concave. The basal bone of the dorsal spine of moderate size, crescent-shaped. Dorsal spine of moderate strength, more than half as long as the head, granulated in front and slightly serrated behind; the first soft ray is longer than the spine and as high as the body. Adipose fin shorter than the dorsal. Caudal deeply forked, with the upper lobe longest, its length being contained five times and a half in the total. Pectoral spine serrated along its inner edge and on the extremity of the outer edge. Ventral fin shorter than pectoral. Sides of the body silvery; vertical fins greyish; basal half of the inner side of the paired fins black.



One example, 13 inches long, was obtained by Messrs. Godman and Salvin in the Lake of Yzabal.

Hexanematichthys hymenorrhinos, Bleek. Versl. & Mededeel. Akad. Wetensch. Amsterd. 1862, xiv. p. 377, appears to be closely allied to the above species; and we should not hesitate to refer our specimens to it, if the barbels of Bleeker's species were not much longer, those of the maxillaries extending on to the base of the ventral fin, and the outer ones of the mandible to the base of the pectoral. The specimen in the Leyden Museum is 8½ inches long.

219. Arius dovii.

Mr. Gill (Proc. Acad. Nat. Sc. Philad. 1863, p. 170) describes a species discovered by Capt. Dow on the Pacific coast of Central America, under the name of *Leptarius dowii*. *Leptarius* is a distinct genus, according to Mr. Gill, characterized by having the band of teeth quadripartite, the head granulated and without lateral fontanelles, a slender body, and a very slender caudal peduncle, the anal fin rather low and oblong, the thin adipose fin extending behind the anal, and the fins little developed.—The species is not described; but detailed comparative measurements of the single example (which is 5¾ inches long) are given.

222. Ælurichthys nuchalis. (Plate LXXXI. fig. 2.)

Günth. Fish. v. p. 179.

D. 1/7. A. 26. P. 1/12.

The height of the body is rather less than the length of the head, which is two-ninths of the total (without caudal); the greatest width of the head is three-fourths of its length; snout longer than the eye, the diameter of which is rather less than one-fourth of the length of the head. The vomerine band of teeth is separated in the middle by a short interspace, each half being as broad, and long as the palatine band, with which it is subcontinuous. The maxillary barbels extend to the root of the ventral, those of the mandible nearly to the pectoral. The dorsal buckler is as broad behind as in front, with rounded lateral margins, each half being bent downwards on the side. Dorsal fin narrow and elevated, the first ray being considerably longer than the spine, which is as long as the head without snout; pectoral spine equal to the dorsal spine. The origin of the anal fin is much nearer to the base of the caudal than to that of the pectoral. The first pectoral ray is produced into a long filament reaching beyond the origin of the anal. Ventrals extending beyond the vent, their length being three-fifths of that of the head. Iridescent blue above, silvery below.

One example, 11 inches long, was obtained by Messrs. Salvin and Dow on the Pacific coast of Panama.

223. Ælurichthys panamensis.

Gill, Proc. Ac. Nat. Sc. Philad. 1863, p. 172.

This species is described thus:—

D. 1/7. A. 27. P. 1/13.

The greatest height is contained five times in the length to the base of the caudal fin, and six times and a half in the total. The height of the caudal peduncle equals half the interorbital area, and is half its length behind the anal fin. The smooth head enters four times in the length to the middle of the central caudal ray, and nearly five times in the total. The width of the head enters once and one-third in its length, and the width of the interorbital area once and two-thirds. The eye is elliptical, its diameter equals a fourth of the head's length, and the distance from the anterior nostril is equal to it. The maxillary barbels extend backwards nearly to the anus, and the mental to the bases of the pectoral fins. The dorsal buckler is rather longer than wide, with its anterior margin concealed, and its lateral and posterior very conspicuous, rounded towards the posterior angles, and emarginated behind; the sides slope and form a rectangle, and the surface is filled with deep oblong pits. The anal fin is situated midway between, or scarcely in advance of, the central point between the bases of the pectoral and caudal fins; it is oblong, and equals or nearly equals the width of the head. The pectoral filaments extend about to the middle of the anal fin; the ventrals are inserted midway between the lower jaw and base of caudal, and extend backwards to the anus, entering twice and a half in the head's length. The colour above is plumbeous; the pectorals thickly dotted with black on their inner faces, and the anal less so.

One specimen, 8 inches long, has been collected by Capt. Dow on the Pacific coast of Panama.

224. PLECOSTOMUS BICIRRHOSUS (Gronov.).

Messrs. Kner & Steindachner (Abhandl. bayer. Ak. x. p. 60) mention a species of this genus from Pacific and Atlantic rivers of Panama, which they regard as a variety of *Plecostomus bicirrhosus*, but which differs in several respects.

225. CHÆTOSTOMUS ASPIDOLEPIS.

D. 1/7. A. 5. P. 1/6. L. lat. 25.

Head large, depressed, a little longer than broad, its length being contained thrice and one-third in the total (without caudal); snout very broad, rounded in front. Interorbital space nearly flat, with a very slight rising along the middle. Orbit small, its diameter being one-third of the width of the interorbital space. Margin of the snout granulated. Interoperculum with very few, and for the greater part short, setiform spines, the longest of which is about half as long as the orbit. Thorax and belly granulated, with naked patches. Dorsal fin higher than long, the length of its anterior rays being nearly equal to that of the head; the length of its base equals its distance from the hinder axil of the adipose fin. There are seven scutes between the two dorsal fins. The pectoral spine is strong, rather longer than the head, covered behind with setiform spinules. The ventral fins extend somewhat behind the anal. Twelve scutes between anal and caudal. Scutes of the body with a prominent keel, each keel with from four to seven short setiform spines. Posthumeral ridge rather distinct. Each scute is variegated with dirty yellow and dark brown.

I have received of this species only a single skinned example, $12\frac{1}{2}$ inches long; it is from Veragua.

226. Chætostomus cirrhosus (Val.).

Messrs. Kner & Steindachner (*l. c.* p. 61) mention this species from the Rio Chagres; but their species is probably distinct from it.

227. Loricaria uracantha.

Kner & Steindachner, Abhandl. bayer. Akad. x. p. 56, Taf. 6. fig. 3.

Snout broad, of moderate length; eye of moderate size, with a notch in its posterior margin, its horizontal diameter is one-half of the width of the interorbital space, which is slightly concave, owing to the raised supraorbitals. Eight or ten rather large bifid teeth in each jaw. Labial folds broad, with numerous papillæ, and a small lateral barbel. The lower side of the head naked; scutes of the neck but very indistinctly bicarinate. L. lat. 27. There are seven lateral scutes between the pectoral and ventral fins. Thorax and belly with numerous small irregular scutes. The origin of the dorsal is opposite to that of the ventrals. The length of the outer pectoral ray is contained six times and a half in the total (without caudal). *The upper caudal ray very thick and strong.* Rays of all the fins spotted.

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229. Macrodon microlepis (Gthr.).

The fish described by Messrs. Kner and Steindachner (*l. c.* p. 28) under the name of *M. tareira* belongs to this species.

256. Tetragonopterus æneus (Gthr.).

This species has been recognized in a collection from Panama by Messrs. Kner and Steindachner (*l. c.* p. 46).

237. Chalcinopsis dentex. (Plate LXXXII. fig. 1, $\frac{2}{3}$ nat. size.)

Brycon dentex, Günth. Proc. Zool. Soc. 1860, p. 240.
Chalcinopsis dentex, Günth. Fish. v. p. 337.

D. 11. A. 35–36. L. lat. 48–55. L. transv. $\frac{9\text{–}10}{7\text{–}8}$. Vert. 23/22.

The height of the body is contained thrice and one-fourth or thrice and one-third in the total length (without caudal), the length of the head four times and one-third or four times and two-thirds. The maxillary does not quite extend to below the centre of the eye. Snout as long as the eye in young examples, but much longer in adult ones. Interorbital space convex, its width being much more than the diameter of the eye in old specimens. The origin of the dorsal fin is nearer to the root of the caudal than to the extremity of the snout; its hinder rays are vertically above the anterior anal rays. The free portion of the tail is considerably longer than high. Caudal deeply forked. The pectoral extends to, or nearly to, or a little beyond, the ventral. Silvery, sometimes with a reddish hue; a part of the scales have sometimes a black margin, or are spotted with black; humeral part of the gill-opening black; sometimes a black spot at the root of the caudal. Anal fin generally with a black margin.

Specimens, up to 16 inches in length, were collected by Messrs. Salvin and Godman in the Rio Motagua and Usumacinta, and at Yzabal. The species occurs also in Ecuador.

240. ANACYRTUS GUATEMALENSIS. (Plate LXXXII. fig. 4.)

Anacyrtus (*Rœboides*) *guatemalensis*, Günth. Fish. v. p. 347.

D. 11. A. 51. V. 8. L. lat. 80. L. transv. 19/22.

Upper and lower jaw anteriorly on each side with a short, conical, tooth-like process directed forwards; teeth in the intermaxillary, maxillary, and mandible in a single, rather irregular series; no canine teeth in the upper jaw, those in the lower small and short. Back elevated, the upper profile of the head and nape forming an S-shaped curve. The height of the body is contained twice and three-fourths in the total length (without caudal), the length of the head four times. The lower jaw is rather shorter than the upper; the maxillary extends to the vertical from the centre of the eye. The width of the interorbital space is a little less than the diameter of the eye, which is two-sevenths of the length of the head. The humeral process in front of the pectoral terminates in a point anteriorly and posteriorly. The origin of the dorsal fin is a little nearer to the extremity of the snout than to the root of the caudal, above the fifth or sixth anal ray; caudal deeply forked; the ventral is inserted below the middle of the pectoral, which extends nearly to the origin of the anal. Light reddish olive with a silvery lateral band.

Specimens, up to 6 inches in length, were collected by Mr. Salvin at Huamuchal, and in the Chagres River.

244. EXOCŒTUS CALLOPTERUS. (Plate LXXXIII.)

Günth. Fish. vi. p. 292.

D. 11–12. A. 8. L. lat. 46.

Body stout, its height being one-fifth of the total length (without caudal), the length of the head being somewhat less than one-fourth. The depth of the head equals the distance between the extremity of the snout and the hind margin of the præoperculum. Snout obtuse and depressed, three-fifths of the length of the diameter of the eye, which is one-third of the length of the head, and less than the width of the interorbital space, which is slightly concave. The pectoral fin extends to the end of the dorsal. Ventral fins midway between præoperculum and root of the caudal, extending nearly to the end of the base of the anal. The dorsal commences far in advance of the anal, its anterior rays being half as long as the head. *The distance between the first dorsal ray and the first rudimentary caudal ray equals the length of the head.* There are thirty-four scales between the occiput and origin of the dorsal, and nine longitudinal series of scales between the origin of the dorsal and the lateral line. Pectoral with numerous small roundish blackish-brown spots and with the lower and upper rays whitish. Ventral white, the middle rays greyish.

Two examples, 10 inches long, were obtained by Capt. Dow on the Pacific coast of Panama.

CHARACODON.

Günth. Fish. vi. p. 308.

Cleft of the mouth small, developed laterally and horizontally; mandible short, with the bones of each side firmly united. Snout short. Teeth rather small, bicuspid, in a single series; but there is a narrow band of villiform teeth behind the series of incisors. Scales of moderate size. Origin of the anal fin opposite, or nearly opposite, to that of the dorsal. Sexes not differentiated. Intestinal tract but slightly convoluted.

247. CHARACODON LATERALIS. (Plate LXXXII. fig. 2, fem.)

D. 10–11. A. 13 in fem., 15–16 in male. L. lat. 35. L. transv. 12.

In general habits very similar to a Cyprinodon. Body rather elevated, with the neck somewhat arched, its greatest depth being rather more than the length of the head, and one-third of the total (without caudal). Head thick and broad, with the snout obtuse, as long as, or rather longer than, the diameter of the eye, which is one-fourth or two-ninths of the length of the head. The mandible ascends obliquely, and is longer than the eye. There are about twenty smallish teeth in each jaw, their apex is indistinctly notched. Interorbital space flat, its width being two-fifths of the length of the head. The origin of the dorsal fin is a little nearer to the end of the caudal than to the occiput, and a little behind that of the anal. Both fins are small and rounded. In the male the six anterior rays of the anal are of nearly equal length, but considerably shorter than the following, forming a very distinct portion of the fin; all these rays are very closely set. Caudal fin small, truncate or slightly convex. The distance between dorsal and caudal is somewhat more than the least depth of the tail, and equal to the distance between eye and gill-opening. Brownish olive (in spirits), with a darker band running from the eye to the root of the caudal: this band is sometimes broken up into a more or less regular series of brownish-black spots.

There are several examples, from $1\frac{2}{3}$ to $2\frac{1}{2}$ inches long, in the British Museum; they are from Dr. Seemann's collection, who obtained them in Southern Central America.

248. Haplochilus dovii. (Plate LXXXII. fig. 5.)

Günth. Fish. vi. p. 315.

D. 8. A. 14. V. 6. L. lat. 31. L. transv. 8.

The height of the body is contained five times in the total length (without caudal), the length of the head thrice and two-thirds; head elongate, low, and depressed, with the snout much produced and the upper jaw somewhat longer than the lower; the eye occupies exactly the middle of the length of the head, its diameter being two-ninths of it, and more than one-half of the width of the interorbital space, which is flat. The origin of the dorsal fin is a little nearer to the extremity of the caudal than to the gill-opening, and corresponds to the twenty-third scale of the lateral line. Anal fin entirely before the dorsal; pectoral extending to ventral, which reaches the vent; caudal rounded; all the fins well developed. Light brownish olive; posterior half of the dorsal and anal fins with black cross bands; basal half of the caudal with round light spots.

Two specimens, 6 inches long, probably males, were collected by Capt. Dow at Punta Arenas, Costa Rica.

249. Fundulus labialis. (Plate LXXXIV. figs. 1 & 2.)

Günth. Fish. vi. p. 319.

B. 6. D. 13–14. A. 16–17. V. 6. L. lat. 37–39. L. transv. 15.

The height of the body, taken on the level of the base of the pectoral, is two-ninths of the total length (without caudal). Head rather depressed, its length being contained four times or four times and a third in the total. Interorbital space broad, slightly convex, its width being less than one-half of the length of the head. Snout broad, obtuse, depressed, with the jaws perfectly equal in front; mandible very short, not longer than the eye. Upper lip well developed, broad, extending to the angle of the mouth. The diameter of the eye is less than the length of the snout, or than one-fourth of that of the head, and, in females, one-half of the width of the interorbital space, whilst in males the forehead is somewhat narrower. The origin of the dorsal fin is midway between the extremity of the caudal and the orbit, and corresponds to the first ray of the anal. Dorsal fin as high as long in both sexes; anal fin rounded in the male, scarcely higher than long; much elevated in the female, the length of its base being two-thirds only of its depth. Genital opening of the female immediately in front of, but disconnected from, the anal fin. Basal third of the caudal fin (which is subtruncate) scaly. Body uniform brownish olive, paler below; sometimes irregular cloudy markings on the tail. Fins immaculate; the anal fin of the male is black at the base, and bright yellow on its marginal half; also the upper margin of the dorsal fin of the same sex is yellowish.

Numerous examples, up to 4½ inches long, were collected by Messrs. Salvin and Godman in the Rio San Geronimo and at Yzabal. Figure 1 represents the male, and fig. 2 the female.

250. Fundulus punctatus. (Plate LXXXIV. fig. 5.)

Günth. Fish. vi. p. 320.

D. 12. A. 13. V. 6. L. lat. 34. L. transv. 12.

The height of the body, taken on the level of the base of the pectoral, is two-ninths of the total length (without caudal). Head depressed, its length being one-fourth of the total. Interorbital space very broad, slightly convex, its width being one-half of the length of the head. Snout broad, obtuse, much depressed, with the lower jaw scarcely projecting beyond the upper; mandible longer than the eye. Upper lip of moderate breadth, not extending to the angle of the mouth. The diameter of the eye is less than the length of the snout, two-ninths of that of the head, and less than one-half of the width of the interorbital space. The origin of the dorsal fin is somewhat nearer to the extremity of the caudal than to the orbit, and corresponds to the nineteenth scale of the lateral line. The first anal ray is opposite to the third of the dorsal. Dorsal and anal fins subquadrangular, with the outer margins convex: both are a little longer than high. Caudal fin subtruncate, scaly on its basal half. Pectoral fins shorter than the head without snout, not extending to the base of the ventrals. Brownish olive, paler below, each scale, especially those on the tail, with a vertical dark purplish violet spot on the centre. Dorsal with three or four series of blackish dots, anal with a whitish margin.

A single male, 3½ inches long, was obtained by Mr. Salvin at Chiapam.

251. Fundulus guatemalensis. (Plate LXXXIV. figs. 3 & 4.)

Günth. Fish. vi. p. 321.

D. 12 (13). A. 14–15 (16). L. lat. 32–35. L. transv. 12.

The height of the body, taken on the level of the base of the pectoral, equals the length of the head, and is one-fourth or rather more than one-fourth of the total length (without caudal). Head thick and broad; interorbital space broad, slightly convex, its width being a little less than one-half of the length of the head. Snout broad, obtuse, with the lower jaw slightly projecting beyond the upper; mandible longer than the eye. The diameter of the eye is equal to, or, in the larger specimens, less than the length of the snout, one-fourth of that of the head, and one-half of the width of the interorbital space. The origin of the dorsal fin is midway between the extremity of the caudal and the posterior margin of the orbit, and corresponds to the nineteenth scale of the lateral line. The first anal ray corresponds to the second of the dorsal. Dorsal and anal fins subquadrangular, rather low, longer than high in the male, and as long as high in the female. Two-thirds of caudal covered with small scales. Brown above and on the sides, pale below; females with a very indistinct dark band along the side. Fins immaculate; anal with a light margin.

The sexual opening of the female is not attached to the anterior anal rays

Numerous examples, up to $3\frac{1}{2}$ inches long, were collected by Mr. Salvin in the Lakes of Dueñas and Amatitlan, and in the Rio Guacalate. This species occurs also in Western Ecuador. Figure 3 represents the male, and fig. 4 the female.

252 Fundulus pachycephalus. (Plate LXXXIV. fig. 6.)

Günth. Fish. vi. p. 321.

This species is closely allied to *F. guatemalensis*, but has a thicker head and smaller eye.

D. 13–14. A. 15. V. 6. L. lat. 35. L. transv. 12.

The height of the body, taken on the level of the base of the pectoral, is contained thrice and one-fifth or thrice and four-fifths in the total length (without caudal). Head very thick and broad, its length being contained thrice and one-third in the total. Interorbital space very broad, slightly convex, its width being one-half of the length of the head. Snout broad, obtuse, with the lower jaw slightly projecting beyond the upper; mandible longer than the eye. The diameter of the eye is less than the length of the snout, one-fourth of that of the head, and one-half of the width of the interorbital space. The origin of the dorsal fin is midway between the extremity of the caudal and the anterior or posterior margin of the orbit, and corresponds to the sixteenth scale of the lateral line. The first anal ray corresponds to the third of the dorsal. Dorsal and anal fins subquadrangular, of moderate height, the latter fin being scarcely higher than long. Caudal fin subtruncate. Brownish above and on the sides, each scale darker on the tip; an indistinct dark band along the middle of the tail. Fins immaculate, anal with the lower margin whitish.

Three males, $2\frac{1}{2}$ inches long, were obtained by Mr. Salvin in the Lake of Atitlan.

254. Gambusia nicaraguensis. (Plate LXXXII. fig. 3, fem.)

Günth. Fish. vi. p. 336.

D. 8. A. 10. L. lat. 29. L. transv. 8.

The height of the body is contained thrice and a third in the total length (without caudal), the length of the head thrice and two-thirds. Snout broad, subspatulate, with the lower jaw projecting beyond the upper. The diameter of the eye is a little more than the length of snout, one-third of that of the head, and three-fifths of the width of the interorbital space. In the female the origin of the dorsal fin is somewhat nearer to the extremity of the caudal than to the end of the snout, and opposite to the last ray of the anal fin. Pectoral fins not quite reaching as far backwards as the ventrals, which terminate immediately in front of the anal fin. Free portion of the tail rather short, the length of the base of the anal fin being one-half of its distance from the caudal fin. Brownish olive above, sometimes with series of black dots along the rows of scales. Dorsal and caudal fins crossed by series of black dots; middle of anal blackish.

Several females, $1\frac{1}{2}$ or 2 inches long, were obtained by Capt. Dow in the Lake of Nicaragua.

259. Pœcilia elongata. (Plate LXXXV. fig. 2, fem.)

Günth. Fish. vi. p. 342.

D. 9. A. 8. L. lat. 30–32. L. transv. 9.

The height of the body is contained four times in the total length (without caudal), the length of the head four times and a third. The free portion of the tail is elevated, its least depth being contained once and two-thirds in its own length, and nearly equal to the length of the head without snout. The diameter of the eye equals the length of the snout, is two-sevenths of that of the head, and more than one-half of the width of the interorbital space. Snout much depressed. Lower jaw with a single series of very small teeth only; and also in the upper the posterior band of villiform teeth is very indistinct. Origin of the dorsal fin nearer to the root of the caudal than to the occiput, a little behind that of the anal, above the fourteenth scale of the lateral line. Dorsal fin higher than long, its longest ray being as long as the head without snout. Anal small. There are eight longitudinal series of scales on each side of the tail. Caudal rounded, its base only covered with scales. Uniform greenish; the membrane of the pouches of scales with a blackish margin. Fins immaculate.

This species is known from a female only, 5 inches long; it was obtained by Capt. Dow at Panama.

260. Pœcilia petenensis. (Plate LXXXV. fig. 3, male; fig. 4, fem.)

Günth. Fish. vi. p. 342.

D. 11. A. 8. L. lat. 29–30. L. transv. 8–9. Vert. 16/14.

The height of the body (measured below the anterior dorsal rays) is contained four times and one-fifth in the total length (without caudal) in females, and thrice and one-fourth in males, the males having the body much higher and shorter. The length of the head is one-fifth of the same length in the female, and one-fourth in the male. The diameter of the eye is a little less than the length of the snout, two-sevenths or one-fourth of that of the head, and somewhat more than one-half of the interorbital space. The origin of the dorsal fin is further distant from the root of the caudal than from the occiput, and corresponds to the eleventh or twelfth scale of the lateral line. Origin of the anal opposite to the fourth ray of the dorsal (in the female). Dorsal fin of moderate size; anal rather small, but pointed; caudal scaly in its basal third. The free portion of the tail is compressed, rather high, its least depth being one-half of its length, and equal to the length of the the head without snout. There are seven longitudinal series of scales on each side of the tail. Lateral line rather indistinct. Greenish, each scale with a black vertical spot. Dorsal and basal half of the anal irregularly and finely marbled with brown.

The male has the dorsal fin somewhat elevated, the longest ray being rather longer than the head. Anal fin modified into an intromittent organ, and advanced to between the ventrals, in front of the dorsal. Tail strongly compressed, and much higher than in the female, its least depth being equal to the length of the head.

Five examples, up to 6 inches in length, were collected by Mr. Salvin in Lake Peten.

262. Pœcilia gillii.

Messrs. Kner & Steindachner (Abhandl. bayer. Akad. Wiss. x. p. 25, Taf. 4. fig. 1) have described a species of this genus from the Rio Chagres under the name of *Xiphophorus gillii.* It would appear to be most closely allied to *P. dovii*; but there are some apparently slight differences, which have induced me to keep the two species distinct until I shall have had an opportunity of comparing specimens from the Rio Chagres with the typical examples of *P. dovii.*

264. Mollienesia petenensis. (Plate LXXXVI. figs. 1–3.)

Günth. Fish. vi. p. 348.

B. 6. D. 15. A. 8–9. L. lat. 30. L. transv. 10. Vert. 17/13.

The height of the body is one-third of the total length (without caudal), the length of the head one-fourth or two-ninths. The diameter of the eye is equal to the length of the snout, two-sevenths of that of the head, and rather less than one-half of the width of the interorbital space. The length of the dorsal fin of the male is one-half of the distance between eye and root of the caudal, in the female two-fifths; caudal rounded, with scales at the base only. The free portion of the tail is as high as long, and covered by nine longitudinal series of scales on each side. Lateral line very indistinct. Greenish, or brownish green, silvery below; a dark spot to each scale of the upper and middle caudal series and the lower part of the trunk. Dorsal fin of the adult male with small irregular brown lines or spots, and with a row of large rounded spots along the middle of its height. Interradial membrane of the caudal with numerous black dots; the lower part of the hind margin black. Females and immature males have the dorsal fin simply ornamented with small irregularly curved brown spots.

Three examples, up to 5 inches in length, were collected by Mr. Salvin in Lake Peten.

Figure 1 represents the adult male, fig. 2 the immature male, and fig. 3 the adult female, all of the natural size.

265. Xiphophorus hellerii (Heck.). (Plate LXXXVII. figs. 2–6.)

This species varies considerably in coloration. Two varieties occur in the river Chisoy—one with two yellowish green bands along the side, separated, and bordered above and below by a blue band; the second, without bands, has the body covered all over with irregular black spots.

The figures are of the natural size. The specimens are from an affluent of the Chisoy River,—fig. 4 representing an adult male of a variety, fig. 2 an adult female, fig. 5 a male approaching to maturity, fig. 3 an adult female of a variety; finally, fig. 6 represents a Mexican example, half-grown male.

266. Girardinus pleurospilus. (Plate LXXXVII. fig. 1.)

Günth. Fish. vi. p. 353.

D. 8. A. 9. V. 6. L. lat. 28. L. transv. 8.

The height of the body is somewhat more than the length of the head, which is one-fourth of the total (without caudal); the diameter of the eye is more than the length of the snout, one-third of that of the head, and two-thirds of the width of the inter-orbital space, which is slightly concave. In the female the origin of the dorsal fin is in the middle of the total length, and conspicuously behind that of the anal fin. Caudal fin large, longer than the head, subtruncate behind; the free portion of the tail is somewhat elongate, the length of the base of the anal being one-third of its distance from the caudal. Pectoral fin not quite as long as the head, and not extending as far backwards as the ventral fins, which reach the vent.

In the male the origin of the dorsal is somewhat nearer the extremity of the caudal than that of the snout; the anal process is quite straight, nearly twice as long as the head, and terminating in a simple tapering point. Caudal very short. Reddish olive; a series of six or seven round blackish spots, each about the size of the eye, runs along the middle of the side, a black line along the base of the anal fin and the lower and upper margins of the tail. Caudal fin with two indistinct dark cross bands.

Mr. Salvin has discovered this species in the Lake of Dueñas. Females attain to a length of 2 inches, males to half that size only.

267. Sclerognathus meridionalis.

Günth. Fish. vii. p. 23.

D. 29–30. A. 10. L. lat. 38. L. transv. $7\frac{1}{2}/7\frac{1}{2}$.

Mouth small, inferior, slightly corrugated. The height of the body is contained thrice and one-half or thrice and one-fourth in the total length (without caudal), the length of the head four times or four times and one-half. Head not much longer than high. Eye rather small, one-fifth of the length of the head, and two-thirds of that of the snout. Suborbitals narrow. The anterior dorsal rays are not much produced, being shorter than the head. Caudal fin forked. The origin of the ventral fin is vertically below the fourth dorsal ray. Pectoral fin not extending to ventral. There are five longitudinal series of scales between the lateral line and the root of the ventral.

Coloration uniform. Pharyngeal teeth very numerous and small, increasing somewhat in size downwards.

Four examples, from 9 to 10 inches long, were obtained by Mr. Salvin in the Rio Usumacinta.

271. Pristigaster macrops.

Günth. Proc. Zool. Soc. 1866, p. 603; and Fish. vii. p. 461.

D. 13. A. 61. L. lat. 53.

Abdominal profile but slightly convex, the greatest depth of the body being one-third of the total length (without caudal); the length of the head is contained four times and two-thirds in the same length; eye very large, its diameter being more than one-third of the length of the head, and nearly equal to that of the postorbital portion of the head. There are thirteen scales in the transverse series ascending from the origin of the anal fin to that of the dorsal, four of the series being above the lateral line. Origin of the dorsal fin midway between the root of the caudal and the scapula; origin of the anal nearer to the end of the snout than to the root of the caudal. A round black spot on the scapula.

A specimen, 8 inches long, was found by Messrs. Dow and Salvin on the Pacific coast of Panama.

272. Pristigaster dovii.

Pristigaster argenteus, Günth. Proc. Zool. Soc. 1866, p. 603 (not Cuv.).
—— *dovii,* Günth. Fish. vii. p. 461.

D. 11. A. 56. L. lat. 51.

Abdominal profile but slightly convex, the greatest depth of the body being two-sevenths of the total length (without caudal); the length of the head is nearly one-fifth of the same. Eye large, its diameter being two-sevenths of the length of the head, and two-thirds of that of the postorbital portion of the head. There are eleven or twelve scales in the transverse series ascending from the origin of the anal fin to that of the dorsal, four of the series being above the lateral line. Origin of the dorsal fin much nearer to the root of the caudal than to the scapula; origin of the anal midway between the end of the snout and the root of the caudal. Scapula with an indistinct blackish spot.

A specimen, $8\frac{1}{2}$ inches long, was found by Capt. Dow at Panama.

273. Clupea libertatis.

Meletta libertatis, Günth. Proc. Zool. Soc. 1866, p. 603.
Clupea libertatis, Günth. Fish. vii. p. 433.

D. 17. A. 19. L. lat. 48.

Closely allied to *C. thrissa.* The length of the head is contained thrice and two-thirds in the total (without caudal), the height of the body thrice and a half. The origin of the dorsal fin is much nearer to the end of the snout than to the root of the caudal. The dorsal filament does not extend on to the caudal. Uniform silvery, without humeral spot.

A single example, $2\frac{1}{2}$ inches long, was obtained by Messrs. Salvin and Dow at Libertad.

274. Chatoëssus petenensis.

Meletta petenensis, Günth. Proc. Zool. Soc. 1866, p. 603.
Chatoëssus petenensus, Günth. Fish. vii. p. 408.

D. 14–15. A. 20–23. L. lat. 40.

The length of the head is two-sevenths of the total (without caudal); the height of the body is contained thrice or twice and three-fourths in the same. The origin of the dorsal fin is nearer to the end of the snout than to the root of the caudal, and in advance of the ventrals. The dorsal filament does not extend on to the caudal. A small black round spot on the shoulder.

Four examples, from 3 to 4 inches long, were obtained by Mr. Salvin in Lake Peten.

276. Engraulis poeyi.

Kner & Steindachner, Abhandl. bayer. Akad. x. p. 23, Taf. 3. fig. 3.

D. 16. A. 24. L. lat. 42.

The length of the head is nearly equal to the height of the body, which is two-ninths of the total (without caudal); snout very short and rather obtuse; eye rather larger than one-fourth of the length of the head. The origin of the dorsal fin is nearer to the root of the caudal than to the end of the snout; origin of the anal fin opposite to the middle of the dorsal. Pectoral fin reaching a little beyond the root of the ventral. Upper and lower jaws with small teeth.

Rio Bayano.

277. Engraulis macrolepidota.

Kner & Steindachner, *l. c.* p. 21, taf. 3. fig. 2.

B. 12–13. D. 12. A. 29. L. lat. 35. L. transv. 9.

The length of the head is two-sevenths of the total (without caudal), the height of the body one-third. Snout pointed, very short. The diameter of the eye is one-fourth of the length of the head. The origin of the dorsal fin is a little nearer to the root of the caudal than to the end of the snout; origin of the anal fin immediately behind the end of the dorsal. Maxillary edentulous, extending to the angle of the præoperculum.

Rio Bayano.

278. Cetengraulis mysticetus.

Engraulis mysticetus, Günth. Proc. Zool. Soc. 1866, p. 604.
Cetengraulis mysticetus, Günth. Fish. vii. p. 383.

D. 17. A. 20. L. lat. 42. L. transv. 14.

Head exceedingly large, its length being contained twice and four-fifths in the total (without caudal); the height of the body is contained thrice and two-thirds in the same; the depth of the head is two-thirds of its length; snout compressed, pointed, considerably shorter than the eye, the diameter of which is contained five times and a half in the length of the head. The origin of the dorsal fin is nearer to the root of the caudal than to the end of the snout; origin of the anal somewhat in advance of the end of the dorsal. Pectoral fin reaching a little beyond the root of the ventral. Scales adherent. Silvery, back greenish.

Three examples, the largest 6 inches long, were obtained by Messrs. Dow and Salvin on the Pacific coast of Panama.

279. Carapus fasciatus (Pall.).

Two examples from the Rio Motagua are of a uniform brown coloration, but do not differ structurally from South-American specimens.

284. Tetrodon politus (Gir.).

D. 8. A. 7.

Nasal cavity with a short, imperforated papilla. Body smooth, except in the inter-pectoral region, which is provided with minute spines. Head as broad as high, its greatest depth being equal to the distance between the gill-opening and the front margin of the orbit. Eye rather nearer to the gill-opening than to the end of the snout. Upper parts blackish brown, with numerous black dots; belly and lower part of the sides white. Dorsal and caudal fins brown; axil of the pectoral blackish.

One specimen, 13 inches long, was obtained by Mr. Salvin at San José.

285. Tetrodon geometricus.

D. 8. A. 7.

Nasal cavity with a short, imperforated papilla. Body covered with minute spines, except on the snout and tail. Belly pendent, very extensible. Head nearly as high as broad, its depth being equal to its length without snout. The eye occupies the middle of the length of the head. Upper parts blackish, with bluish transverse lines, curved on the sides; sides with some scattered black spots, lower parts white. Caudal fin white in its basal, and black in its outer half; the other fins whitish.

One example, 3 inches long, was obtained by Messrs Dow and Salvin at Panama.

289. Balistes frenatus (Lacép.).

A specimen, 8 inches long, obtained by Capt. Dow at Gonzalez Island, differs in being of a more uniform coloration, the yellow band on the head being but slightly indicated.

292. Lepidosteus tropicus.

Atractosteus tropicus, Gill, Proc. Ac. Nat. Sc. Philad. 1863, p. 172.

D. 10–11. A. 11. L. lat. 54. L. transv. 8/12.

The length of the head is nearly one-fourth of the total; the width of the interorbital space is two-fifths of the length of the snout, which equals the distance of the front margin of the orbit from the fifth scale of the lateral line. The root of the ventral fin is nearer to the base of the caudal than to the end of the snout.

Two examples, 18 inches long, were obtained by Mr. Salvin at Huamuchal.

293. Mustelus dorsalis.

Gill, Proc. Ac. Nat. Sc. Philad. 1864, p. 149.

"Teeth unicuspid. The posterior angle of the first dorsal fin projects to the vertical of the origin of the ventrals, although the anterior fourth of the base of the fin is above the pectoral. The caudal fin equals the distance between the snout and third branchial aperture; and its terminal lobe nearly equals a third of the length, and is obliquely truncated behind."

Panama.

295. Carcharias maculipinnis.

Isogomphodon maculipinnis, Poey, Repertor. Fis. Nat. Cub. 1865, p. 191.

This species belongs to the subgenus *Prionodon*. Teeth with the terminal portion much constricted—the serrature being very fine, and only in a few distinct to the point; there are twelve on each side of the upper jaw; teeth of the lower jaw without any denticulations. The length of the snout, from the front margin of the mouth, is not much less than the width of the cleft of the mouth; the latter very deep, forming nearly a semicircular arch. The dorsal fin commences opposite to the inner posterior angle of the pectoral; pectoral pointed, not twice as broad as long. Coloration uniform grey, tips of most of the fins black.

One example, 4 feet long, was obtained by Mr. Salvin at Chiapam; the species was first described from a Cuban specimen.

297. Rhinobatus leucorhynchus.

The anterior nasal valve is not prolonged to the inner angle of the nostril. Disk longer than broad; the prænasal part of the snout is not so long as broad at the base, but longer than the distance between the front extremities of the nostrils. Skin very finely granular; a series of very small, distant, smooth, oblong tubercles along the median line of the back. Nostrils longer than the space between their posterior extremities, but shorter than the mouth. Upper parts uniform ashy brown, the præocular part of the snout yellowish white.

One male, 21 inches long, was obtained by Capt. Dow on the Pacific coast of Panama.

299. Urolophus mundus.

Urotrygon mundus, Gill, Proc. Ac. Nat. Sc. Philad. 1863, p. 173.

Mr. Gill proposes the generic name of *Urotrygon* for *U. torpedinus* and the present species, the new genus being distinguished by the rounded and not angular outline, the longer tail and posterior insertion of the spine, and especially the acute teeth. The new species is thus characterized:—

The disk is orbicular, with a slight linguiform projection in front, and with the pectoral fins behind broadly rounded. The distance of the snout from the hinder margin of the pectorals equals the width of the disk. The tail (behind the anus) is rather longer than the body (in front). The spine is inserted behind the middle of the tail, and is about as long as the distance between the snout and the nostrils. The ventral fins extend outwards, the rectilinear anterior margin tending little backwards; and the external margins are on a line with and complete the outline of the disk. The posterior margin in the male is nearly rectilinear, while in the female it is slightly convex, especially towards the inner angles. The upper velum is very sinuous and fimbriated. The teeth are pointed and pyramidal. The spiracles are oval, interrupted at the intero-anterior angle by the eyes; and the margins are entire and well defined. The skin is beset with numerous small stelliform tubercles, larger on the dorsal region. The colour is a uniform dark brown above.

Two small specimens, male and female, were collected by Capt. Dow on the Pacific coast of Central America.

300. Aëtobatis latirostris (A. Dum.).

This species was known from one very young example only, from the west coast of Africa; Messrs. Dow and Salvin have rediscovered it in the Bay of Panama. The specimen, which to the root of the tail is 12 inches long, and has a tail of 44 inches, does not differ in anything from the Atlantic example. I may remark here that the soft rostral appendage is naturally bent upwards, like the nose-leaf of certain Chiroptera, and is not horizontally stretched forward as represented by M. A. Duméril.

EXPLANATION OF THE PLATES.

PLATE LXIII.

Map of the States of Central America, exhibiting localities mentioned in the paper. The areas less than fifteen hundred feet above the sea-level are coloured *green*.

PLATE LXIV.

Fig. 1. *Pristipoma macracanthum*, p. 416.
Fig. 2. *Umbrina elongata*, p. 425.
Fig. 3. *Conodon pacifici*, p. 417.

PLATE LXV.

Fig. 1. *Centropristis macropoma*, p. 409.
Fig. 2. *Hæmulon margaritiferum*, p. 419.
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[1] The figures on this plate ought to have been reversed.

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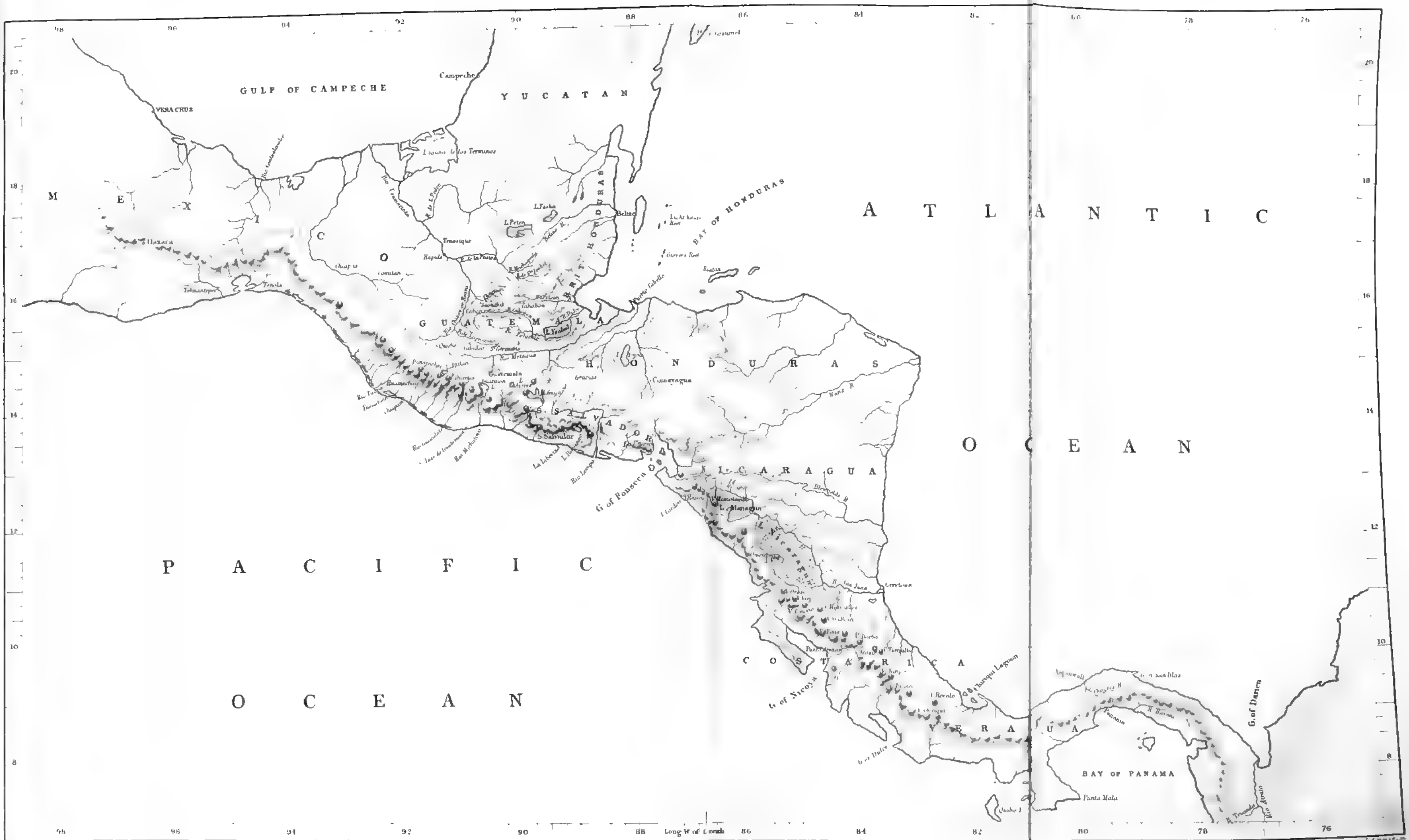
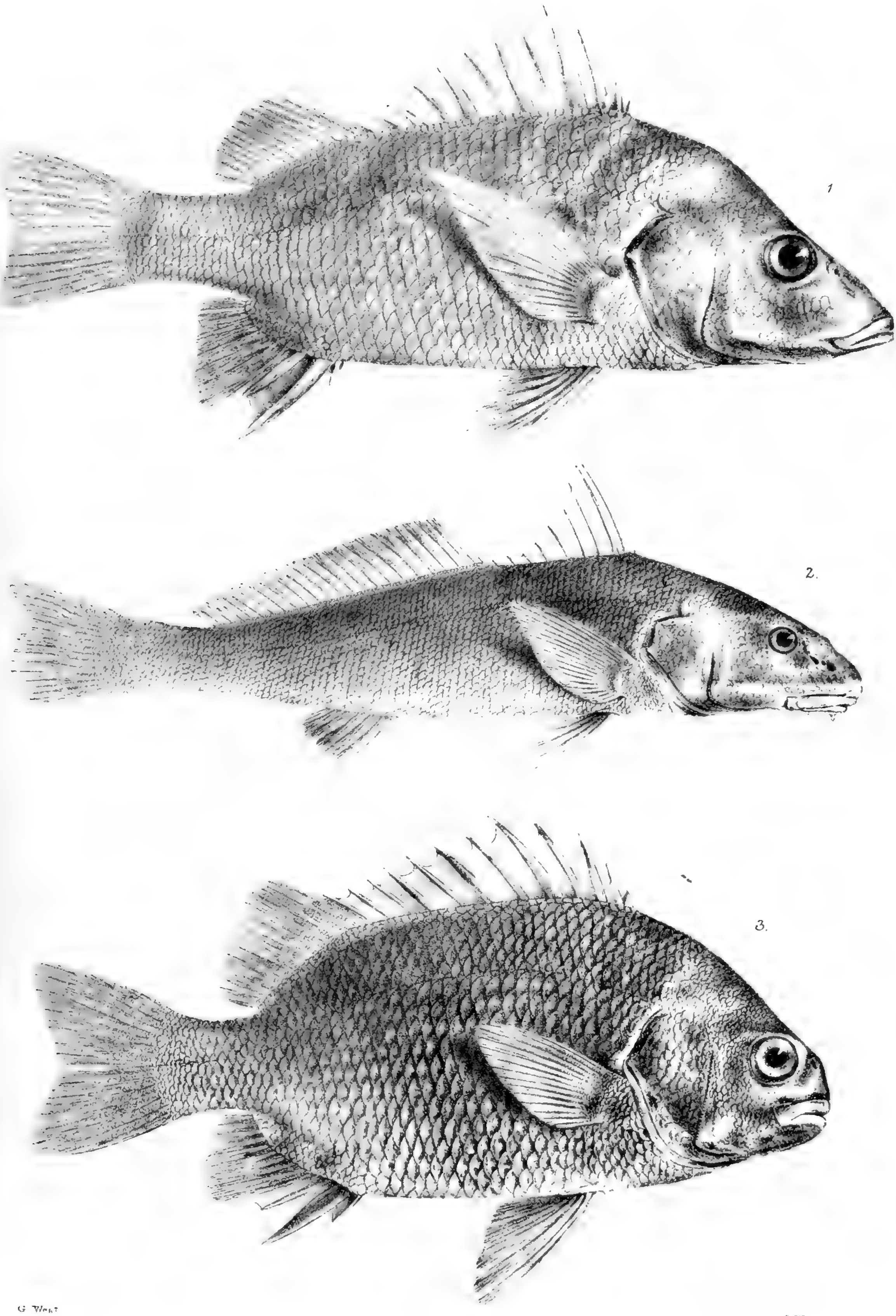
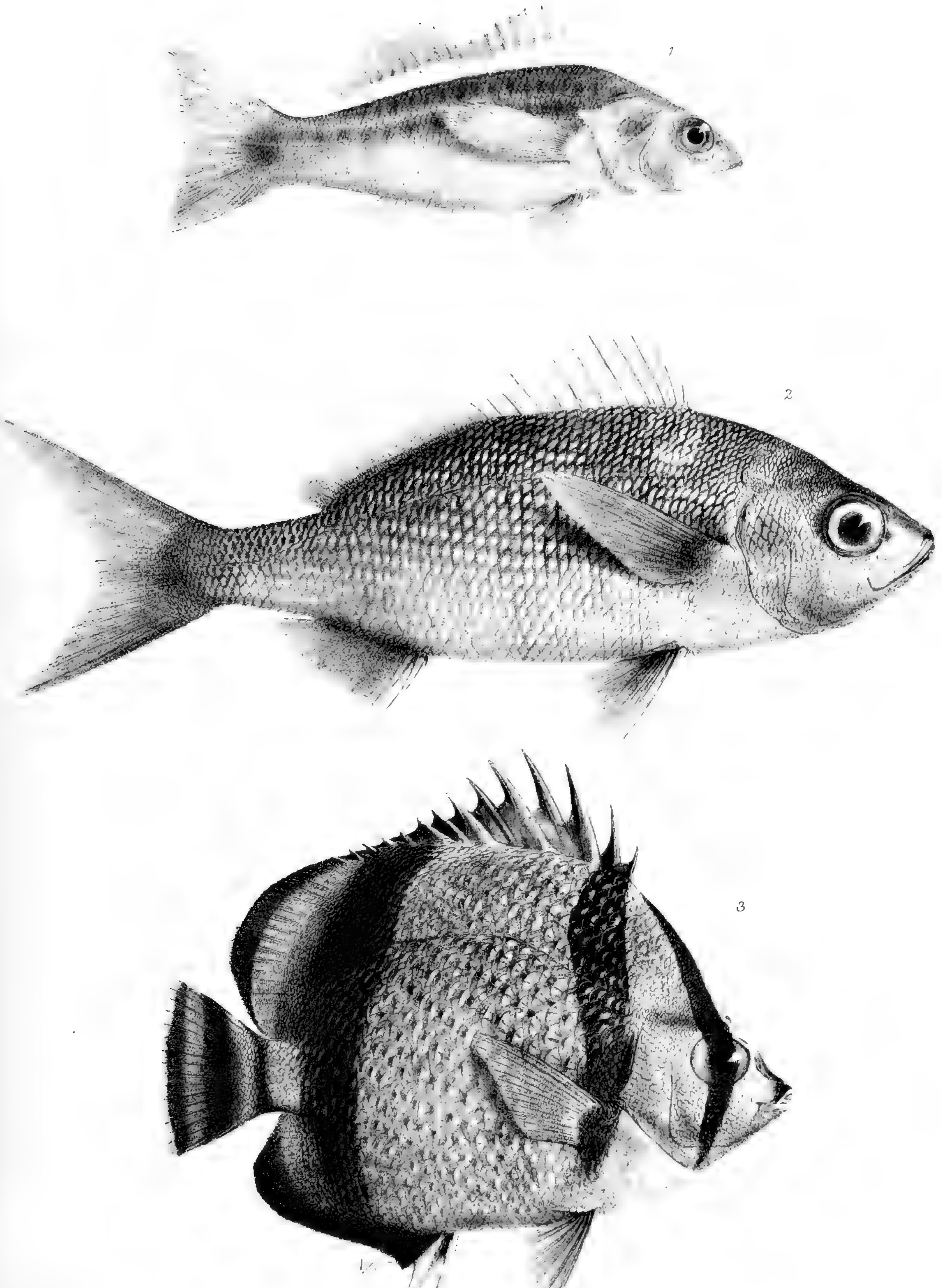


GULF OF CAMPECHE
YUCATAN
Campeche
VERA CRUZ
MEXICO
GUATEMALA
BRIT. HONDURAS
BAY OF HONDURAS
Belize
L. Peten
HONDURAS
Comayagua
NICARAGUA
L. Managua
G. of Fonseca
S. Salvador
COSTA RICA
G. of Nicoya
Greytown
VERAGUA
BAY OF PANAMA
Punta Mala
G. of Darien
ATLANTIC OCEAN
PACIFIC OCEAN
Long. W. of Greenwich



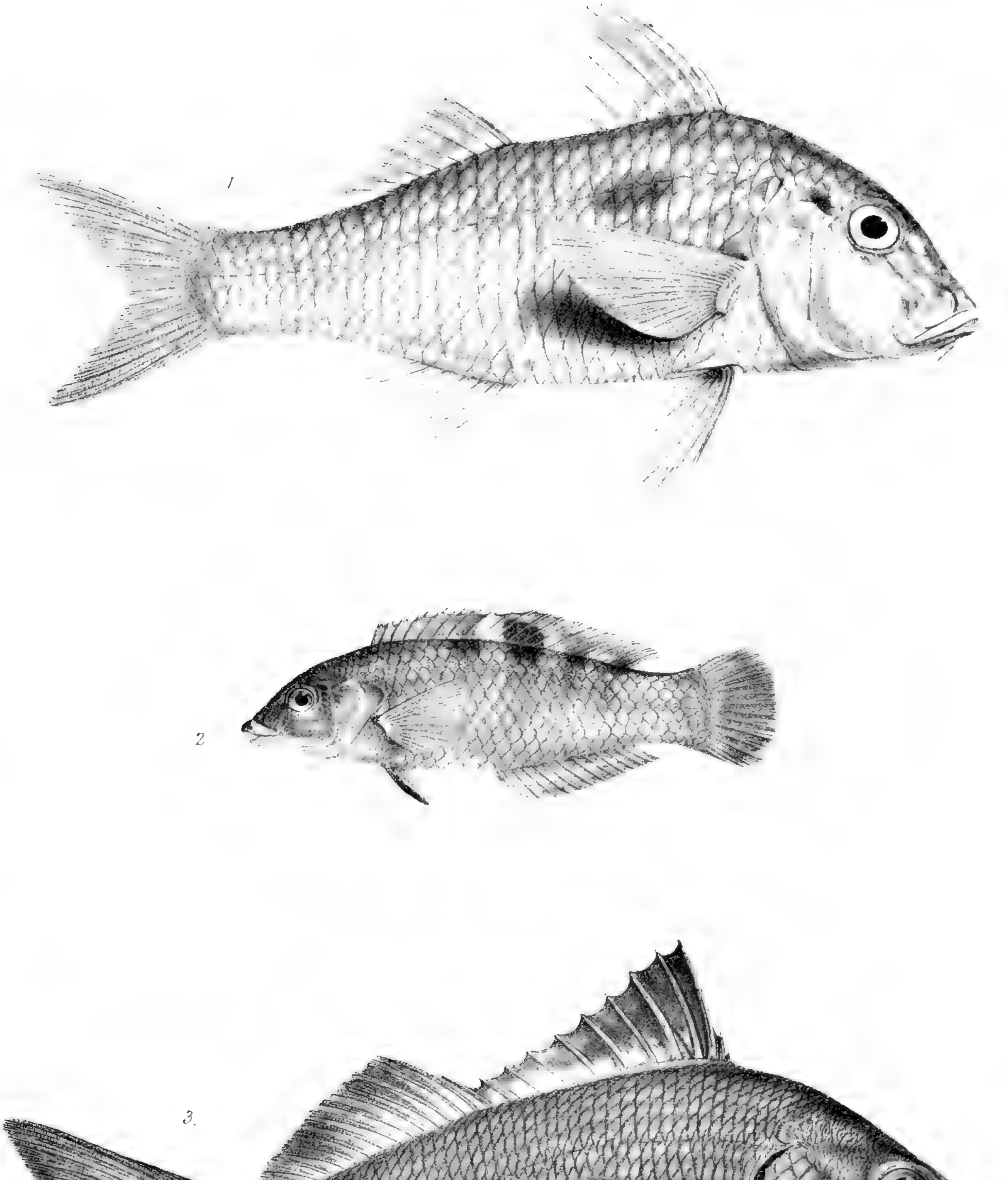
G. West
W West imp

1. PRISTIPOMA MACRACANTHUM. 2. UMBRINA ELONGATA. 3. CONODON PACIFICI.



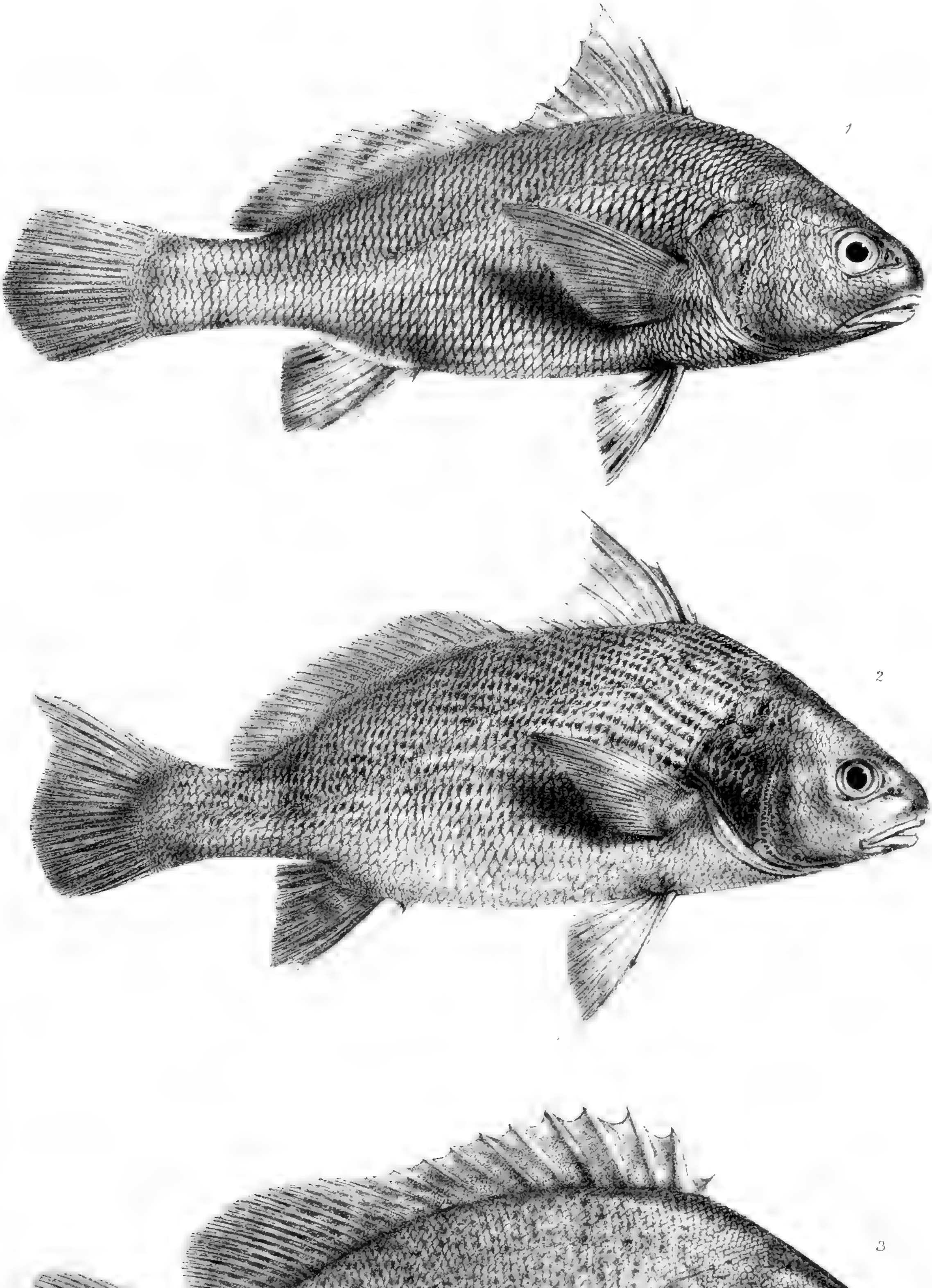
G. H. Ford W West imp

1. CENTROPRISTIS MACROPOMA. 2. HÆMULON MARGARITIFERUM
3. CHÆTODON HUMERALIS.



G.H. Ford W. West imp.

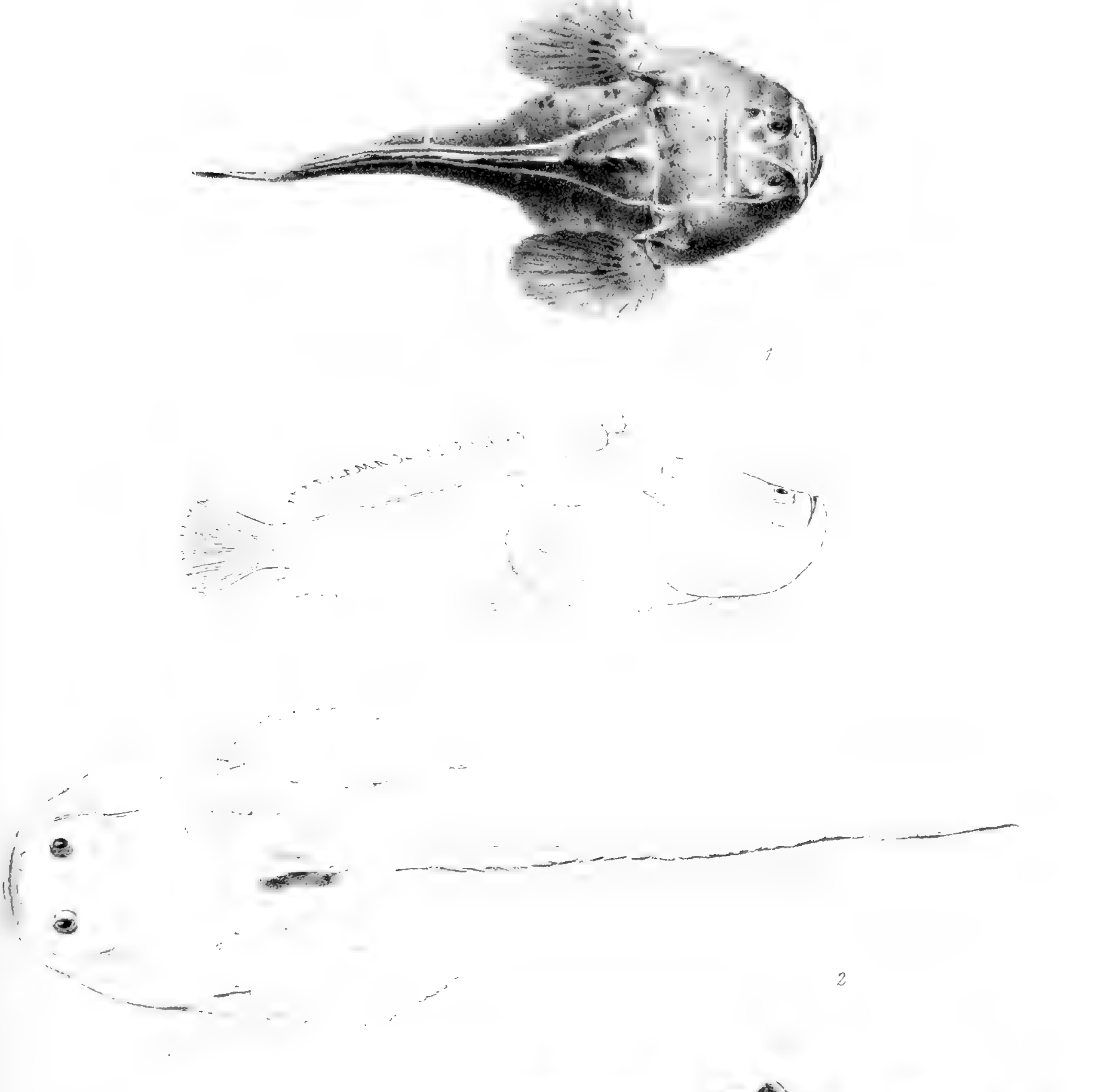
1. UPENEUS TETRASPILUS. 2. PSEUDOJULIS NOTOSPILUS. 3. PRISTIPOMA LEUCISCUS.



G.H Ford

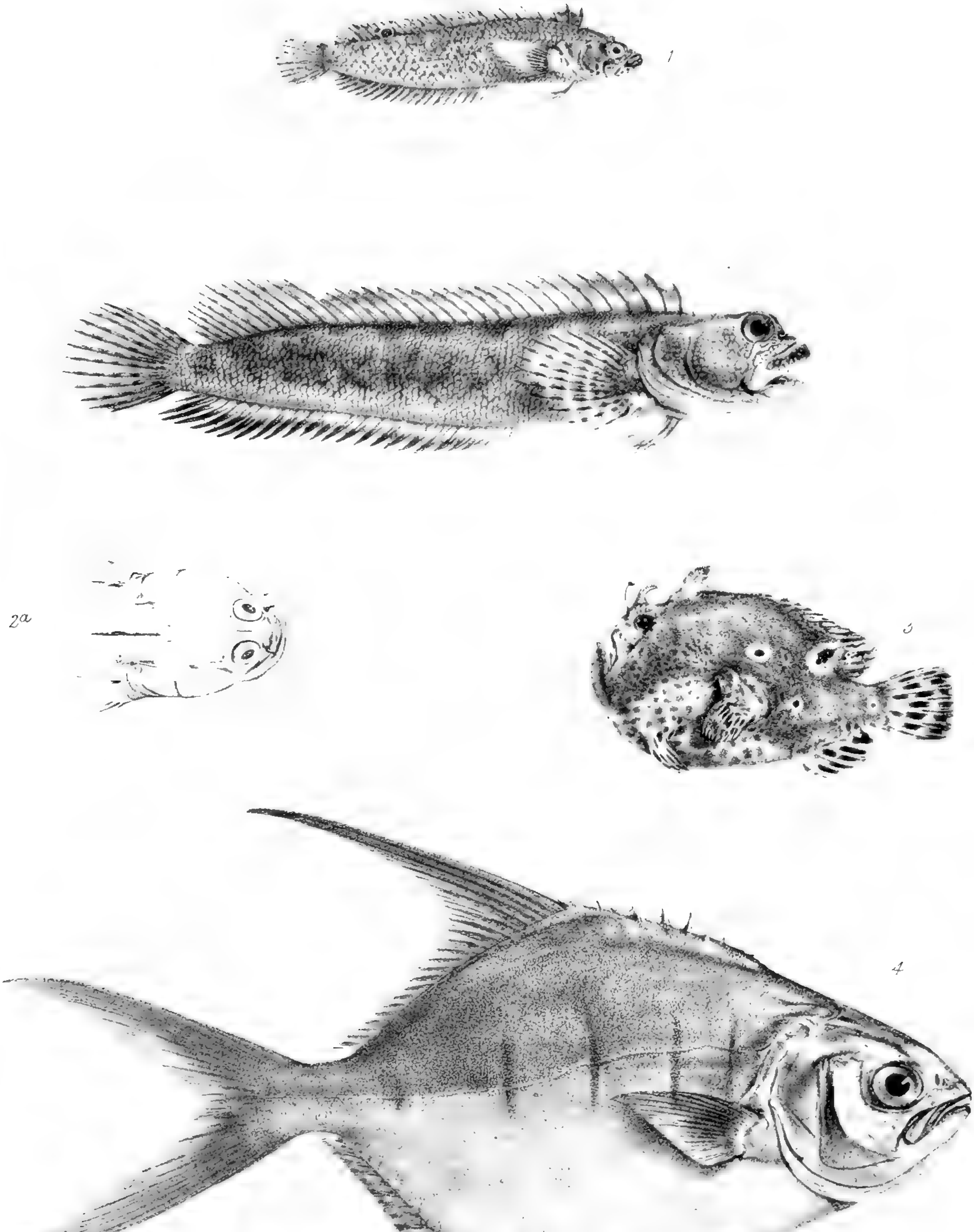
W West imp

1. CORVINA CHRYSOLEUCA. 2. C. VERMICULARIS. 3. PLECTROPOMA AFRUM.



G. West. W West imp

1. THALASSOPHRYNE MACULOSA. 2 T. RETICULATA



G H Ford. W West imp

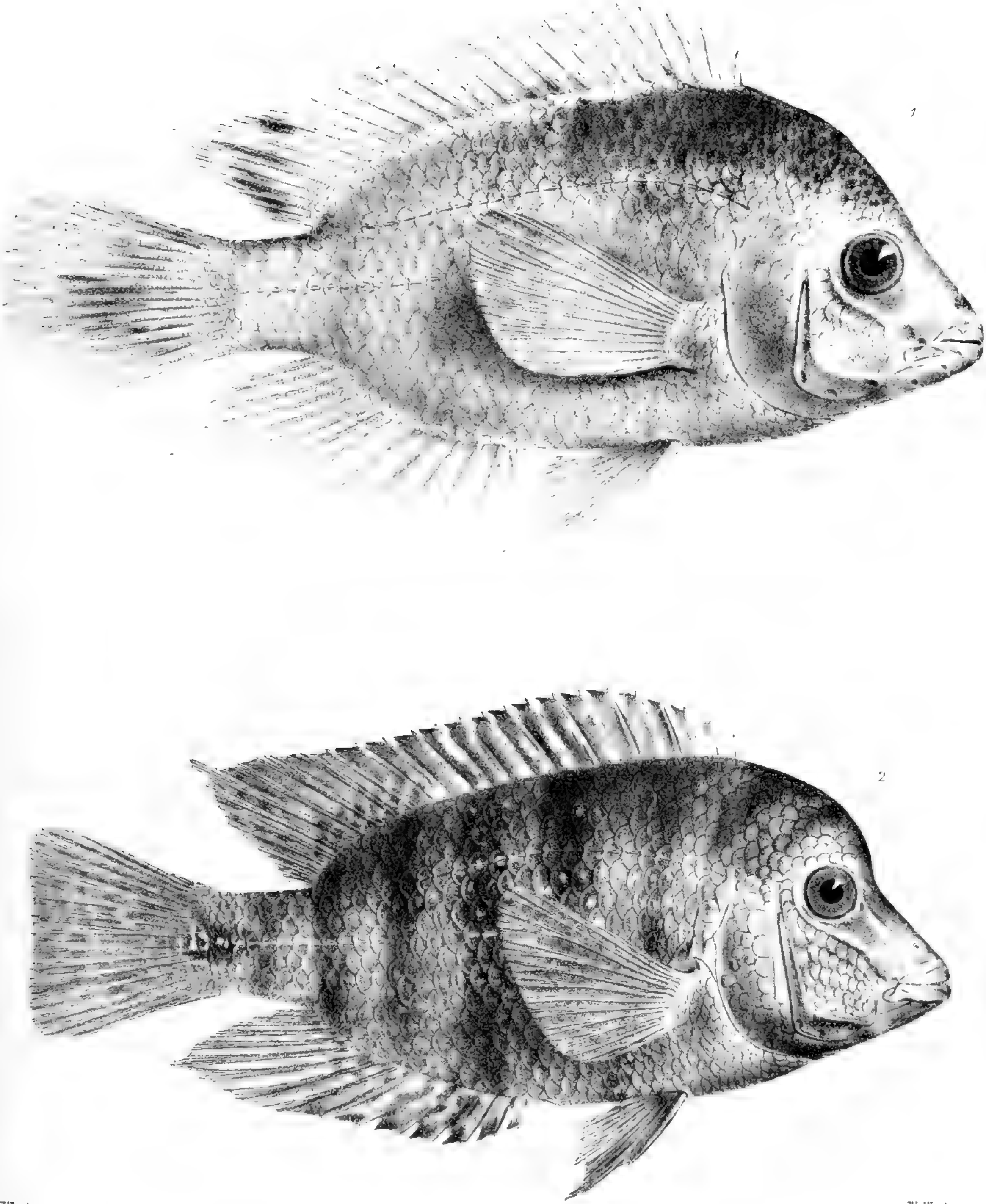
1. CREMNOBATES MONOPHTHALMUS. 2. CLINUS MACROCEPHALUS.

3. ANTENNARIUS LEOPARDINUS. 4. TRACHYNOTUS FASCIATUS.

G H Ford

W West imp

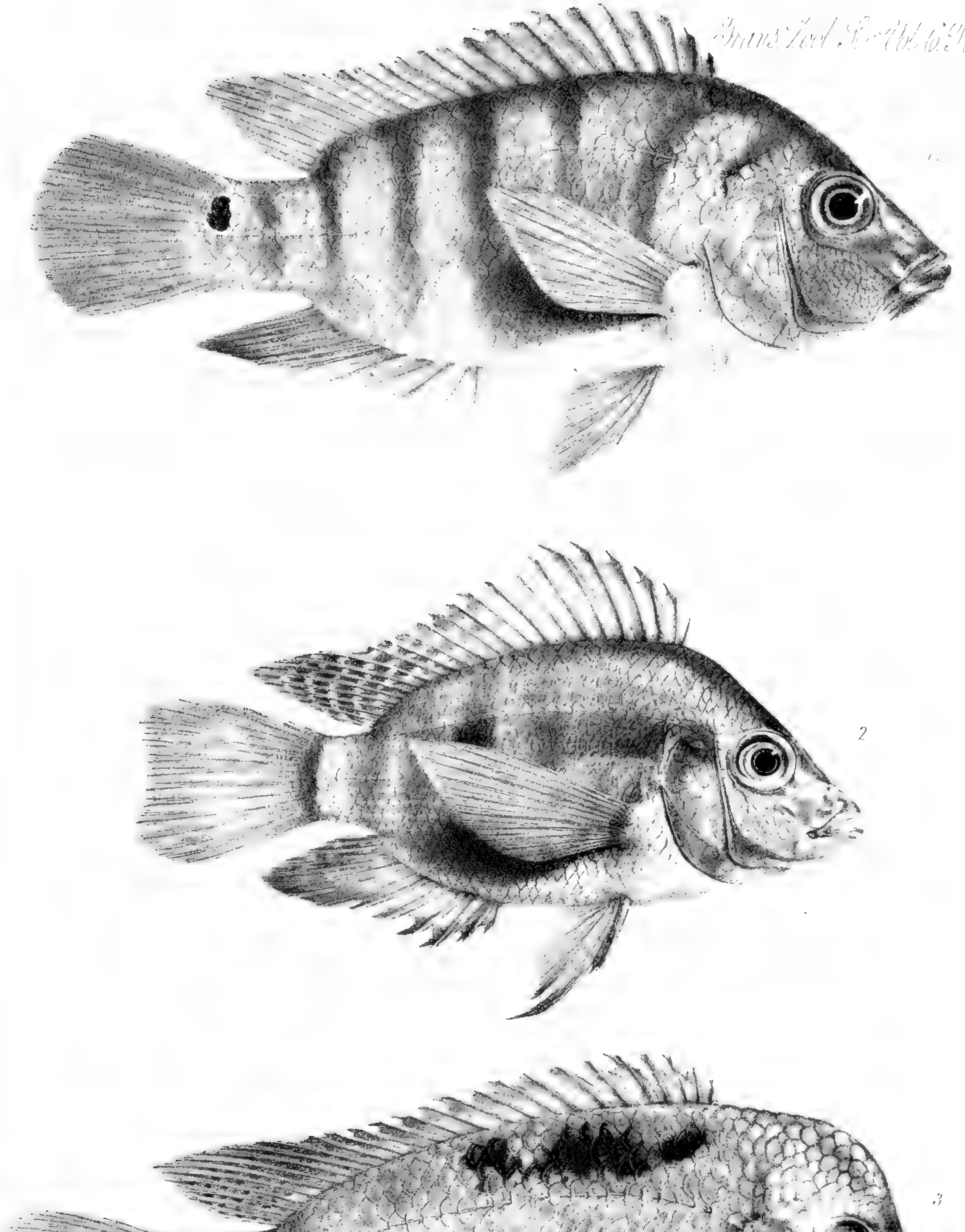
1 AGONOSTOMA MICROPS. 2. A. NASUTUM.



G. West.

W West imp

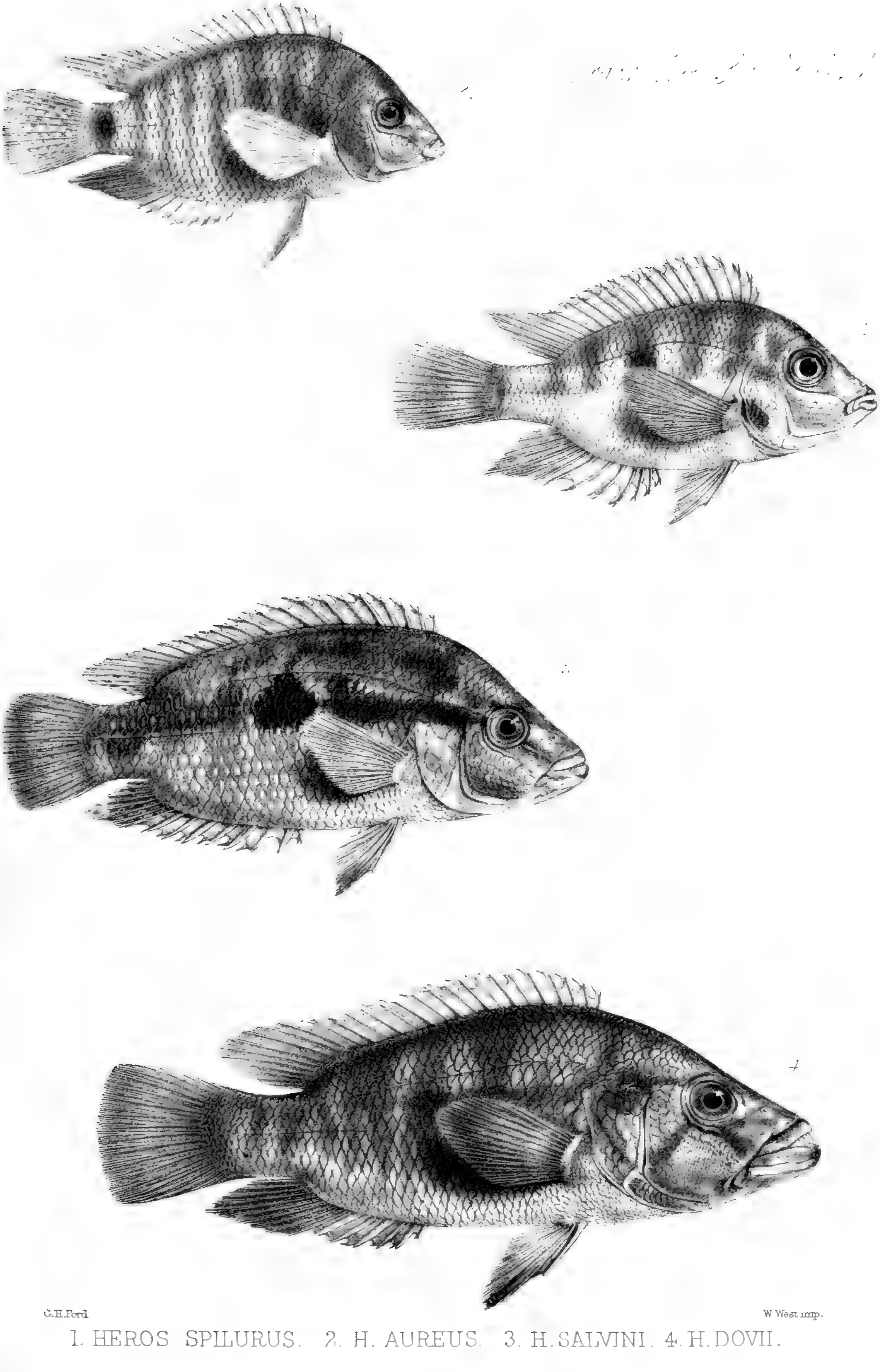
1. HEROS CITRINELLUS. 2. HEROS MARGARITIFER.



G H Ford

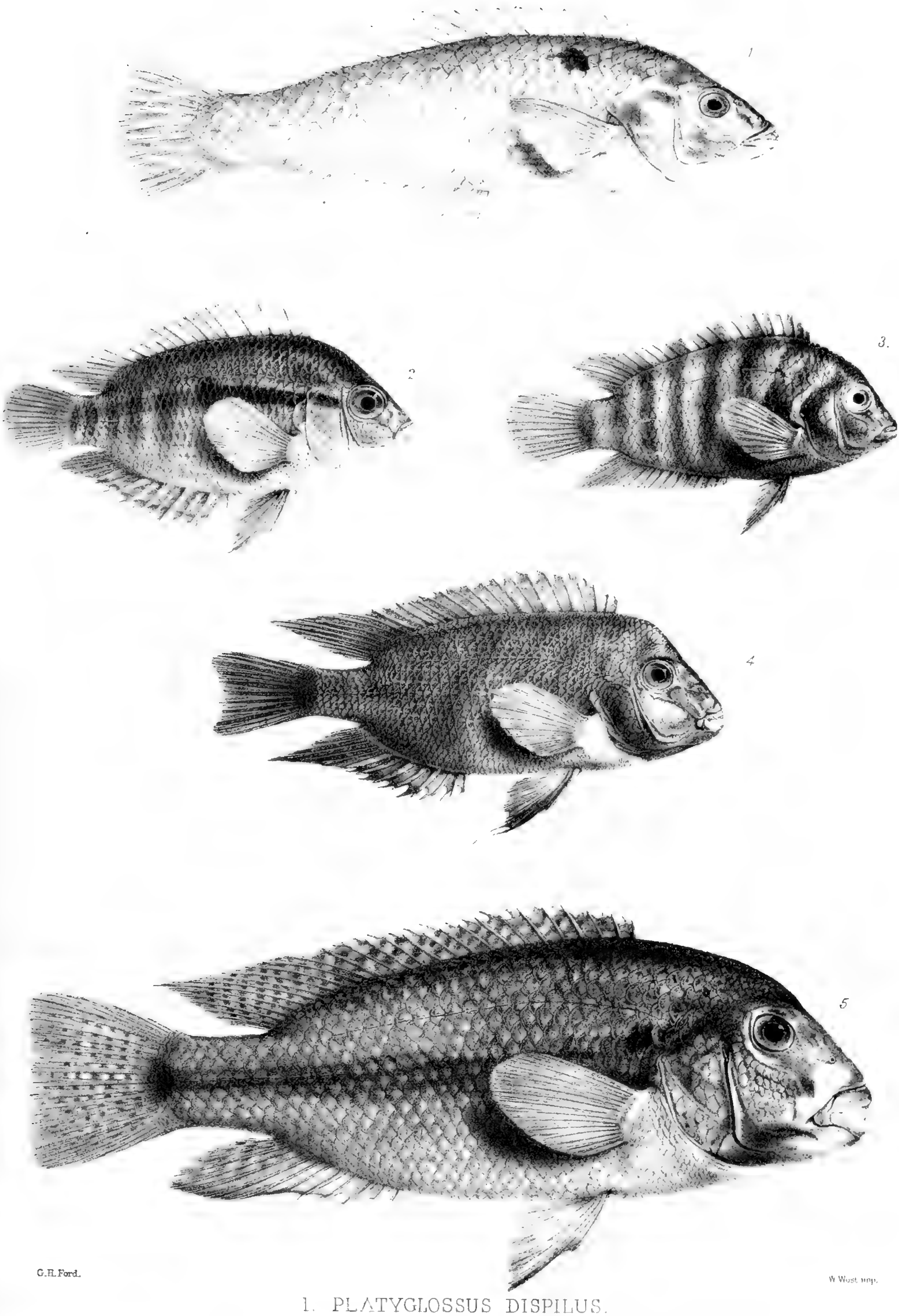
W West imp

1. HEROS UROPHTHALMUS. 2. H. LONGIMANUS 3. H. MELANURUS.



G.H.Ford W West imp.

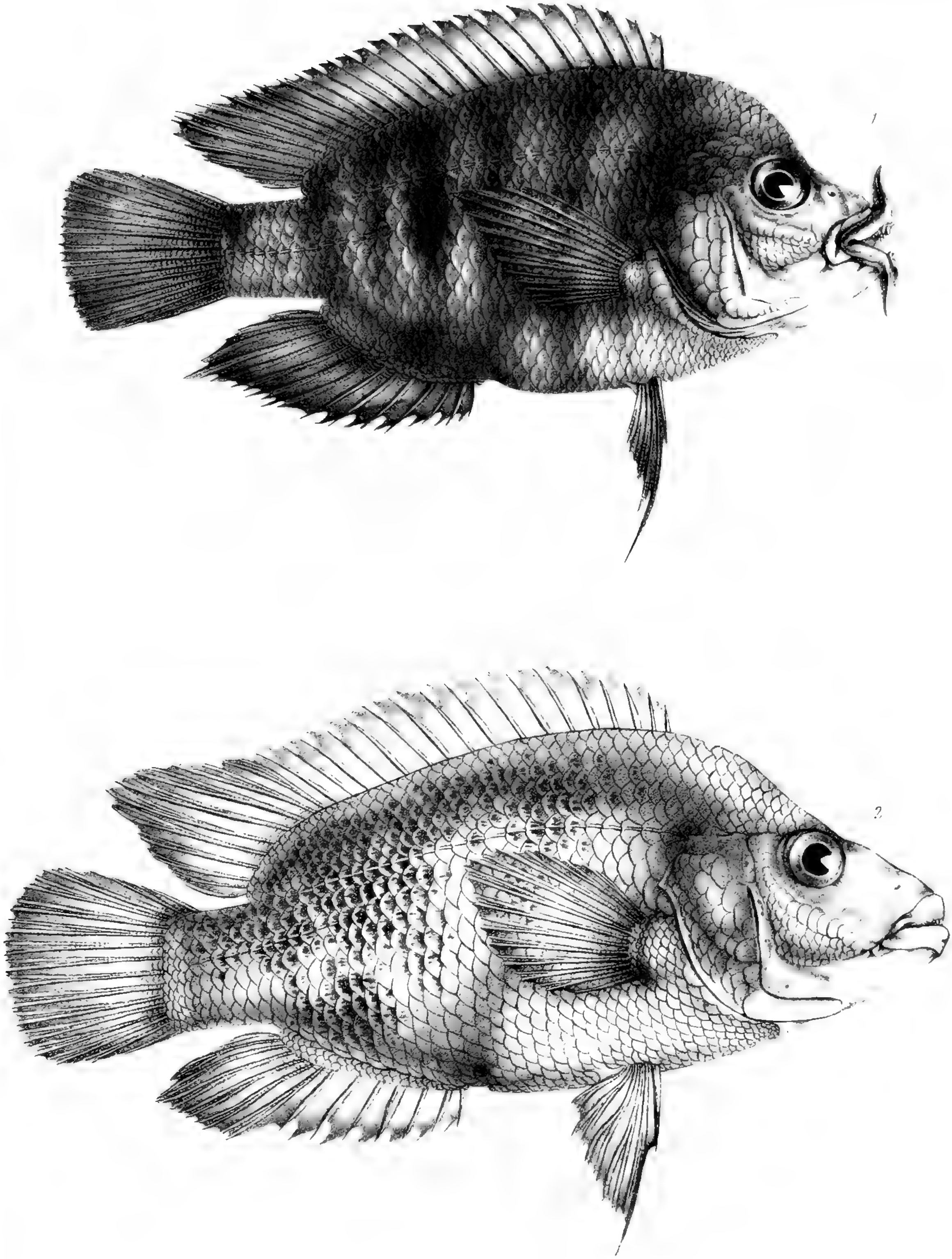
1. HEROS SPILURUS. 2. H. AUREUS. 3. H. SALVINI. 4. H. DOVII.



G.H. Ford.

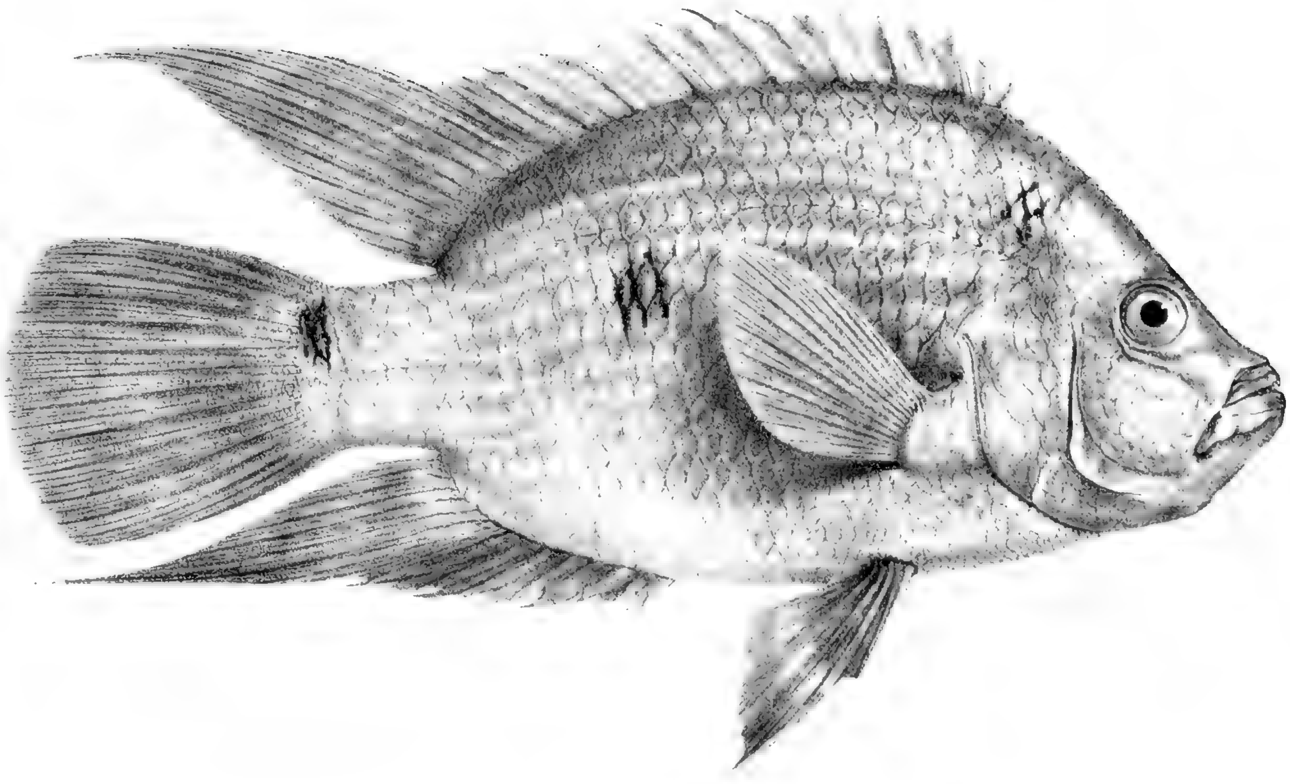
W West imp.

1. PLATYGLOSSUS DISPILUS.
2. HEROS MULTISPINOSUS. 3. H. NIGROFASCIATUS. 4 NEETROPLUS NEMATOPUS.
5. HEROS GODMANNI.



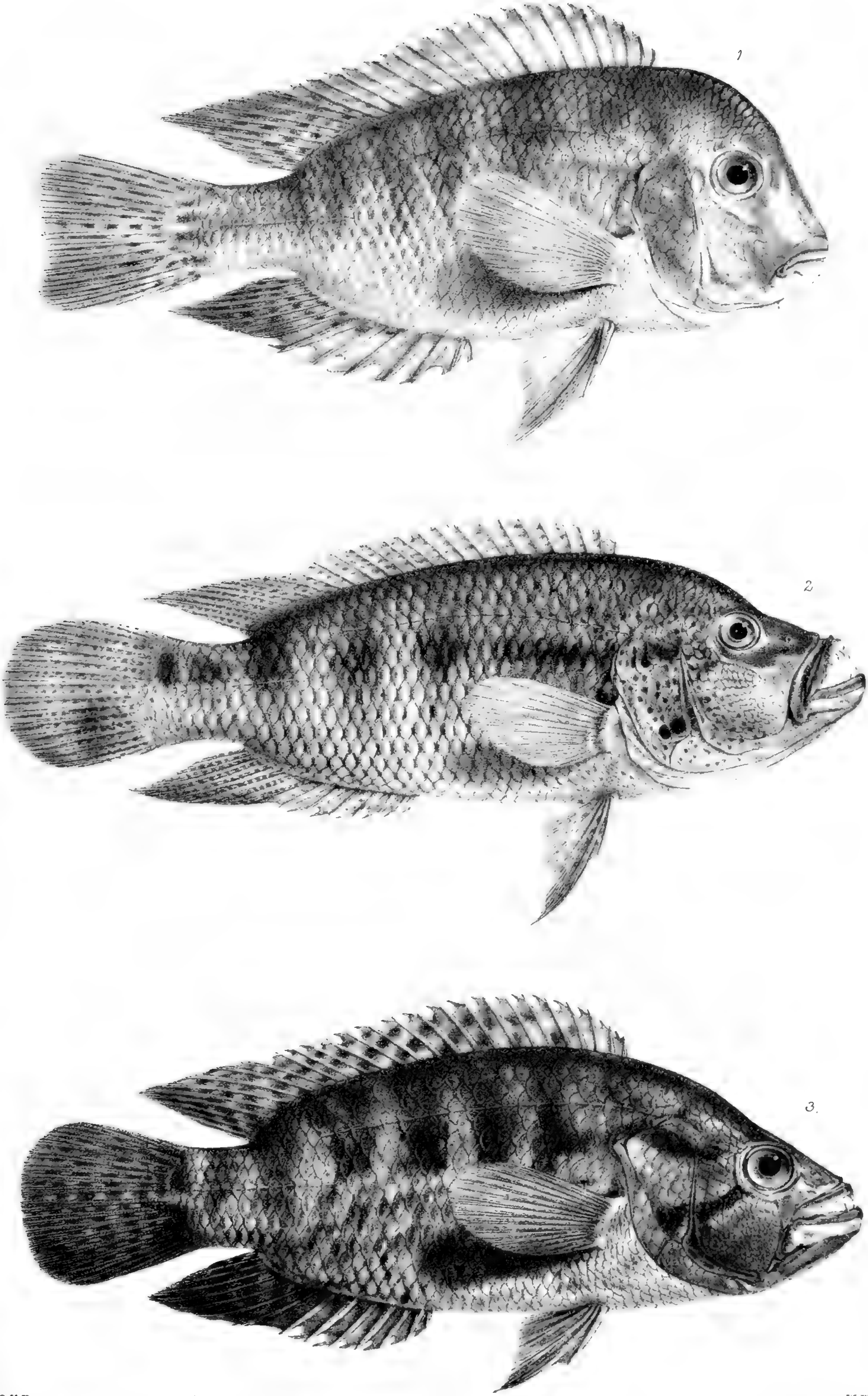
T. Susini lith.

1. HEROS LOBOCHILUS. 2. H. [illegible]



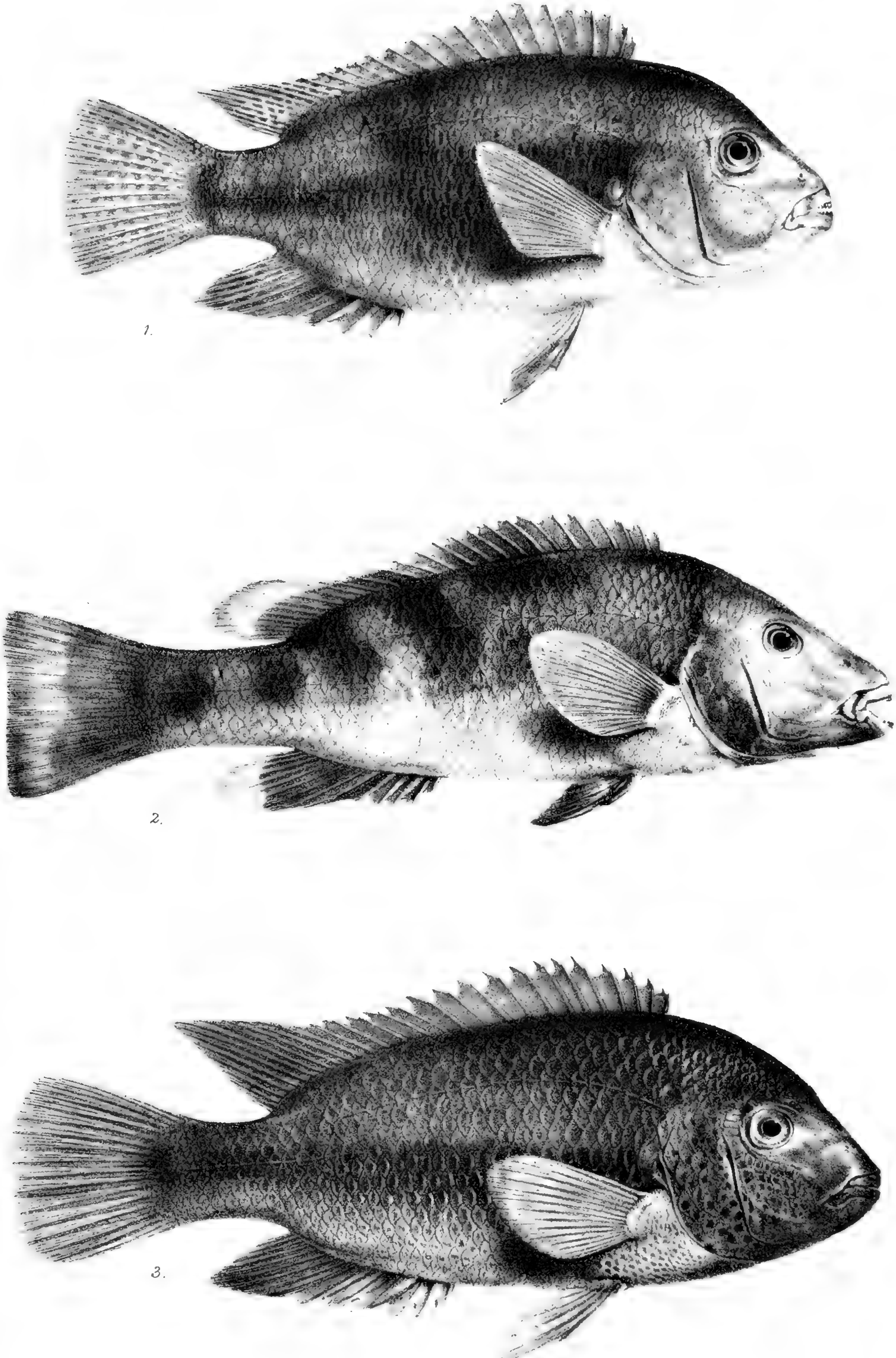
G H Ford W West imp

HEROS TRIMACULATUS.



G. H. Ford. W. West imp.

1. HEROS NICARAGUENSIS. 2. H. MOTAGUENSIS. 3. H. MANAGUENSIS.

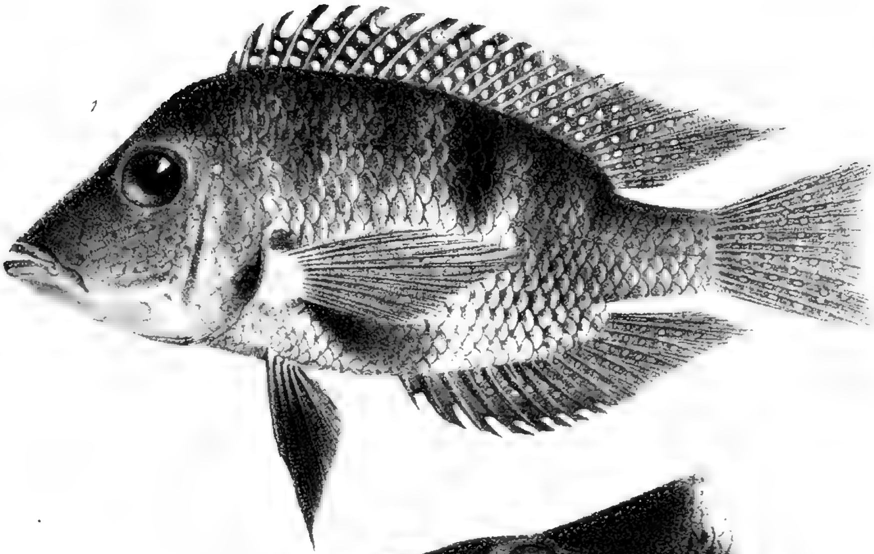


G. H Ford.

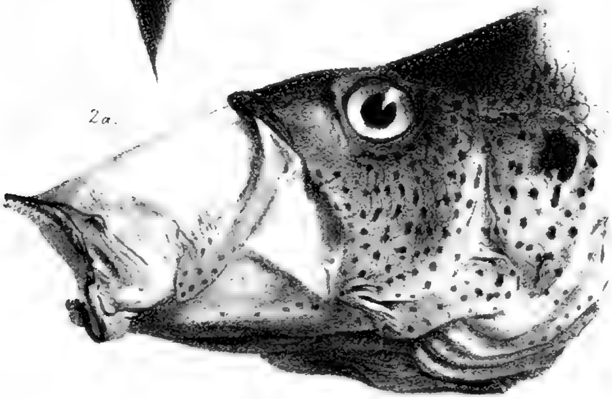
W West imp

1. HEROS INTERMEDIUS. 2. H. IRREGULARIS. 3. H. GUTTULATUS

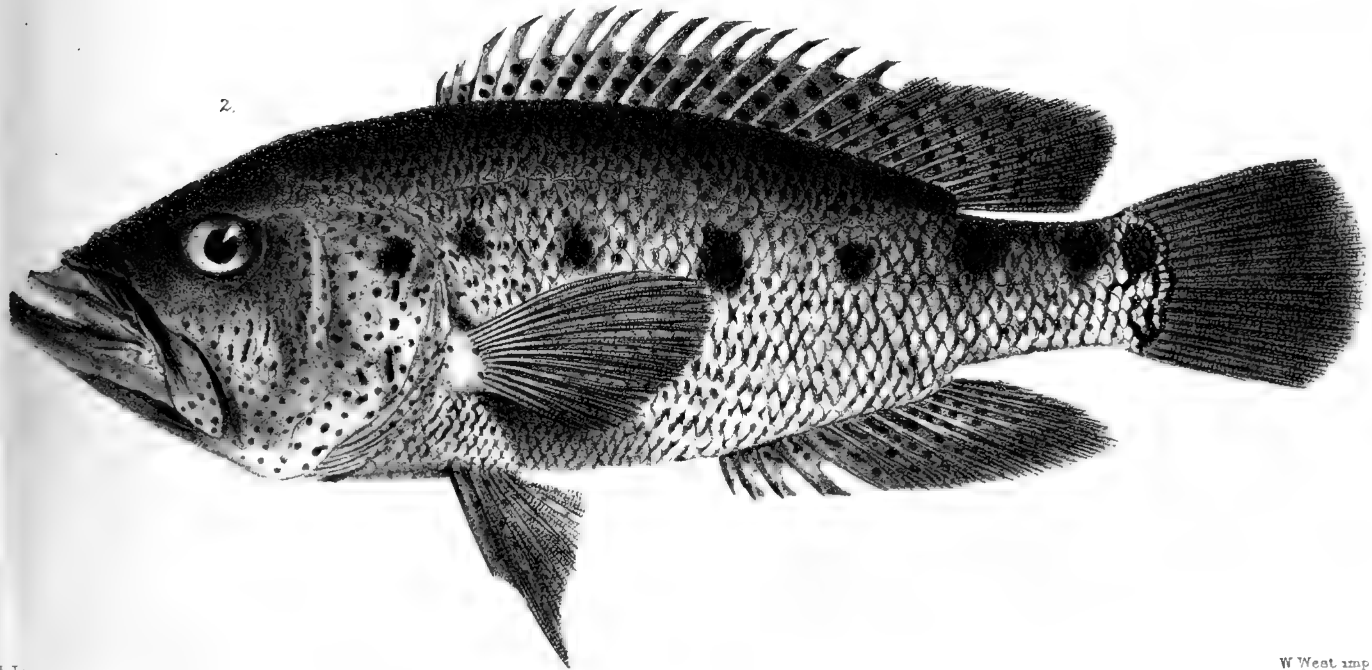
1



2a.



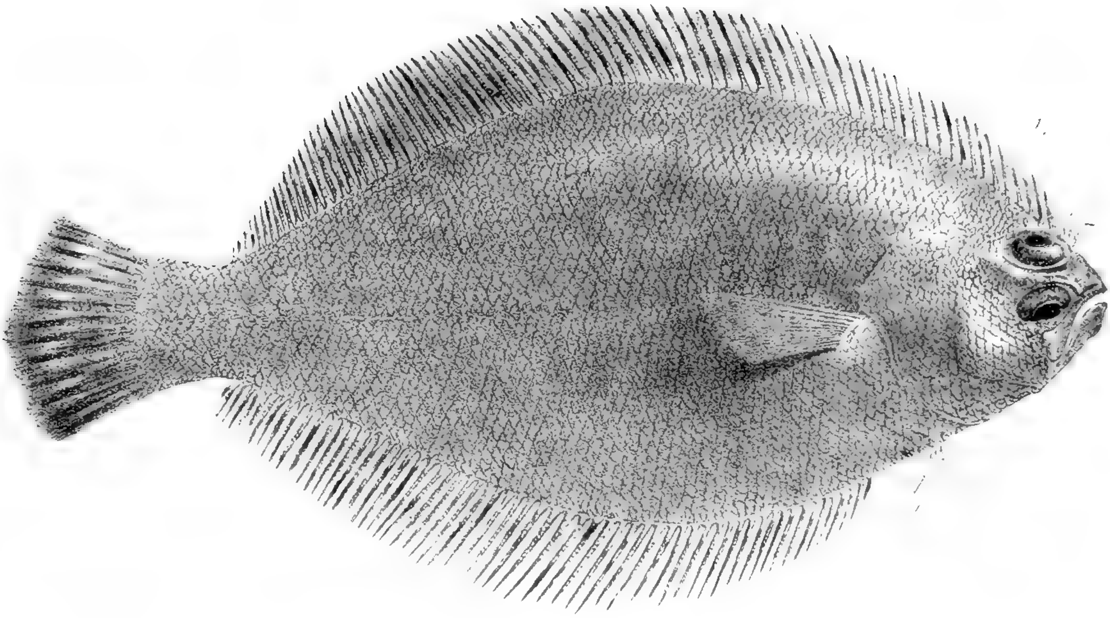
2.



J Jury

W West imp

1 HEROS AFFINIS. 2, 2a. PETENIA SPLENDIDA.



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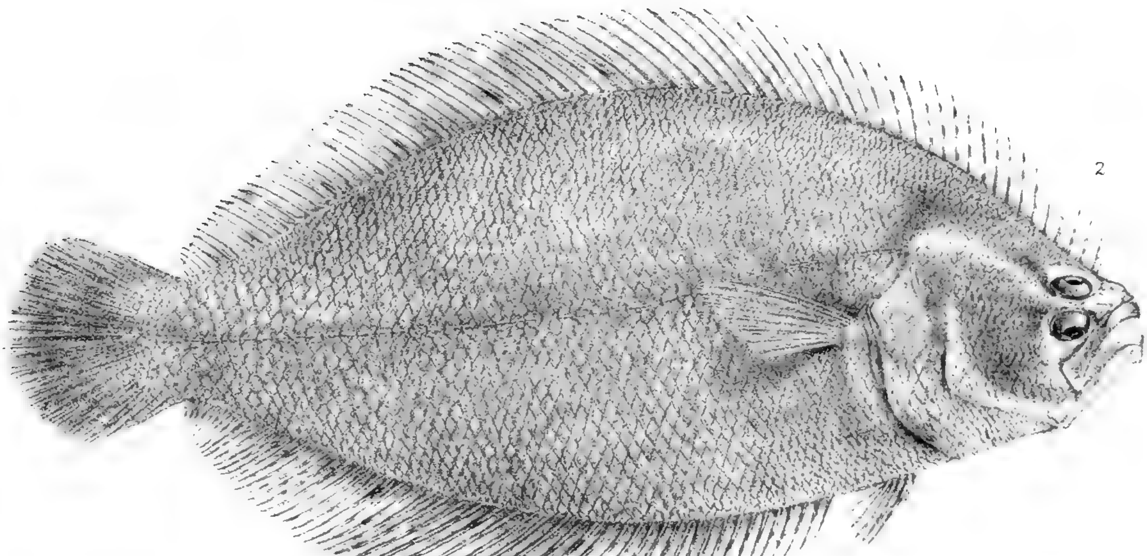


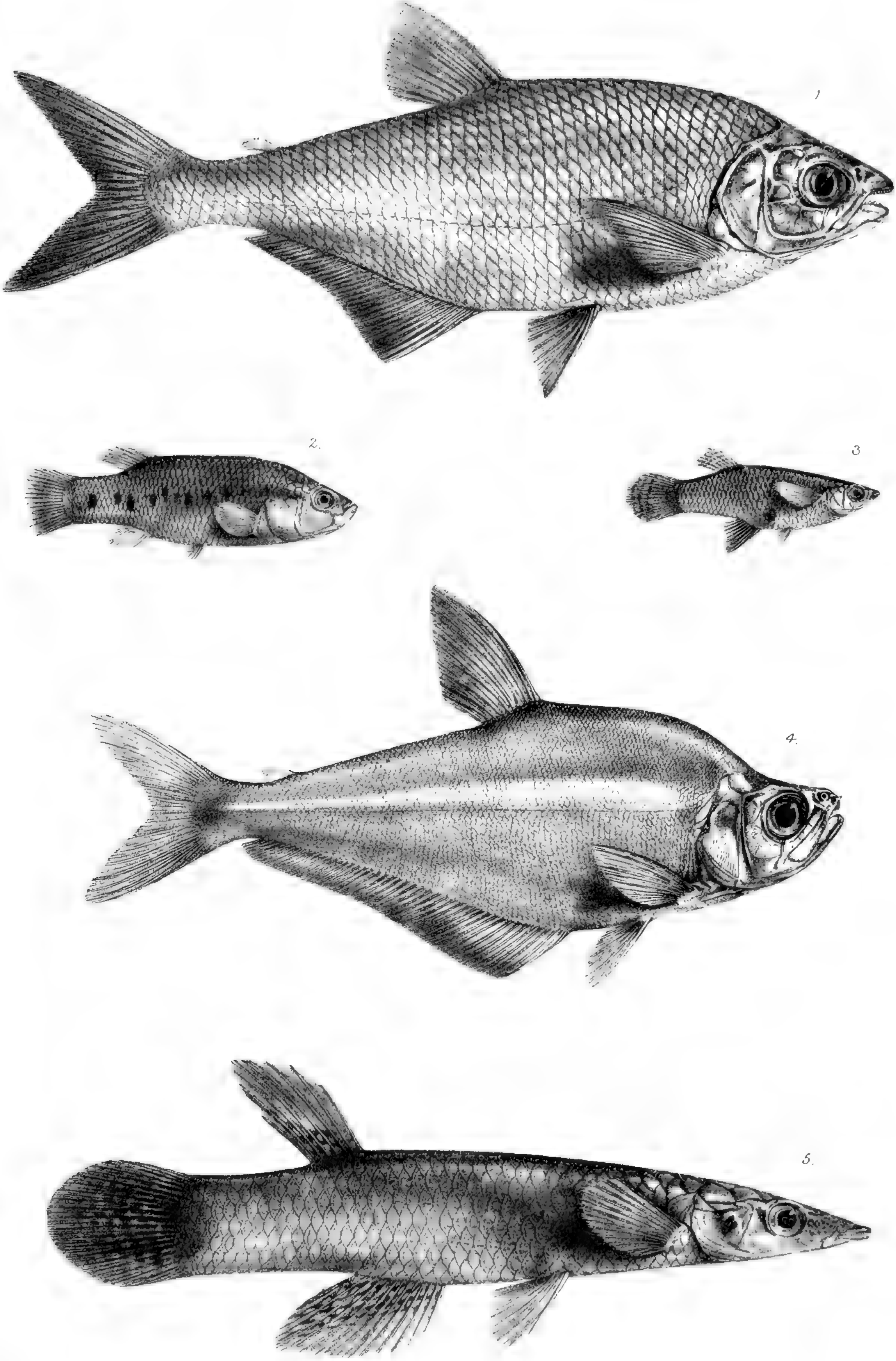
2

J. Jury

W West imp.

1. HEMIRHOMBUS OVALIS. 2. CITHARICHTHYS SPILOPTERUS.

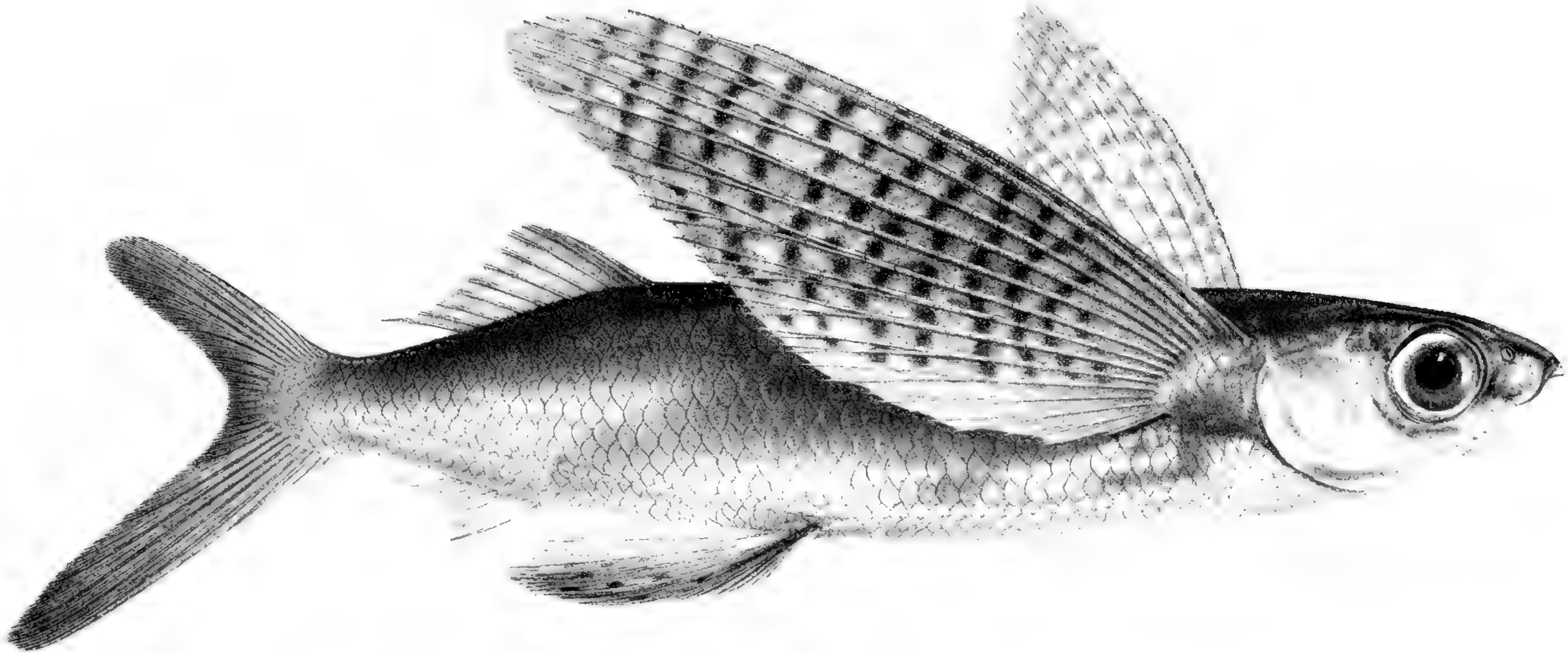
1. AMIURUS MERIDIONALIS. 2. AELURICHTHYS NUCHALIS.



G.H. Ford

W. West imp.

1. CHALCINOPSIS DENTEX. 2. CHARACODON LATERALIS 3. GAMBUSIA NICARAGUENSIS.
4. ANACYRTUS GUATEMALENSIS. 5. HAPLOCHILUS DOVII.



G H Ford W West imp

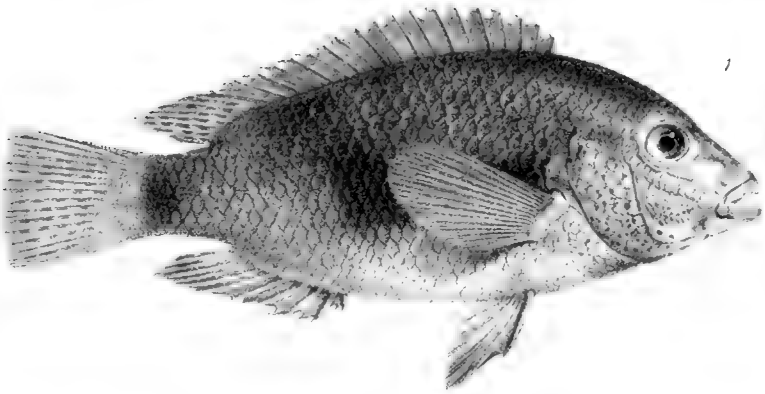
EXOCOETUS CALLOPTERUS.

G H Ford

W West imp

1. FUNDULUS LABIALIS. *male.* 2. *ej. fem.* 3. F. GUATEMALENSIS, *male.* 4 *ej. fem.*
5. F. PUNCTATUS, *male* 6. F. PACHYCEPHALUS, *male*

1



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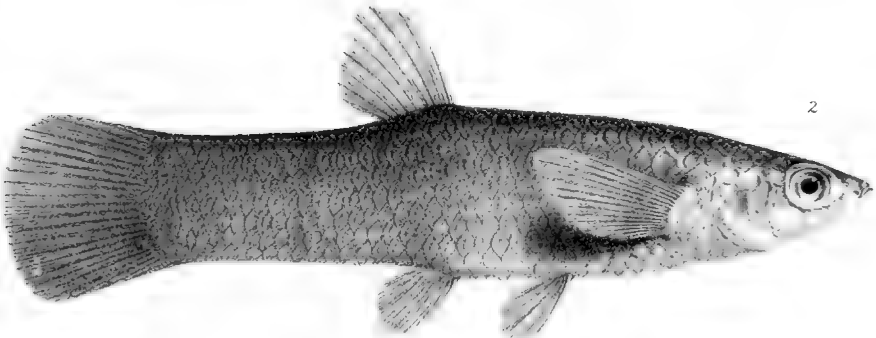

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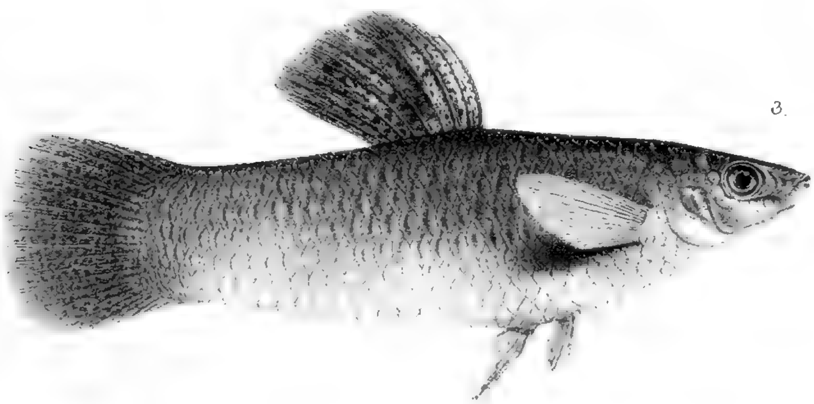
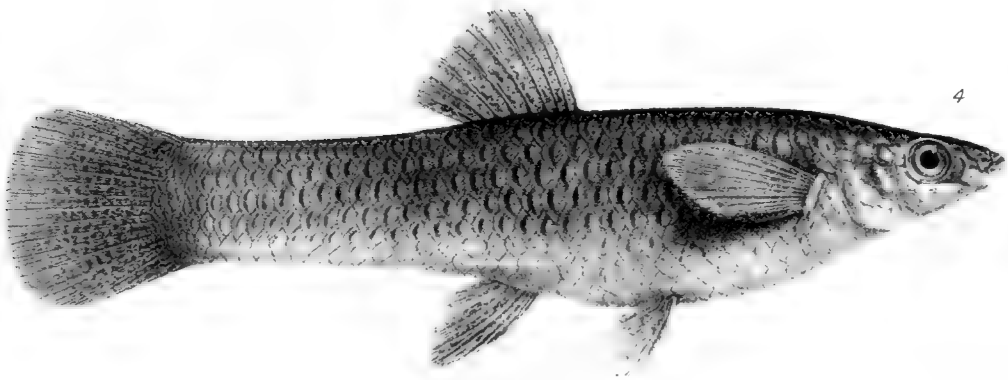
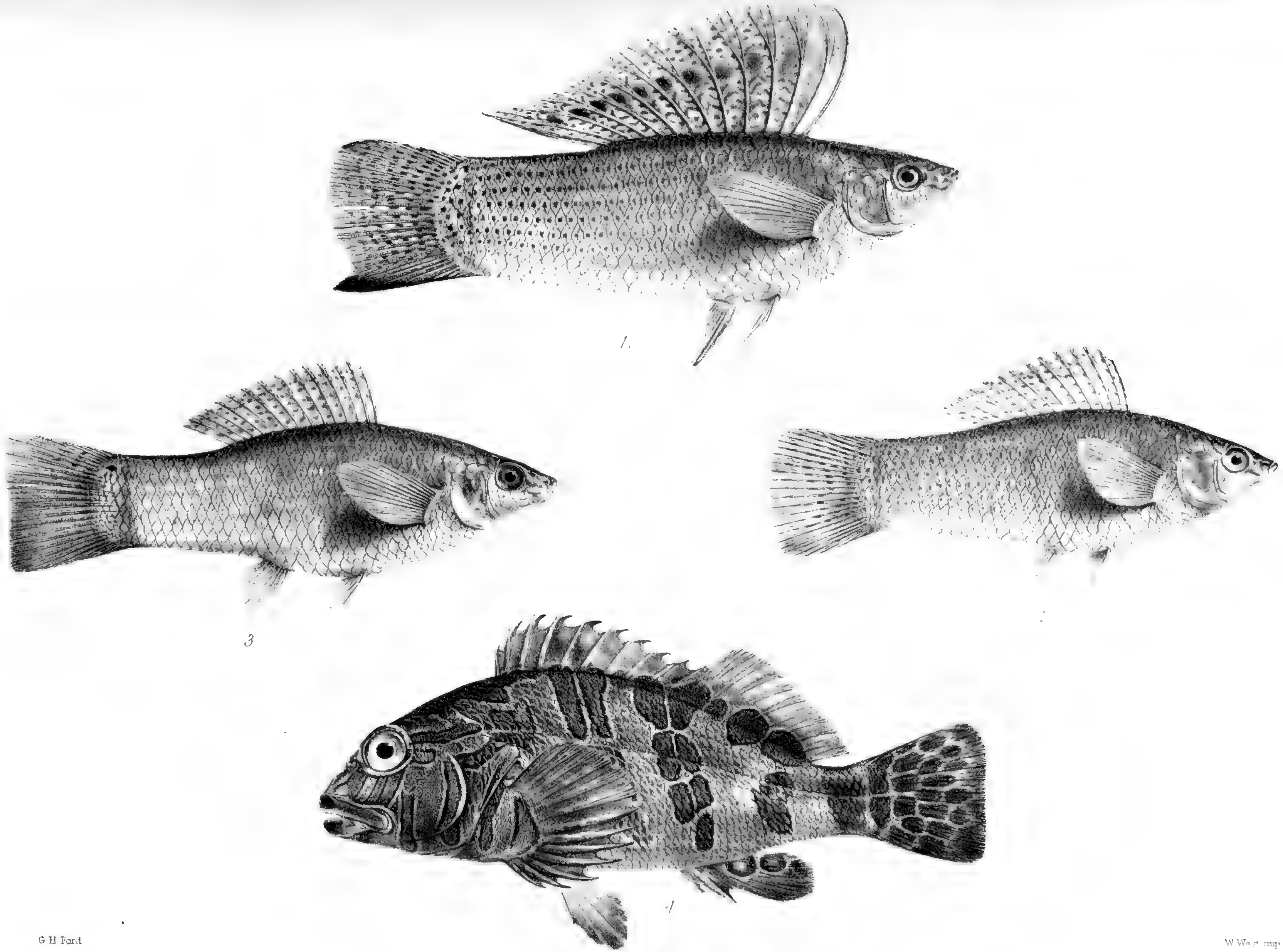


4



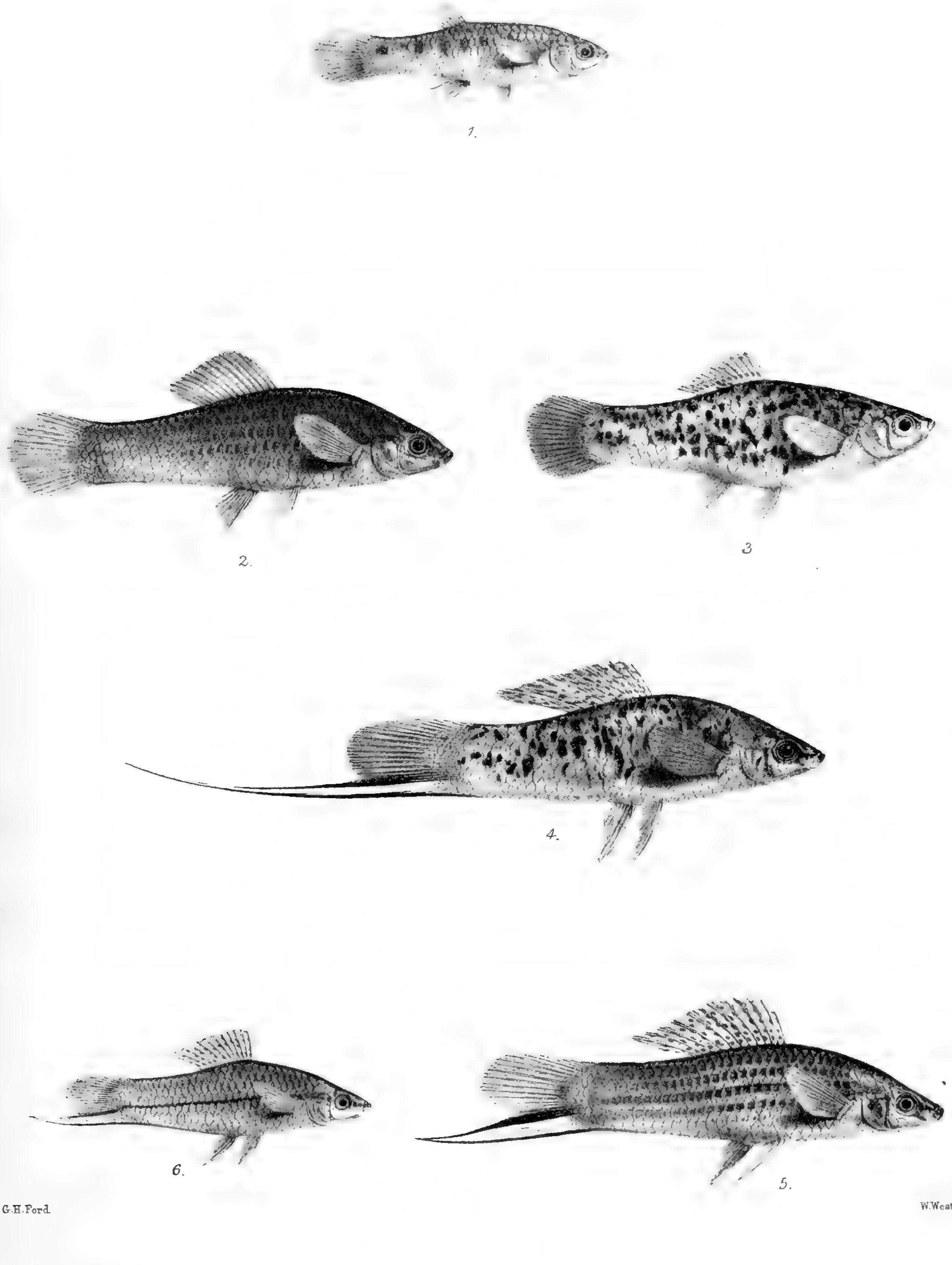
G. H. Ford. W. West imp.

1. HEROS ANGULIFER. 2. PŒCILIA ELONGATA, *fem.* 3. P. PETENENSIS, *male.*
4. P. PETENENSIS, *fem.*



G. H. Ford W. West imp.

1. MOLLIENESIA PETENENSIS, *adult male.* 2. *immature male.* 3. *adult female.* 4. CIRRHITICHTHYS R[illegible]LATUS.



G.H. Ford. W. West imp

1. GIRARDINUS PLEUROSPILUS. 2 & 3. XIPHOPHORUS HELLERI. *female.*
4, 5 & 6. XIPHOPHORUS HELLERI, *young & adult males*

XV. *On* DINORNIS (Part XI.): *containing a Description of the Integument of the Sole, and Tendons of a Toe, of the Foot of* Dinornis robustus, *Ow.* *By* Professor OWEN, *F.R.S., F.Z.S., &c.*

Read November 28th, 1867.

[PLATE LXXXVIII.]

THROUGH the liberality of the President and Council of the Philosophical Society of York I have been favoured by the transmission, for examination and description, of the portion of the foot, with the adherent tendons and integument, of the skeleton of the Moa, referred to in the letter of Dr. Hector, F.G.S., quoted in a former Memoir (Part IX.)[1], which skeleton, having been transmitted to the Museum of the Philosophical Society at York, I determined, and referred, in that Memoir, to the *Dinornis robustus.*

The toe, so preserved, with the tendons, sesamoids, and tegumentary sole-pads (Pl. LXXXVIII.), is the inner one (*ii*) of the right foot, and includes the three phalanges, corresponding in size and character with those figured in the Memoir (Part IV.)[2].

To the outer side of the proximal end of the first phalanx the capsule of the joint adheres (Pl. LXXXVIII. fig. 1, *e*), whence it is continued upon the same side of that part enclosing the metatarsal trochlea, and is extended upon the upper part of the sheath of the tendons and sesamoids (*s*, ib. *a*, *b*, *c*) beneath the joint between that phalanx and the corresponding (innermost) trochlea of the tarso-metatarsal. Part of the dried cartilage also adheres (at *f*) to the proximal articular surface of the phalanx.

The terminal portions of the tendon (*a*), inserted by means of the sesamoids and their ligament into the base of the first phalanx, part of the perforating tendon (*b*), similarly inserted into that of the second phalanx, and part of the upper perforating tendon (*c*), which is continued to that of the last phalanx, are here preserved.

The largest portion of the sole-skin includes the pad (ib. fig. 2, *d d'*) beneath the trochlear division of the metatarse answering to the above toe, with part of that which extended beneath the middle trochlea, but wanting the outer portion. The under surface of so much as remains of this "heel-pad" measures 3 inches 8 lines by 3 inches 6 lines.

The margin (*d' d'*) towards the missing outer heel of the pad shows abrasion; but where the under surface is entire, it is beset with large papillæ, having a tendency to a

[1] Transactions of the Zoological Society, vol. v. part v. p. 340.

[2] Ib. vol. iv. part i. pl. 1. fig. 1, II. 1, II. 2, II. 3.

circular arrangement about a smoother space, which seems to have received the chief pressure of the inner trochlea. On the inner or tibial side of the pad (*d*) the papillæ increase in breadth and number, and are aggregated in the form of penta- or hexagonal oblongish scales, about $2\frac{1}{2}$ lines in long diameter, diminishing in size (and chiefly in breadth) at the inner margin of the pad.

The skin becomes thinner and smooth at the part yielding to the bend of the toe upon the metatarse (ib. fig. 1, *h*), and that to an extent and with a degree of infolding in the dry integument which indicate great flexibility of the toe.

In advance of this, beneath the expanded ends of the first and second phalanges, the skin thickens and spreads into a second broad flat pad (*i*) beset with coarse scattered papillæ.

A short smooth tract (*k*) below the middle of the second phalanx intervenes between the second (*i*) and the third (*l*) papillose pad, which latter is beneath the joint between the second and third phalanges; the papillæ are here longer and more close-set, the transverse extent prevailing in most.

All the papillæ are formed, or covered, by thick epidermal matter as hard as horn. It is, however, together with the more gelatinous matter of the tendons and tendinous sheaths, soluble; and, unless the remains of the bird had been buried in very dry sand, it can hardly be supposed that it would have resisted for many years the action of moisture.

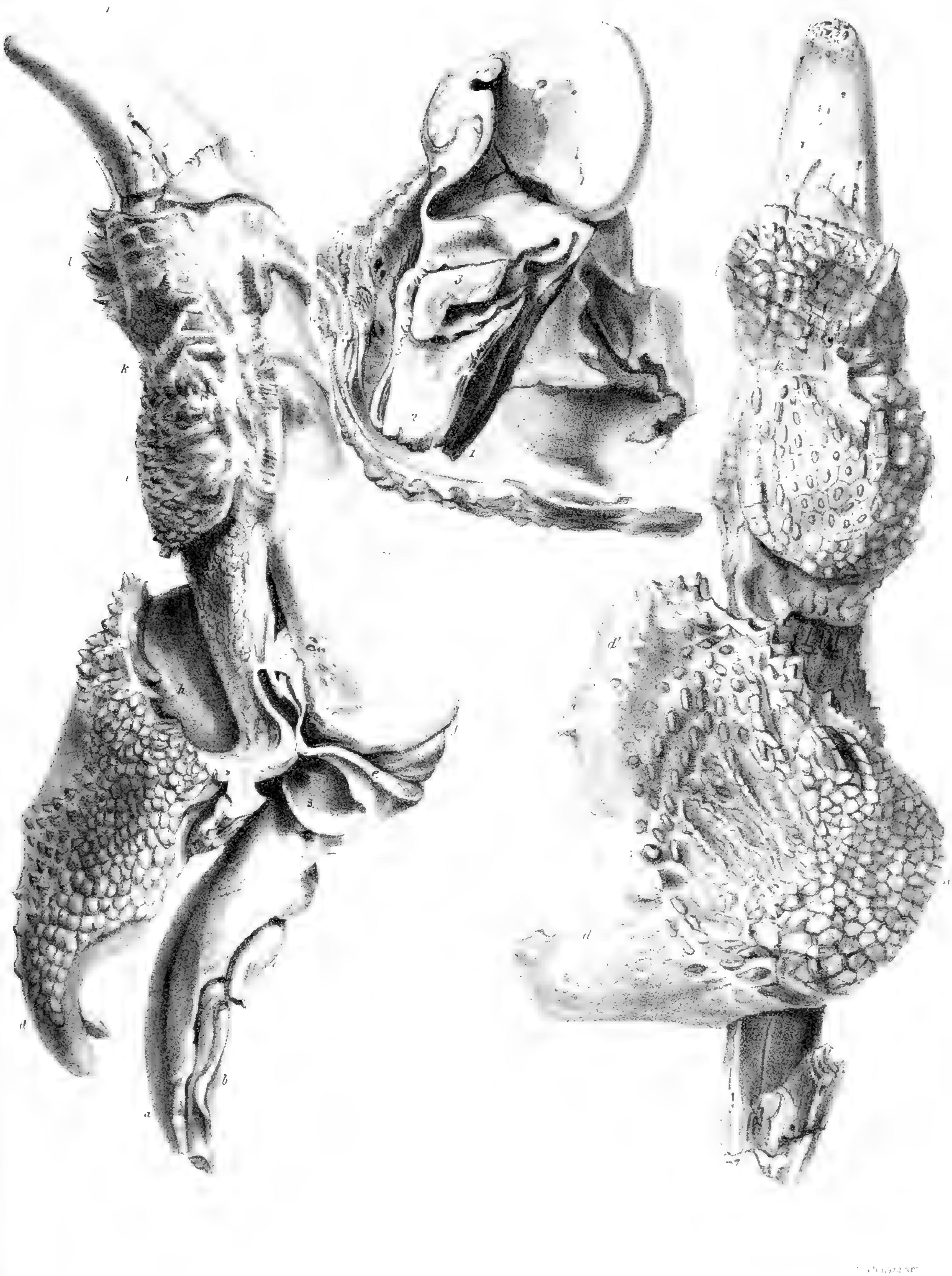
DESCRIPTION OF THE PLATE.

PLATE LXXXVIII.

Fig. 1. Inner-side view of the inner toe (*ii*) of the right foot, *Dinornis robustus*, Ow.

Fig. 2. Under view of the same toe.

Fig. 3. Proximal end of first phalanx of the same toe, with appended integument, tendons, &c. Natural size.



Dinkel del.t on Stone by J. Erxleben

XVI.—*On* DINORNIS (Part XII.): *containing a Description of the Femur, Tibia, and Metatarsus of* Dinornis maximus, *Owen.* *By* Professor OWEN, *F.R.S., F.Z.S., &c.*

Read November 28th, 1867.

[PLATES LXXXIX., XC.]

IN the letter of the date of February 15th, 1864, in which Dr. Hector, F.G.S., Provincial Geologist of Otago, New Zealand, communicated to me the particulars of the discovery of the almost entire skeleton of the *Dinornis*, of which the skull and scapulo-coracoid were described in a previous Memoir (No. IX.), he remarked that "The skeleton was not that of one of the largest-sized Moas, the tibia, for instance, being only 27 inches in length, whereas I have frequently seen them as much as 36 inches."[1]

The tibia of the specimen in the British Museum, which is the type of my *Dinornis robustus*, measures 32 inches in length; and it is probable that the difference in the length of the tibia of this specimen and that of the skeleton at York (27 inches) indicates the range of size as exemplified in individuals of different sexes of this species.

I have, however, for some years, been cognizant of a species of *Dinornis* from the Middle Island of New Zealand, having a tibia rather exceeding the length stated by Dr. Hector, and of a thickness proportionally the same as in *Dinornis robustus*. In 1858 the Duke of Argyll favoured me by sending for my inspection a tibia of this size, together with a femur and metatarsus of like proportions, and purporting to be of the same limb of a *Dinornis*, which bones had been transmitted to His Grace from the Middle Island, New Zealand, by the Rev. Dr. Lillie. With the liberal permission of the Duke, casts were taken from these bones for the British Museum, which have been exhibited in the Palæontological Gallery as of the "*Dinornis giganteus*, var. *maximus*."

In 1861 I was favoured by Henry Joseph, Esq., with an inspection of a femur of a *Dinornis* of the dimensions of that of *D. maximus*, which had been found beneath drift-sand at Otago, New Zealand.

In 1863 Professor Tennant, F.G.S., was so kind as to bring for my inspection the shaft of a femur of a *Dinornis*, from New Zealand, locality not stated, of the general dimensions of the two above specified, but heavier from some infiltration of mineral matter, and rather more robust. The least circumference, *e. g.*, of the shaft of the femur in Dr. Lillie's and Mr. Joseph's specimens was 8 inches 1½ line; in Professor Tennant's specimen it was 8 inches 9 lines.

In March, 1867, I was favoured by Major J. Michael, of the Madras Staff Corps, with

[1] Trans. Zool. Soc. vol. v. p. 340.

the opportunity of inspecting the femur, tibia, and metatarse figured in Plates LXXXIX. and XC., of the natural size, which had been discovered in August, 1865, on the Glenmark Estate of "Kermode & Co.," about forty-five miles from Christchurch, Canterbury Settlement, Middle Island, New Zealand. They were discovered, in the course of running a drain across a bog or swamp, about 4 feet below the surface, in such juxta position as to lead to the inference that they were bones of the same leg (the left); and their dimensions a little exceed those of the bones on which I had previously founded the variety or species *Dinornis maximus.* They are such, indeed, as to lead me to believe that the proposed specific term may be a safe one. I can hardly conceive that any bones as much larger than these as they are in comparison with *Dinornis giganteus* remain to be discovered in New Zealand—that land of these strange giants of the feathered class.

To have evidence of a bird as large as the Ostrich of Africa, from so comparatively small a tract of territory, seemed to me in 1839 the most wonderful result of the determination of the bone figured in plate III., Volume III., of the 'Zoological Transactions.' When I subsequently received a femur surpassing in length that of the struthioid species (*Dinornis struthioides*[1]) by 2 inches, I called the species *Dinornis ingens*[2]; then receiving a femur of the length of 15 inches, with other leg-bones to match, I proposed for it the term *Din. giganteus*[3]. Leg-bones equalling those of *Dinornis giganteus* in length, but in all cases exceeding them in thickness, and from an island where bones of the true *Dinornis giganteus* have never been found, represent the species called *Dinornis robustus*[4]; and now, having almost exhausted the vocabulary of terms expressive of hugeness, I venture on the superlative for the species represented by the bones which form the subject of the present Memoir.

Femur. (Plate LXXXIX. fig. 1.)

This presents all the generic characters of that bone in *Dinornis*[5]. The roundness of the shaft, the thickness of the walls of the medullary cavity, the absence of pneumatic foramina, the thickness of the shaft, and breadth of the articular extremities, especially of the distal one, in proportion to the length of the bone, the tuberous "lineæ asperæ" on the back of the shaft (Pl. LXXXIX. fig. 1), the production of the anterior intermuscular ridge from the lower end of the longitudinally extended thick and rugged pretrochanterian ridge, the rough, deep, well-defined fossa at the upper and fore part of the femoral shaft, the still deeper ecto-gastrocnemial fossa, and the very wide rotular channel—each and all of these Dinornithic characters of the avian femur are strongly marked in the present species. The surface, on the head of the femur, for the attach-

[1] Trans. Zool. Soc. vol. iii. pl. 21. fig. 3. (Length 10".)
[2] Ibid. fig. 1. (Length 12".)
[3] Ibid. p. 250. (Length 15".)
[4] Ibid. vol. iv. pl. 1. fig. 1. (Length 14" 6"'.)
[5] Ibid. vol. iii. p. 247.

ment of the ligamentum teres is as if a slice of the convexity had been cut off obliquely from its most prominent part backward and a little upward, so that no part of this surface appears in a direct front view; and it is slightly, if at all, depressed: part of this large flat surface had been broken away in the specimen figured (Pl. LXXXIX. fig. 1).

In the few femora of the general size attributable to *Din. maximus* there are variations in the relations of the circumference of the shaft to the length of the bone, and in one instance (the femur from Mr. Joseph) in the proportion of the breadth of the distal end. In the instance (Mr. Joseph's) where this end of the bone is narrower, the back part of the inner condyle is much narrower, and is more convex and more backwardly produced. The form of the popliteal space also differs. In Plate LXXXIX., and the majority of femora of *Dinornis*, it is a deep oblong oval pit, definitely excavated, the larger end toward the inner posterior tuberosity of the "linea aspera," and deepening to the back ridge of the inner condyle, which extends toward the outer one. In the femur from Mr. Joseph the depth of the popliteal pit is due to the backward projection of the condyles and their uniting posterior ridge, dividing the popliteal from the inferior intercondylar fossa, which is unusually deep. The modification of the distal end of the less robust femur (from Mr. Joseph) is, indeed, such as to suggest a specific difference. The trochanter, also, rises more abruptly, is higher, and the outer ridge of the antero-superior pit is unusually prominent.

Tibia. (Plate XC.)

Of the tibia (Pl. XC.) there need only to be given the dimensions, taken in accordance with those which have been previously recorded of the *Dinornis giganteus* and other species[1]. All the characters of the bone which distinguish it generically as of *Dinornis* are closely repeated in the present specimen.

Metatarsus. (Plate LXXXIX. figs. 3 & 4.)

The same remark applies to the metatarse (Pl. LXXXIX. fig. 3); but between that bone in Major Michael's series and the one in Dr. Lillie's there are differences of proportion (probably within the limits of individual variety), which may be mainly appreciated by comparison of the outline of the latter (fig. 4) added to the Plate (LXXXIX.) which contains the finished lithograph of Major Michael's specimen (fig. 3).

Dr. Lillie's specimen is longer and more slender, but with a greater transverse expansion of the distal end. The back part of the middle articular trochlea at the distal end projects more abruptly in Dr. Lillie's specimen; but the generic characters of the metatarsus of *Dinornis* are closely maintained in both specimens.

Subjoined are dimensions of the three chief bones of the hind limb of the present enormous species (*D. maximus*), together with those of the same bones in *Dinornis giganteus*.

[1] Trans. Zool. Soc. vol. iii. p. 246.

Dimensions of Femur.

	Dinornis maximus.						*Din. giganteus.*	
	Major Michael's.		Dr. Lillie's.		Mr. Joseph's.			
	in.	lines.	in.	lines.	in.	lines.	in.	lines.
Length	18	3	17	0	18	0	16	0
Breadth of proximal end, in the axis of the neck, or transverse diameter	6	6	6	3	6	2	6	0
Breadth of antero-posterior diameter	6	0	5	6	4	7	5	6
Breadth of distal end, transverse diam.	7	6	7	0	6	9	6	3
Circumference of middle	9	6	8	9	8	0	7	9

Dimensions of Tibia.

	Dinornis maximus.		*Din. giganteus.*	
	in.	lines.	in.	lines.
Length	39	0	35	0
Breadth of proximal end	8	6	7	6
Breadth of distal end	5	0	4	0
Circumference of middle	8	6	6	6
Tibular ridge extends down	20	0	13	0

Dimensions of Metatarse.

	Dinornis maximus.				*Din. giganteus.*	
	Major Michael's.		Dr. Lillie's.			
	in.	lines.	in.	lines.	in.	lines.
Length	20	0	21	6	18	6
Circumference of middle of shaft	8	4	6	4	5	6
Breadth of middle of shaft	3	0	2	7	1	11
Breadth, transverse, of distal end	6	9	7	3	5	1
Breadth, transverse, of proximal end	5	6	5	3		

DESCRIPTION OF THE PLATES

PLATE LXXXIX.

Fig. 1. Femur, back view, *Dinornis maximus*: nat. size.
Fig. 2. Femur, back view, Turkey (*Meleagris gallopavo*): nat. size.
Fig. 3. Metatarsus, front view, *Dinornis maximus* (Major Michael's specimen): nat. size.
Fig. 4. Metatarsus, front view, *Dinornis maximus* (outline of Dr. Lillie's specimen): nat. size.
Fig. 5. Metatarsus, front view, Turkey (*Meleagris gallopavo*): nat. size.

PLATE XC.

Fig. 1. Tibia, front view, *Dinornis maximus*: nat. size.
Fig. 2. Tibia, front view, Turkey (*Meleagris gallopavo*): nat. size.

Fig. 3

Fig. 4

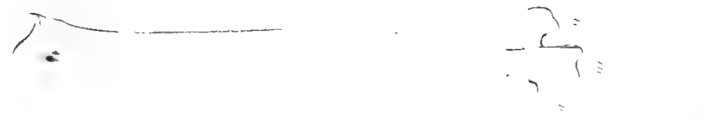


Fig. 5

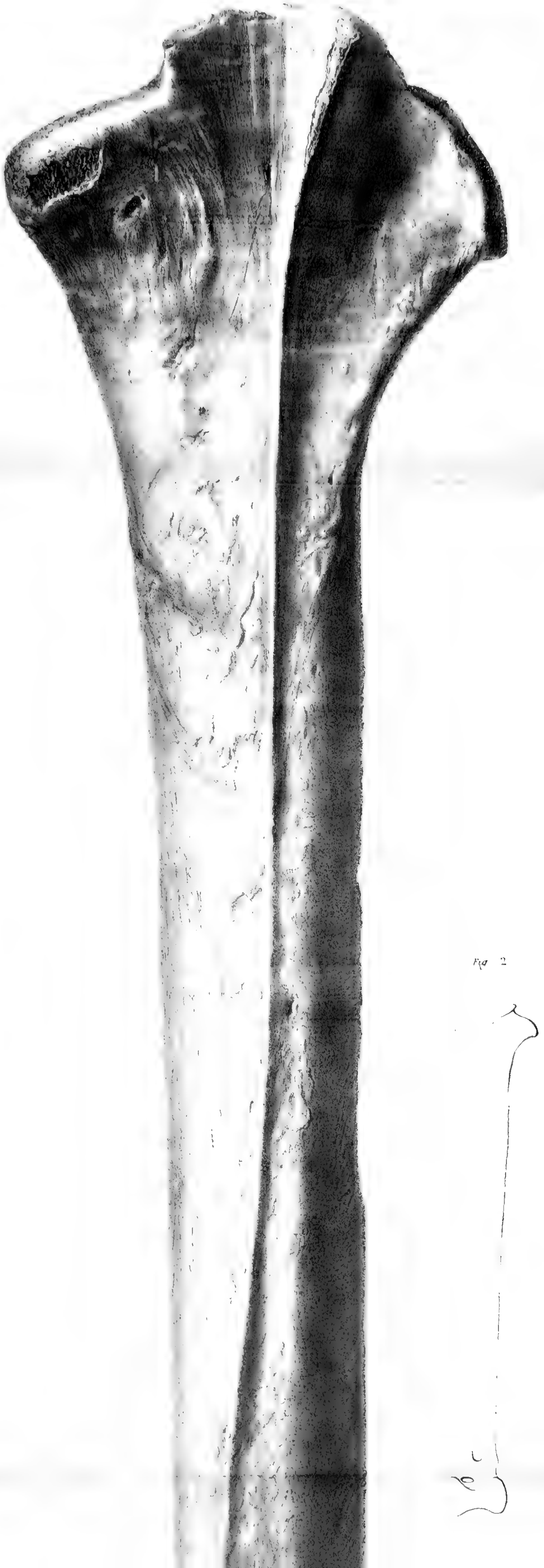


Fig. 2

DINORNIS MAXIMUS

XVII. *On the Osteology of the Kagu* (Rhinochetus jubatus). *By* W. K. Parker, *F.R.S.*, *F.Z.S.*

Read January 9th, 1868.

[Plates XCI., XCII.]

In the Proceedings of this Society for 1864 (pp. 70–72) there is a short account given of my views of the zoological position of the Kagu; but no details are added as that paper was merely intended to be an introduction to one more exhaustive and that should contain the results of much more labour and thought. More recently, in my memoir "On the Shoulder-girdle and Sternum" (Ray Soc. 1868, pp. 158–160), I have spoken of the relationships of this bird; but those remarks merely have reference to what is indicated by the parts of the skeleton which are there treated of. With regard to the nomenclature of those parts (namely, the breast-bone and shoulder-bones), reference to the memoir itself will show that there is some change of the terms used in my older papers on these subjects; this has become a necessity on account of the additional light obtained from severer research. Here, also, I must crave the liberty of modifying terms used by me in time past, and also of dropping some that seem now to be inaccurate, and of coining new words in cases of absolute need. The splint-bones that invest the face have cost me the most trouble in researches into the morphology of the skull; for I have strained after an harmonious view of the facial bones in the whole vertebrate subkingdom, and the Bird has always appeared to me to be the very class-type that ought to show the transition from the Ovipara to the Mammal. Undoubtedly it does; but it presents the greatest difficulties to the anatomical student—the process of ossification being so intense in degree, and so varied in relation to time in this Class. Hence the morphological observer has to lie in wait for the various osseous centres, never knowing when they may appear in the different groups, and being equally uncertain when they shall lose their individuality. The Bird's face has always appeared to me to be what one might suppose that of a Fish to become, if that low type were to undergo a series of metamorphic changes; it is this great unlikeness of the Bird's face to that of a Reptile or a Mammal which makes its morphology so difficult of interpretation. When I first lighted upon an additional bony element (a bone which I at once saw must answer to the outer alveolar plate of the mammalian maxillary), my difficulties with regard to the Bird's upper jaw were only becoming greater instead of receiving their ultimate elucidation. Well knowing from embryological researches into the structure of the skull and face in the large Serpents that their so-called "turbinal" was, in reality, one of the maxillary series, it seemed to me perfectly possible that this bone, which I proposed to call the "prevomer" (see Zool. Trans. vol. v. p. 157), should reappear in the Bird as enormously developed as the premaxillary, and that thus I had an explanation of those *quasi-turbinal* outgrowths which make the maxillary of the Bird so unlike that of a Mammal.

Thus it appeared that the true maxillary was only exceptionally present in the Bird, and that the huge prevomerine splint not only retained its reptilian character but also grew largely into tracts which were left open to it by the abortion of the "maxilla proper."

Nothing occurred to disturb this view until the end of the year 1865, when Professor Huxley very forcibly put it to me that the bird's great maxilla does actually correspond to that of the mammal, *minus* its outer alveolar plate; this view is given in my paper on the Ostrich's skull (Phil. Trans. 1866, pp. 113, 114). If that view were the true one, then the so-called "turbinal" of the Snake and the Lizard might also be referred to the same category. Frequently returning to this subject, being severely criticised by Professor Huxley for using the term "prevomer," and receiving new ideas upon the subject from fresh research, I have at last determined to alter my nomenclature. I give up the obnoxious term "prevomer," and propose to call the pseudo-turbinal splint the "septo-maxillary"; the small additional maxillary of certain birds may be called the "postmaxillary"; and the great upper jaw-bone of the bird will retain its old name—the "maxillary." Nevertheless it is *less* than the maxillary of the Mammal, its outer alveolar plate being aborted by the premaxillary; and *more*, for it oftentimes has the attributes of the "septo-maxillary" added to its own, although in the Bird merely as a *region*, not as a distinct osseous piece. I have traced, as I think, the septo-maxillary through a large series of Ovipara, from the Ganoid fish to the Lizard; I am quite prepared to see it continuous with the maxillary of the bird, which has many splint-bones single that are double in the Lizard. A few other changes will be spoken of in the course of my description; but the maxillary series has presented the greatest difficulty, and needed to be put plain at once; for my determination of the so-called "turbinals" of the Lizard to belong to the maxillary splint-system, and the discovery of the attributes of these bones in the maxillaries of the bird, have caused no little difficulty in the nomenclature of those parts.

I have already ventured to classify the Kagu (see 'Shoulder-girdle and Sternum,' p. 158), putting it into a family with the *Psophia* and the Sun-Bittern, and calling this group the "Psophiinæ," with the qualification, however, that each of the three types deserves to be placed at the head of a distinct subfamily. These Psophiine types are essentially Cranes, but they are very aberrant.

Notwithstanding the essential relationship of these three "Geranomorphs," the first view of their skulls would not suggest so near an affinity. If the Kagu's skull be placed in the midst of a series of skulls of the "Grallæ," the Night-Heron's skull and that of the Norfolk Plover (*Œdicnemus*) would arrest attention first, as coming nearest; and if that of the Kagu were placed between these two, it would at once be seen to be a perfectly intermediate form.

This need excite no surprise; for the Cranes are certainly Pluvialine birds, having no little affinity for the Herons; and, moreover, the Kagu, being a generalized type, comes much nearer to the true Ardeinæ than do the typical Cranes.

In the Psophia's skull there is a very strong resemblance, in general outline, to that of a Pheasant; but this vanishes on closer inspection, and then its exceeding nearness to the Rails is at once evident: moreover it has the superorbital chain of the Tinamou. The skull of the *Eurypyga* is seen at once to come quite as close to that of a Stilt-Plover (*Himantopus*) as to that of a Bittern, and, indeed, closer; more minute observation shows that it is essentially the same as that of the Kagu, but feebler and having a more elongated face.

The face and skull of the Kagu are of equal length (Pl. XCII. figs. 1–3); the orbits, as in *Œdicnemus*, are extremely large, the postfrontal region being unusually wide and overhanging. The skull is very broad behind (Pl. XCII. fig. 4); the only related bird that makes any approach to the Kagu in this respect is the Night-Heron; and here the Kagu departs furthest from the Pluvialine, and comes nearest to the Ardeine type; for the temporal fossæ are extremely large, and are bounded by strong ridges in front (the coronal), at the mid line (the sagittal), and behind (the lambdoid). Compare with this state of things the low, small, widely separated temporal fossæ of *Anthropoïdes*, *Balearica*, *Psophia*, *Eurypyga*, *Ocydromus*, and *Œdicnemus*. In *Nycticorax* the postorbital angle is very distinct from the postfrontal process; in the Kagu they are coincident (Pl. XCII. fig. 3). But the Kagu and *Nycticorax* are very similar in the bounding of the temporal fossa below, this valley being in both very deep between the postfrontal and the descending spur of the squamosal (zygomatic process of the Mammal). This spur, however, is much the largest in the Kagu; and in this respect this bird shows an affinity to the Struthionidæ on one hand, and to the Cariama on the other. The foramen magnum (fig. 2) is large; and the condyle is a little wider in the transverse than in the longitudinal direction. The tympanic wings of the exoccipital (figs. 2, 3, 4) are very much like those of the Night-Heron, but are larger and deeper. The symmetrical bosses of the basitemporal are very mammillate and distinct; they agree with those of the Gruinæ proper; but the anterior lip of the basitemporal plate is delicately thin, as in the Ardeinæ (Pl. XCII. fig. 2). The large, trumpet-like anterior extension of the tympanic cavity, on each side, is like what is seen in all the congeners of the Kagu; they are formed in front by the posterior pterygoid processes of the basisphenoid. In front of these, the "anterior pterygoid processes" are seen as small, aborted, angular projections (Pl. XCII. fig. 2); and in front of these the "rostrum" (formed by the *grafting* of the parasphenoid on to the true basisphenoidal beam) is narrow, subcarinate, and completely fused with the base of the orbito-septal plate. These two parts are somewhat separated by a notch anteriorly (Pl. XCII. fig. 3). The under surface of the superorbital plate of the frontal forms one continuous plate of bone with the alisphenoid, which has no fenestra, and which has completely coalesced with all the surrounding bones (Pl. XCII. figs. 2 & 3)[1].

The Kagu approaches both the Herons and the Rails in the structure of the interorbital septum; for the orbito-presphenoid (Pl. XCII. fig. 3) is feeble and oblique; but it is feebler and more oblique than in either of those types, the posterior process of the perpendicular ethmoid and the alar part of the anterior sphenoid being very feeble at their junction. This leads towards *Eurypyga*, which has complete abortion of the connecting bar, as in *Himantopus* and *Phalacrocorax*. Two small fenestræ are seen on each side of the feeble four-winged orbito-sphenoid; below, the presphenoid is a minute separately ossified spur (fig. 3). As in the Stanley Crane, and unlike that in the Night-Heron and Rail, the great ethmo-basisphenoidal bar, bounding the interorbital space below, is very deep (fig. 3), and thickens as it approaches the parasphenoidal beam. The cleft between the orbital and the nasal septum is incomplete (fig. 3), and the latter is partly ossified, as in the Ardeinæ: it is much deeper than in Grallæ generally. There are three septal ossifications—two upper (the small one foremost), and one lower; this lower bony plate answers to the antero-inferior bone of the Rapacious bird—that which sends out the *vestibular* bars to join the maxillary on each side. The nasal septum, like the alæ nasi, only occupies the hinder half of the bony nasal opening; the rest is filled up by fibrous tissue. The septum nasi is alate below, and each semilanceolate cartilaginous wing is attached to the *septal* process of the maxillo-palatine plate.

The prefrontal region (Pl. XCII. fig. 3) is only partly ossified, the antorbital plate being cartilaginous above and externally, and the perpendicular ethmoid sending very little bony matter into the upper alæ. The aliseptal region (inferior turbinal and its root) and the alinasal are quite soft in the adult; the alinasal flaps are obliquely oblong, lie low down, bulge but little, and only reach halfway along the bony nasal opening; the anterior nostril is a low-lying valvular slit.

As the bony nostrils are extremely open, the body of the premaxillary only reaches one-third of the way to the angle of the bone. The nasal processes (Pl. XCII. fig. 1) are completely fused, as in the Cranes, the *Psophia*, the *Eurypyga*, and the Rail, but they keep very distinct from the nasals. The nasal process is strong, flat, even somewhat concave at the middle of the bone, and is very unlike what is seen in the related types. Below (fig. 2) there is seen to be a degree of filling-in by bony matter that approaches what we find in the true Herons, and the fusion of the parts is complete. This narrow, gently concave anterior part of the bony palate is composed of the inner part of the dentary plates and the palatine bars of the premaxillaries. Joined to them are

[1] I must refer the reader to the plates accompanying my paper on the Gallinaceous and Struthious skulls for the *lettering* of especial parts, with this proviso, namely, that p.v. (prevomer) should be read as mx. (maxillary), and mx. as pt.mx. (postmaxillary).

the sharp anterior spurs of the palatines and of the maxillaries. As the maxillary of the bird has cost me more trouble than any other part, I shall take some pains to describe it, especially as the Kagu and its relatives have this part in a very instructive condition. Here the strictest watch has to be kept, lest the mind should be deceived by external resemblances, and by actual function of the parts; nothing but a study of the development of the face can give any solution of this difficulty. In the first place let it be noted that the maxillary of the Bird is extremely like that of the typical Fish, being secondary in so great a degree to the premaxillary, and lying within and behind it; the manner, also, in which the palatine stretches forwards to the front of the face and articulates with it is very ichthyic. But the maxillary of the Bird for a long while seemed to me to be merely a very inordinately developed septo-maxillary (the so-called turbinal of the Lizard); so that the Lacertian relationship appeared to be that which was most evident. Now, however, I have no doubt about its being truly the maxillary of the other Vertebrata; but I do see in it also the Lacertain septo-maxillary in a high state of development in many cases, but continuous with the true maxillary. But comparison of the Bird's maxillary with that of the cold-blooded Vertebrata (excluding the Crocodiles) fails to give any explanation of its meaning; and it is only by comparing it, also, with a series of Mammalian counterparts that it can fully be understood. Perhaps the first thing that strikes the eye in the anterior part of a bird's palate is the large azygous "anterior palatine foramen;" this is quite unlike what is seen in Mammals generally. In the Bird the space between the dentary and palatine plates of the premaxillary is filled up by the sharp wedge-like fore end of the maxillary; whilst the "anterior palatine foramen" is seen to be merely the space between the palatine plates of the premaxillaries. The Pangolin (*Manis*) and, especially, the Hedgehog (*Erinaceus*) explain this, the symmetrical passages being almost filled up by the wedge-like anterior ends of the maxillary palatine plates. But in the Pangolin, and also in the Coati (*Nasua fusca*), the palatine plates of the premaxillaries are bowed out in some degree, forming a third opening in their fore-palate. This structure is precisely the morphological link wanting to make the Bird and the Mammal hang together here. In the Pangolin the palatine plate of the maxillary is one continuous, narrow, obliquely scooped sheet of bone, attached by "harmony" to the palatine plates of the palatine behind, and wedged in between the premaxillary forks in front. In the Hare (*Lepus timidus*), however, four-fifths of this plate is absent; and behind only does the maxillary send inwards an elegant, subquadrate, pedate plate to meet its fellow of the opposite side, and to be underlain behind by the much feebler palatine plates of the palatines.

In the Bird the part answering to the fore end of the Pangolin's palato-maxillary plate is differentiated from the hinder part, is very narrow, and entirely fills up the space between the premaxillary forks. Behind, the Bird's maxillary developes the exact counterpart of the palato-maxillary plate of the Hare; and this part, instead of keeping to the palatal floor, as in the Hare, ascends into the nasal labyrinth, occluding it in no small degree, and, being thus developed into *pseudo-turbinal* outgrowths, does correspond, not numerically so far as ossific points are concerned, but truly, in a morphological sense, to the *pseudo-turbinal* (my "prevomer" or "septo-maxillary") of the Snake and the Lizard. At first sight, no one would doubt that the Pangolin came in to explain the small "postmaxillary" seen in certain birds; for on the projecting zygomatic angle of the main bone there is a small ossicle, apparently the precise counterpart of the little face-bone of the bird. This likeness, however, is quite deceptive; for the bone in the Pangolin is articulated to the zygomatic process of the maxillary, and is the "malar" or "jugal;" whereas in the Bird it answers to the extreme angle of the dentary plate, and is a curiously segmented representation of that elegant pupiform maxillary chamber which, in the young Pig (*Sus scrofa*), contains the hindermost molar tooth. The supplementary ornithic bone can only be explained by referring to the multiple ganoid face-wall of the *Lepidosteus*. The "septo-maxillary" gets its interpretation from the same fish; but it crops up in several other ichthyic types—for instance, in another ganoid the (*Amia*), in *Clarias*, and in the Clupeoids.

The maxillary of the Bird may be described as a lateral facial splint, which develops several spurs and plates, passing in various directions, namely:—the outer or dentary part, which only appears for a small space on the outside, close below the descending crus of the nasal; the palatine part, which is composed of two portions, an anterior and a posterior; and the long, styliform zygomatic process. The long anterior palatine process wedges in between the two forks of the intermaxillary, and articulates by its inner side with the styliform fore end of the palatine. The posterior palatine plate is only moderately broad where it is given off; it then suddenly narrows, both margins being concave, and then expands into what Professor Huxley terms the "maxillo-palatine plate." Below, this part tends to, and often does unite with, its fellow of the opposite side, between the palatines; this answers to the submesial sutural part of the palatine plate of the maxillary in the Hare. Above, the plate in many birds developes an "anterior septo-maxillary spur" to articulate with the septum; this spur answers to the transverse bar of the septo-maxillary which partly occludes the nares in the Cyclodont Lizards. Above and behind, we have the large, oblique "posterior septo-maxillary lobe;" this answers to that part of the Lizard's and Snake's septo-maxillary which overlaps the vomer.

In the Kagu the maxillary has coalesced to a great extent with the surrounding bones; but with care its boundaries can be discovered; it is best seen from the under and side aspect (Pl. XCI. figs. 2 & 3). This bone is a long style, pointed at both ends, and sending inwards a broad and complex plate. The anterior style fills up the intermaxillary fork, and answers to the fore end of the palato-maxillary plate of the Mammal; the posterior style is the very long and slender zygomatic process; and the middle transverse bar answers to the palato-maxillary plate of the *Leporidæ*, and is developed upwards into the septo-maxillary processes. The anterior style has an inward direction; the posterior or zygomatic style is turned obliquely outwards, and is clamped by the equally delicate jugal. The posterior maxillo-palatine bar lies at an exactly right angle to the cranio-facial axis: it is 3 lines broad at its root, but as it passes inwards it becomes only half that width; and both its margins are elegantly concave. This plate lies a considerable height above the deep palatine (figs. 2 & 3); it shows itself very little in the interpalatine region; but the widening of the palatine on the inner side, near the fore end of the vomer, is due to the down-growth of this part of the maxillary. This edge does not nearly meet its fellow of the opposite side [1]; but it is the exact homologue of the sutural region of the palato-maxillary plate of the Hare. This interpalatine portion of the maxillary is merely the lower edge of the large spoon-shaped "posterior septo-maxillary lobe" (fig. 3), which is gently convex on the inner face, scooped on the outside, moderately thick, and slightly fenestrate. The soft inferior turbinal is attached to the upper and inner edge of this lobe; below, the vomer lies a small distance within it (as in its counterpart in the Lacertilia and Ophidia); and in front it thickens where it underprops the descending crus of the nasal (fig. 3). Inside the foot of the nasal, before the bone has narrowed to form its anterior palatine portion, it developes a squarish mass, which is prickly in front, and is attached to the cartilaginous wing of the septum; this is the "anterior septo-maxillary spur," and is the counterpart of the transverse vestibular bar of the septo-maxillary of the Cyclodont Lizard. This hooked plate is better developed in *Eurypyga*; but attains its highest condition in the *Psophia*, where it is a large, transversely oval lobe, constricted round its base, so as to be somewhat pedicellate; it also reappears in *Caprimulgus europæus* as a long, slender, sigmoid style.

In *Psophia*, as in *Cyclodus*, the nasal vestibule is formed by the facial splint (by the distinct septo-maxillary piece in the Lizard); but in many birds, especially the Raptores, the "anterior septo-maxillary spur" is but little produced inwards, and the vestibule is completed by the largely developed transseptal bar: without a transverse section the septo-maxillary of the Cyclodont might easily be mistaken for one side of an ossified septum nasi like that of the Owl or Hawk. In the *Eurypyga* the maxillary comes exceedingly close to that of the Kagu; but the plate answering to the Hare's palato-maxillary is extremely contracted before it expands submesially; its "posterior septo-maxillary" lobe is also much more fenestrate, and developes itself behind into an elegant, flattened thimble-like pouch: it also appears more in the interpalatine space. In the *Psophia* these plates are very thick and spongy (approaching those of the Herons, Pigeons, Owls, &c.), and they have a large, oblong interpalatine portion. There is no "postmaxillary" bone in the Kagu; and the "dentary" portion of the maxillary is an extremely small angle just below the angular flap of the premaxillary (fig. 3). The fusion of these parts, however, makes the boundaries somewhat indistinct;

[1] In this respect the Kagu is "Schizognathous;" but in the fresh state the wings of the nasal septum are strongly tied to the maxillaries, and thus it is, practically, "Desmognathous."

but in the *Psophia* and *Eurypyga* this angle is a very delicate style: in the latter the premaxillary angle also is continued over the zygoma as a very slender needle of bone. The vomer (fig. 2) is a very long, delicate style in these three aberrant types; it comes very near to that of *Talegalla*, but is longer. The posterior third is bifurcate; it then becomes deeply grooved above, and sharply carinate below, and is bowed upwards: this middle part lies between the interpalatine portion of the maxillaries. The anterior third then descends and becomes broader, as in the Chelonians; but what is gained in depth is lost in height, and the fore part is a very slender needle of bone. In the *Psophia* the vomer is split halfway; and the edges of the basifacial groove are thickened and denticulate, as in the Heron; so they are in the *Eurypyga*, which, however, in other respects has a vomer almost the exact counterpart of that of the Kagu,—save that it is still more exquisitely slender, and elongate in front. As to the upper and lateral facial splints the Kagu and the *Eurypyga* agree very closely. The nasals (fig. 1) are very sharply split, the clean fissure between the upper and ascending ramus turning inwards between the lacrymals above. The nasals reach half an inch further backwards than the nasal part of the premaxillaries in the Kagu, and are as thick and cellular as the frontals where they coalesce with those bones. The upper crus of the nasal runs forwards three-fourths of the distance to the fore end of the nasal fossa; the descending crus is sharp below, and is strongly interwedged between the maxillary and premaxillary. Thus this part of the face is thoroughly Gruine in both the *Eurypyga* and the Kagu; the long, open nasal fossa, so sharp above at the bifurcation of the nasals, gives a character to the face common to large groups of Grallæ and Palmipeds (see my figure of the Lapwing's skull, Trans. Zool. Soc. 1864, vol. v. pl. 37. fig. 3, *n*, *px*). In the *Rallidæ* the nasal fossa is semioval, and so it is in the *Psophia*; but in it the division of the nasal, whilst equally obtuse and rounded, yet helps to form a much *shorter* nasal fossa, like that of the young of a typical Raptorial bird, before the ossification of the alinasal cartilages: in that aberrant *Ætomorph* the Cariama, this open condition of the nasal fossa is persistent, but somewhat occluded by the bony "anterior alinasal bridge." The lacrymal (figs. 1 & 3) of the Kagu agrees with that of the *Eurypyga*, save that in the latter the bifurcated descending part is slenderer and is fenestrate, whilst in the Kagu it is cellular. They both differ from *Grus* in having the superorbital part[1] not more developed outwards and backwards than in the Night-Heron; these bones keep distinct, as in the Cranes and Rails. The lacrymal of *Psophia* is larger and thicker, and is greatly clubbed below; but the most remarkable thing in the *Psophia* is, that the lacrymal (preorbital) is followed by a chain of 5–7 free superorbitals, like those of the Tinamous (see Trans. Zool. Soc. vol. v. pl. 40; and Phil. Trans. vol. clvi. pl. 15). This cropping-up again of what the Tinamou had adopted from the Reptile is very interesting, and is not the only character by which these two birds may be connected. In the *Psophia* the anterior frontal region is swollen and cellular, somewhat approaching to what is seen in the Coot

[1] A separate bone in the Lizard.

and the *Palamedea*; but in the *Eurypyga* and the Kagu (Pl. XC. fig. 1) this part is gently concave.

There is nothing to remark upon in the slender jugal and quadrato-jugal (figs. 1–3), save that they coalesce in some degree, as in the Stanley Crane.

The palatines of the Kagu are very noteworthy; they are very steep, forming an acute angle with the cranio-facial axis, and are sharply keeled (Pl. XCII. figs. 2, 3). The pointed anterior portion has coalesced with the maxillary and palatine plate of the premaxillary; this part is nearly horizontal. The next part, on each side of the maxillo-palatine plates, however, is oblique, and is twice as broad. Above the junction of the middle and hinder portion there is a very large "orbital plate" (fig. 3); it is a low triangle in outline, and is convex on its outer side, curling inwards towards the "parasphenoidal rostrum." This orbital plate is in relation in front with the posterior margin of the "posterior septo-maxillary lobe," and above with the vomerine fork of the same side. The hinder part of the palatine is very steep; it is rather thin, but strong: there is a small submesial keel (fig. 2) growing from the basicranial edge of the bone, and a larger outer keel: both these keels send backwards a retral process; and that of the outer keel belongs to the "transpalatine" region. This region is also indicated by a small "fenestra" (fig. 2). The oblong condyle at the end of the palatine, and much of the basicranial edge, posteriorly, is formed by the once distinct "mesopterygoid," a strong wedge of bone with its sharp end forwards. In the *Eurypyga* these characters are repeated in a somewhat softened form; but the fenestræ marking the distinction into a palatine and a transpalatine plate are larger, and there are one or two additional spaces, as is the wont of these arrested clefts. These fenestræ have the highest development in *Tigrisoma leucolophum*, but they occur in other Ardeinæ and in the long-billed Pluvialines.

In *Psophia* the transpalatine angles are more rounded, the keels are less sharp, the bones are less steep, and there are no fenestræ; altogether it comes much nearer the typical Gruinæ, whilst in the Kagu they are very Ardeine, the nearest form being *Nycticorax*.

The pterygoids (Pl. XCII. figs. 2 & 3) are typically Gruine; they are small, and rather slender, flattened anteriorly, with a keeled outer edge, a scooped under surface, and the posterior third compressed, with a rounded upper and lower edge. The anterior condyle is subconvex and three-sided; the posterior is a round, shallow cup, surmounted by a small, obtuse, "epipterygoid" process, the counterpart of the columelliform epipterygoid of the Lizard.

The Kagu comes very close to the typical Cranes (and also to the Herons) in its os quadratum (Pl. XCII. figs. 2, 3); the two neat rounded upper condyles are far apart, and the inner is scarcely behind the outer. The metapterygoid process is bowed out and broad, the free terminal part being somewhat pedate. This bone is broad at its narrowest part, and is much dilated at its base, which turns inwards and forwards. There are a deep "quadrato-jugal cup," a high and neatly finished semioval convex "pterygoid condyle," and two reniform convexo-concave condyles for the "articulare;" the inner of these is the lesser, and has the "hilum" looking backwards; the outer has its concave margin looking forwards and inwards.

The mandibles are typically Gruine, but there is a good Ardeine character even in them; this is the long retral process between the mandibles (Pl. XCII. fig. 1 *a*), growing backwards from the ankylosed symphysis[1]. Here, again, the Kagu and the *Eurypyga* correspond, whilst in the *Psophia* there is the merest rudiment of this part. The fore part of the dentaries is like the fore part of the intermaxillaries; further backwards (Pl. XCII. fig. 3 *a*) the ramus is high, as in *Anthropoïdes*, and only lowers a little in front of the hinge, where it becomes thick also. The fore part of the "coronoid" and the hinder part of the "splenial" is unankylosed; the "dentary," also, has not coalesced with the combined "angular" and "surangular." The fenestra which appears in the *Psophia*, between the forks of the dentary behind, is filled up; so is that which is seen in the Stanley Crane and the *Eurypyga* above the root of the "coronoid" and through the substance of the "surangular;" in this the Kagu agrees with the Grey Heron: there is a trace of this fenestra in *Nycticorax*. The convexo-concave condyles (Pl. XCII. fig. 1 *a*) conform exactly to those of the os quadratum, the concavities and convexities being reversed. The posterior face of the mandible is essentially Gruine, but most evidently Ardeine also; it is triangular, the upper and outer edge forming a right angle (Pl. XCII. fig. 4 *a*).

The "internal angular process" is blunt, and perforated for the passage of air; the "outer angular process" is rather sharp, and projects downwards as much as backwards. In the posterior face of the mandible the Kagu agrees with the typical Gruinæ, but makes some approach to the Ardeinæ; in the *Eurypyga* the Ardeine characters preponderate, whilst the same part in the *Psophia* is about equal to that of the Kagu.

The ceratohyals are lost in my specimen; I suppose that they were long, slender, and unossified. The basihyal (figs. 8 & 8 *a*) is rather long, slender, and well ossified; the urohyal is small, slender, and scarcely ossified at all; and the thyrohyals are slender and feebly ossified.

The sclerotal ring is ossified; but the bony plates are scarcely larger than in *Psophia*, with a much smaller eyeball. In *Dicholophus*, which has the eyeball but little larger than that of the Kagu, the sclerotals are twice as large and twice as strong, and the diameter of the ring is but little short of an inch (11½ lines) from edge to edge. In the Kagu this diameter is 2 lines less; and in it the sclerotals turn forwards very little at their inner edge; in *Dicholophus* this Owl-character is very strongly developed.

The vertebræ vary as to number in the Kagu and its relatives, as follows:—

[1] In this character the Herons and Pelecanine birds agree; in the Cormorant and Gannet this process is well developed.

	Cervical.	Dorsal.	Lumbo-sacral.	Caudal (free).
Psophia crepitans	18	6	17	6
Rhinochetus jubatus	16	5	15	7
Eurypyga helias	18	5	13	7
Botaurus viridis	13	4	14	6
Anthropoïdes stanleyanus	19	5	17	7
Balearica pavonina	20	6		
Grus antigone	19	6	....	7

In the *Psophia* there is one pair of free cervical ribs, and one perfect lumbo-sacral arch; behind this there is a free styloid rib occasionally on the right side, the left coalescing with the sacrum; there is one pair of abdominal ribs. In the Kagu there are two pairs of free cervical ribs, and one nearly perfect lumbo-sacral arch (Pl. XCI. fig. 1); there is no abdominal rib. In the *Eurypyga* the cervical ribs are all ankylosed to the vertebræ; there is one perfect lumbo-sacral arch, small free ribs to the second of that series, and a very small abdominal rib on each side. In *Botaurus viridis* there are free ribs to the last two cervical vertebræ, a nearly perfect lumbo-sacral arch, and a pair of styloid abdominal ribs.

In the *Anthropoïdes stanleyanus* there are two pairs of free cervical ribs, three pairs of lumbo-sacral ribs, the last of which is apt to become ankylosed to the sacrum.

In the Balearic Crane there is only one arch developed from the lumbo-sacral region, and it is perfect; but in *Grus antigone* two pairs of such arches exist, and a pair of styloid floating ribs behind them.

In the Kagu, the *Psophia*, and the *Eurypyga* the first four dorsal ribs are ankylosed together; in *Grus antigone* the last cervical and first two dorsal blend together; in *Balearica pavonina* the first two dorsals only, whilst the Stanley Crane agrees with the Bittern and the Heron in having these bones free of each other—at least for some years.

The last caudal vertebra may, at least, count for seven (it is composed of ten in the Duck); and thus the number six ought to be added to the seven caudal. We may thus make a numerical comparison of the whole series as follows:—

	Total Nr. of Vertebræ.
Psophia crepitans	53
Rhinochetus jubatus	49
Eurypyga helias	49
Botaurus viridis	43
Anthropoïdes stanleyanus	54

These numerical comparisons are of considerable interest, thus:—We see that the *Eurypyga* and the Kagu have the same total number of vertebræ, although they are disposed of differently, that the *Psophia* differs but little from the typical Cranes, that the dorsal vertebræ are more confluent in the aberrant Gruine forms than in the types, and that this character is not constant in the typical genera.

The *Eurypyga* is very typical in having a long neck, and very curiously isomorphic of the Anhingas (*Plotus*) in the unusual elongation of this part[1]; for whilst it has five more joints in this region than the Green Bittern, it has the individual vertebræ as long as in that true Ardeine bird. Yet this elongation of the cervical vertebræ, a most constant character in the true Ardeinæ, is not coupled with the swollen, spongy condition seen in those birds, but the bones are quite Gruine in their histological characters.

But the Kagu differs from all its congeners in the stoutness of its cervical vertebræ (Pl. XCI. figs. 1, 2); this is a correlate of its very large ridgy head, and is similar to what is seen in the *Balæniceps*. This incrassation of the cervical vertebræ is coupled with a diminution of their number; and the strength of the head and neck of this bird is in curious contrast with the feeble condition of many other parts of the skeleton.

In the cervical vertebræ, as in the rest of the skeleton, the Kagu shows a very much feebler ossification (especially with relation to the fibrous bands that are attached to the bones) than the *Psophia* and the typical Cranes; in this it agrees with the *Eurypyga*; and the difference between the vertebræ of these two types is merely such as arises from the slenderness of those of the Sun-Bittern and the breadth and shortness of those of the Kagu.

The "atlas" of the Kagu (Pl. XCI. figs. 1 & 2, and Pl. XCII. figs. 12 & 12 *a*) is a strong ring of bone; its upper portion projects on each side behind; its centrum is tridentate; and it has the "cup" cut away in a rounded manner for the "odontoid process of the axis."

The "axis" (Pl. XCI. fig. 1 and fig. 2, 13, and Pl. XCII. figs. 13, 13 *a*, 13 *b*) has a thick upper and a triangular lower spine; over each of its oblique facets there is a thick ridge; and there is a small bony bridge on each side of the odontoid process (Pl. XCII. figs. 13 *a*, 13 *b*).

The next vertebra (Pl. XCII. figs. 14, 14 *a*, 14 *b*, 14 *c*) is intermediate in shape between the "axis" and the cervicals of the hind region; its spine is smaller than that of the "axis," it has a short, stout rib, confluent with the sides of the bone and forming a bridge for the vertebral artery. The next ten vertebræ have scarcely any spine; the sixth approaches in character the typical form of those of the hind region (Pl. XCI. figs. 1 & 2, 15, and Pl. XCII. figs. 15, 15 *a*, 15 *b*, 15 *c*). In this bone the transverse processes project considerably; there is no process tending to wall-in the carotid artery below; the centrum is deeply concave beneath, and is produced into two ears behind, the transverse convexo-concave hinge being greatly produced outwards. The next four have paired processes, tending to embrace the carotid artery; the penultimate bone of these (Pl. XCI. figs. 1 & 2, 16, and Pl. XCII. figs. 16, 16 *a*, 16 *b*, 16 *c*) is seen to be of great breadth, and rather short, with its oblique facets very diverging. In the next five joints, instead of the paired "carotid processes," there is a flat inferior spine; in these the

[1] The abortion of the "ethmo-presphenoidal" band in the Sun-Bittern is in harmony with what we see not only in the Stilt-Plover but also in the Cormorant.

upper spine begins to reappear, and in the last two the ribs do not become ankylosed. The last but three (the thirteenth)[1] has more breadth than length (Pl. XCI. figs. 1 & 2, and Pl. XCII. figs. 17, 17 *a*, 17 *b*, 17 *c*); and this great development in the transverse direction is still greater in the three last. The spine of the last cervical (Pl. XCI. figs. 1 & 2, and Pl. XCII. figs. 18, 18 *a*, 18 *b*) is very high and also very thick; it has a low inferior spine, a large transverse process that projects beyond the "tuberculum" of its styloid rib, and a neat cup on each side for the corresponding "capitulum costæ;" the styloid feeble ribs (Pl. XCI. fig. 2, 18) are less than an inch in length. The five dorsal vertebræ are all ankylosed together, except the last, and in the free bone the inferior crest has died out (Pl. XCI. fig. 1, *d* 5). The upper spine of the first dorsal is higher than that of the second; they then increase in height until we reach the third sacro-lumbar. As the tendons are but little ossified in the Kagu, the transverse processes of the dorsals are permanently distinct (Pl. XCII. fig. 5 *d*); the bodies of the second, third, and fourth are very thin and carinate.

In the height of the dorsal and lumbo-sacral spines the Kagu comes near to *Ocydromus*; in the Kagu the third sacro-lumbar attains its greatest height (Pl. XCI. fig. 1); behind this the spine aborts rapidly, and the hinder two-fifths of the sacrum has no spine.

The eleventh sacral has a long, unsegmented rib on each side; for this part of the sacrum is of great width (Pl. XCII. figs. 5 & 7); behind the eleventh the component vertebræ gradually lose the distinction in rib and transverse process. The sacrum (Pl. XCI. fig. 1) has its last third more bent downwards than in any bird I know, and the caudal series (*cd*) takes the same downward direction. The caudal vertebræ of the Kagu (Pl. XCI. fig. 1, *cd*, and Pl. XCII. figs. 5 & 7, *cd*) are furnished with long transverse processes, as in the *Eurypyga*; in this they both differ from the *Psophia*. The last piece (Pl. XCII. fig. 1, *cd*) is sharper than in either of the related types. The ribs (Pl. XCI. fig. 1, and Pl. XCII. fig. 5) are feebler than in any related type, and the appendages are small, and only present on the first four. The upper part of the ribs is very much enlarged in *Psophia*, *Ocydromus*, and *Eurypyga*, much less so in the Kagu. The sternal pieces (*sr*) are also feeble, and that belonging to the sacro-lumbar rib (*s.lr*) is imperfect below; altogether, the ribs are very feeble and embryonic.

But the shoulder-girdle and sternum show the most remarkable embryonic characters, and have their only counterpart in this respect amongst the Carinatæ in the feeblest-winged Rail (*Brachypteryx australis*). *Ocydromus* has a more perfect sternum.

The scapula (Pl. XCI. fig. 3, *sc*, and Pl. XCII. fig. 5, *sc*) is an extremely feeble and very curved bone; it is only half the relative width of the scapula of *Psophia* and *Eurypyga*; but in these types this bone is very much curved. The acromion process (Pl. XCII. fig. 5, *sc*) is blunt and of a moderate size, and the suprascapular tip of the

[1] In Plate XCI. fig. 2, the penultimate vertebra is numbered 17 by mistake; in Plate XCII., fig. 17 represents the thirteenth vertebra.

bone is rounded. The coracoid (Pl. XCI. fig. 3, *cr*, and Pl. XCII. fig. 6, *mcr*) is an unusually long and feeble bone; its head is hooked and tuberculate, and its meso-coracoid process (*mcr*) is square; this process, as in the *Eurypyga*, is continuous with a sharp keel that runs along the inner side of the bone, and becomes considerably developed at the angle below. At the outer angle below, the epicoracoid hook (*ecr*) is nearly obsolete. The coracoids (Pl. XCII. fig. 6, *cr*) are separated below by the width of the anterior sternal notch; these bones are most slender just above the middle, where they are pinched to little above a line in thickness, whilst measured across the epicoracoid region they are five lines in breadth. The furcula (*fr*) is of a narrow U-shape; it is a much stronger bone than that of *Brachypteryx* or *Ocydromus*: in *Psophia* and *Eurypyga* the bone is stouter, more V-shaped, and has a distinct inter-clavicular process; in the Kagu this part is much aborted. The whole outline is that of three-fourths of a very elegant ellipse (Pl. XCII. fig. 6, *fr*); and the bone is widest below and above; the upper outcurved parts are broad and flat; and there is a very evident enlargement from the "precoracoid segment" where it articulates at its side with the hooked head of the coracoid, and another addition at its tip where it joins the acromion (mesoscapula); this additional piece, which has become confluent with the clavicle on each side, is the "mesoscapular segment." (See 'Shoulder-girdle and Sternum,' Ray Society, 1868, p. 179.)

In relative size, general form, and in the degree of its morphological development, the sternum of the adult Kagu agrees with that of the ripe chick of a typical Crane (*op. cit.* pl. 14. p. 158). The curvature of the bone is so great that the lower view of the shoulder-girdle, when fairly seen, gives a foreshortened view of the sternum (see Pl. XCII. fig. 6, where the sternum appears too short by half an inch); the lateral views (Pl. XCI. figs. 1 & 3, *st*) show the elegant curvature that the xiphoid part of the sternum makes, passing both upwards and backwards to support the abdominal viscera. As in the *Psophia* and in the typical Cranes, the sternum of the Kagu is as narrow in front as in the Rallidæ, but further backwards it narrows-in still more, and then dilates somewhat at the xiphoid end (Pl. XCII. fig. 6, *x*): this part is only slightly trifid. The general feebleness of the Kagu's sternum will be well seen by comparing it (Pl. XCI. figs. 1 & 3, and Pl. XCII. fig. 6) with that of the entirely unossified sternum of the newly hatched Mantchouri Crane (see 'Shoulder-girdle and Sternum,' pl. 14. figs. 6–8). Even at that early stage the sternum of the typical Crane has a much larger keel (which articulates with the "furcula"), a definite "rostrum" in front overlapping "coracoid grooves," and has the normal Pluvialine fission of the xiphoid region of the sternum into middle, intermediate, and external xiphoid processes.

The general curvature of the sternum is very similar in both these instances. The costal processes (Pl. XCI. fig. 3, *c. p*) are long, triangular, and are hooked inwards behind the posterior face of the coracoid.

The two triangular flaps in which the sternal keel terminates in front in the embryo of *Grus* (*op. cit.* pl. 14. figs. 6, 7) have their counterpart in the thickened projecting lobe of the sternal angle in the Kagu (Pl. XCI. figs. 1 & 3). The primordial notch between the coracoid grooves (Pl. XCII. fig. 6) is quite similar to what is seen in the Cassowary (*op. cit.* pl. 17. fig. 3), and in *Brachypteryx* amongst the feeble-winged Land-Rails. The ridge on the sternal keel of the Kagu, indicating the origin of the pectoral muscles, shows the extreme thinness of the large pectorals; altogether, the outer face of the sternum bespeaks a very feeble development of the muscular masses.

The wing of the Kagu (Pl. XCI. fig. 1, and Pl. XCII. fig. 5) is much feebler than that of either the *Psophia* or *Eurypyga*, but it is considerably stronger than that of *Ocydromus*. In *Eurypyga* the arm is $2\frac{1}{2}$ lines shorter than the forearm, in *Psophia* it is 2 lines longer; in *Ocydromus* the arm is 7 lines longer than the forearm, but in the Kagu the arm is almost equal to the forearm; so that the wing of the Kagu, whilst very inferior to that of the *Eurypyga*, is somewhat better proportioned, although relatively feebler, than that of *Psophia*; it is much stronger than that of the great Land-Rail (*Ocydromus*).

The humerus of the Kagu (*h*) is perfectly typical; but the overhanging anterior crest for the insertion of the "pectoralis major" is much less sharp and outstanding than in *Eurypyga*; the condyles are quite normal; but the rounded, thick process below the lower condyle for the ulna is very large (see Pl. XCI. fig. 1, *h*, *u*, where it is seen lying below the end of the ulna, on the os femoris, *f*). The radius (*r*), ulna (*u*), upper and lower carpals (*c*), free and coalesced metacarpals (*mc*), and digits (*d*) are feeble, but quite normal. There is some appearance of a second free digital joint to the pollex (as is seen in *Porphyrio*) (Pl. XCI. fig. 1), but this is somewhat doubtful; the whole of the "hand" is shorter than the other two regions by about a line in extent.

The following Table will show the relative lengths of the three regions of the wing in the Kagu and its congeners:—

	Arm.		Forearm.		Hand.	
	in.	lin.	in.	lin.	in.	lin.
Rhinochetus	2	3	2	4	2	1
Eurypyga	2	1	2	$3\frac{1}{2}$	2	$0\frac{1}{2}$
Psophia	3	$0\frac{1}{2}$	2	$10\frac{1}{2}$	2	7
Ocydromus	2	$3\frac{1}{2}$	1	$8\frac{1}{2}$	1	10

The pelvis of the Kagu is very peculiar (Pl. XCI. fig. 1); it is bent upon the spine to a greater degree than in any bird I have examined, and the height of the iliac crests and of the third sacro-lumbar spine is very remarkable. This condition is seen, but in a less degree, in *Psophia*, *Ocydromus*, and *Talegalla*; but in *Eurypyga* the whole pelvis is as straight, as broad, and as flat as in the Umber (*Scopus*); indeed the resemblance of the pelves of these two types is very great. But if we come to minutiæ, the pelvis of the *Eurypyga* and that of the Kagu agree very closely, notwithstanding the compression and elevation of the latter and the broad outspread condition of the former.

In curious contrast with the smooth and rounded condition of the Kagu's sternum is the high, ridgy pelvis, the whole structure being scooped, carinate, and in every way forming a fit foundation for most powerful muscles. The high iliac crests (Pl. XCI. fig. 1, *il*) culminate on each side of the third sacro-lumbar vertebra, the spine of which they strongly clamp, like the relation of the suprascapula of the Skate to the cervical and anterior dorsal spines ('Shoulder-girdle and Sternum,' pl. 1. figs. 1 & 2, *ssc*, *v*). This junction of the sacro-lumbar spine with the iliac crests keeps unankylosed (Pl. XCII. fig. 5. *sl*, *il*) as in *Eurypyga*; at any rate it is so in this specimen, the age of which I cannot tell, but which is evidently quite adult. In *Psophia*, as in *Grus* and *Ocydromus*, these parts coalesce. Here let it be remarked that the pelvis of *Psophia* is more like that of *Ocydromus* than that of the typical Crane.

The angle formed by the iliac crest as it bends downwards towards the acetabulum is quite a unique condition. There is as distinct a "preacetabular spur" in the *Psophia* as in *Talegalla*; there is scarcely a trace of this process in *Grus* proper, none in the Kagu and *Eurypyga*, but in *Ocydromus* it is as large as in the typical Gallinæ. The canals formed by the junction of the iliac crests with the sacro-lumbar spine are equally deep in the Kagu and *Ocydromus*; they are open in *Eurypyga*, where the crests keep wide apart, and are filled in by bony matter in *Psophia* and *Grus*. The acetabular fenestræ are very large in all these related Grallæ, the articular surface being a mere crescent below; above, there is an oval, slightly concave facet for the "trochanter major." The overhanging crest of the postfemoral part of the ilium (Pl. XCI. fig. 1, *il*, and Pl. XCII. fig. 5) is nearly as strong as in the *Psophia*. The descending ilio-ischiadic plate (Pl. XCI. fig. 1, *il.isc*) is relatively deeper than it is even in *Psophia*, but in this latter bird this plate is less notched than it is in *Ocydromus*: the notch is more definite in *Grus*; but in the Kagu, as in *Eurypyga*, this notch is very deep, and the ilium and ischium both end in long processes. The long "obturator notch" (*o. n*) and the ovoidal ischiadic fenestra (*is.f*) are quite alike in these two species. The ischiadic fenestra is broad behind alike in *Ocydromus*, *Psophia*, the Kagu, and in *Eurypyga*; but in *Grus* the posterior end of this space is narrow. The pubis (*pb*), which is nearly straight in *Ocydromus*, *Scopus*, and *Psophia*, is much more curved and sigmoid in *Grus*, and still more so in *Eurypyga*; but this curvature is greatest in the Kagu, it becomes almost suddenly bent upwards below the angle of the ischium, and is then deflected inwards in some considerable degree towards its fellow of the opposite side. In its rounded and very feeble condition the pubis of the Kagu comes closest to that of *Eurypyga*; for in *Psophia* it is a stout and even a broad bone, much like that of the Rail (*Ocydromus*). The pubis of *Grus*, making allowance for its great size, is intermediate between that of the Kagu and *Psophia*.

With regard to the serial homologies of the pelvis it may be remarked that the whole of the spinal edge of the ilium is the counterpart of the upper edge of the suprascapula; this is best seen by comparing the ilium of the bird with the suprascapula of the Skate ('Shoulder-girdle and Sternum,' pl. 1. figs. 1–4, *sc. v*). The great backward extension of the ilium in the bird is illustrated by the large, flappy suprascapula of the Lacertians (*op. cit.* pls. 9–11, *s.sc*); in the Rhea, and in a less degree in the Apteryx, the ilium stops short of the ischium behind. The manner in which the three main elements of the "os innominatum" meet in the "acetabulum" is beautifully illustrated in the shoulder-girdle of the Batrachia, especially in *Dactylethra* (*op. cit.* pl. 6. fig. 11). The pelvic counterpart of the great notch between the suprascapula and scapula above and the coracoid below is filled up behind in most birds by a continuous growth of cartilage, so that we have not an ischiadic "notch," but a large "fenestra." In the Skate (*op. cit.* pl. 1. fig. 2, *sc.f*, *cr.f*) there are two fenestræ in the corresponding region of the shoulder-girdle moiety. In the Apteryx, the Emu, the Cassowary, the African Ostrich, and the Tinamous (Trans. Zool. Soc. 1864, vol. v. part 3, pl. 39, *il*, *isc*) this space is open in the same manner as in the shoulder-girdle of the Frog. In *Dactylethra*, in the Chelonians, and in the African Ostrich the space between the precoracoid and coracoid (the counterparts of the pubis and ischium in the pelvis) is a large, deep notch ('Shoulder-girdle and Sternum,' pl. 6. fig. 11, pl. 12. fig. 2, and pl. 17. figs. 5, 6). In birds, generally, the "obturator" space is a very deep notch; in the Rhea it is a huge "fenestra" from the first; in the Buceridæ it becomes so by coalescence of the pubis with the ischium; these differences are all in harmony with what is seen in the various conditions of the shoulder-girdle. The moieties of the hip-girdle only meet below and coalesce in the African Ostrich; in other birds they keep apart; in the Toad (*op. cit.* pl. 5. figs. 15–17) the counterparts of the pubes meet and coalesce, this being, however, an exceptional condition as to the Batrachia, and borrowed from the Skate and Shark (*op. cit.* pl. 1. figs. 1–4).

In certain Fishes the scapular region becomes segmented from the coracoid (*op. cit.* pl. 2. fig. 12, *sc*, *pcr*); in certain Amphibia, as in some other fishes (e. g. *Trigla*, *Agonus*, *Gobius*, *op. cit.* pl. 2. fig. 13), this connectivum is only partially separated; this partial separation appears again in the rudimentary cleft seen in the fundus of the glenoid cup in *Proteus* and *Cryptobranchus* (*op. cit.* pl. 3. figs. 1 & 3, *gl*).

In birds the pelvic counterpart of this cleft is constantly present, and its large size and irregular shape is well illustrated in Professor Owen's paper on *Cnemiornis* (Trans. Zool. Soc. 1866, vol. v. part 5, pl. 64. fig. 7 *a*).

Hence it will be seen that the hip-girdle is the same in its morphology as the shoulder-girdle, that in the Class of Birds its spinal crest is hugely developed but perfectly normal, and that the whole of each moiety is a cartilaginous plate superadded to the axial skeleton and tending to undergo fission in exactly the same manner as the shoulder-girdle moiety. Also it is evident that the hip-girdle is always of a lower morphological type than the shoulder-girdle, its fission and general metamorphosis being so much more arrested in the same individual type; so that, whilst the shoulder-girdle of the Skate illustrates the hip-girdle of the Bird, the hip-girdle of the Mammal and the shoulder-girdle of the Frog lie very nearly on the same morphological level (*op. cit.* pls. 6 & 7).

With regard to the setting-on of the limb-girdle moieties, it will be seen that there is the greatest liberty with regard to the *angle* these plates form with the vertebral axis. As they are merely supplementary parts, and as they appear between the skin and the axial cartilages and muscles, there is nothing to prevent them shooting along the subcutaneous plane in any direction. In the Bird-class, where the skeleton is so marvellously modified in correlation with the functions and habits of a flying creature, the upper edge of the shoulder-girdle is directed very far backwards, the direction, from the narrow suprascapular top, being forwards and a little downwards to the glenoid region, and then suddenly downwards and backwards, the upper and lower halves lying at an acute angle. In the hip-girdle, on the contrary, the true apex is turned forwards, but runs also backwards by a very long upper margin, the general direction of the whole plate being backwards and a little downwards. The Kagu is peculiar among birds for a much more downward direction of the hip-girdle moiety than is common in its Class; but even in it there is but little approach to the condition of these parts in the Lacertian, where the ilium is set on to the spine at almost a right angle.

With regard to the arrested metamorphosis of the hip-girdle in the Bird, it is worthy of remark that the pubis (the counterpart of the precoracoid bar which is the subject in the Bird and in the Mammal of such a large amount of morphological change) does die out at its anterior part in certain Raptores—for instance, the Falcons, Hawks, &c. The pubis, also, like the precoracoid, is the first to become enfeebled and modified, although in a less degree.

The hinder limbs of the Kagu (Pl. XCI. fig. 1, and Pl. XCII. figs. 9–11) are very much like those of its immediate congeners the *Psophia*, the *Eurypyga*, the Cranes, and the Rails. The "os femoris" (Pl. XCI. fig. 1, *f*, and Pl. XCII. figs. 9, 9 *a*, 9 *b*) is slender, more arcuate, and longer, relatively, than in *Psophia* and *Eurypyga*, and therefore more Ralline. A Table showing the comparative lengths of the femur, tibia, tarsus, and middle toe will illustrate this:—

	Femur.	Tibia.	Tarsus.	Middle toe.
	in. lin.	in. lin.	in. lin.	in. lin.
Rhinochetus jubatus	2 7½	4 9	3 11	2 3½
Eurypyga helias	1 4½	3 0	2 1	1 4
Psophia crepitans	2 10	5 10	4 8	2 4
Porphyrio poliocephalus	2 10½	5 4	3 9	4 0½
Ocydromus australis	3 2½	4 6½	2 8	2 6½

Here it is shown how extremely variable the relative proportions of these regions are even in birds so closely related as those given in the list. Altogether, the bones of the hinder limbs are much slenderer in the Kagu than in *Psophia*, *Ocydromus*, and

Porphyrio. Notwithstanding the greater slenderness and inferior size of the tibia of the Kagu (Pl. XCI. fig. 1, *t*, and Pl. XCII. figs. 10, 10 *a*, 10 *b*) as compared with that of *Porphyrio* and *Ocydromus*, yet the crests at its upper part (ectocnemial, entocnemial, and epicnemial) are quite equal to what is seen in those large Rails. This brings us to consider the extraordinary development of these parts in that extinct Grallatorial bird which Professor Owen has called *Cnemiornis* (see Zool. Trans. 1866, vol. v. part 5. pl. 66, p. 401). The condition of the parts in that huge type is merely an exaggeration of what is seen in *Porphyrio* and *Ocydromus*, and especially, also, in the Kagu.

Both extremities of the tibia of the Kagu are large as compared with the slender shaft; the front view of the bone (Pl. XCII. fig. 10) shows this, and also how closely this bone corresponds with that of *Cnemiornis.* The lower condyles are very strongly marked (Pl. XCII. figs. 10 & 10 *b*); there is an oblique tendon-bridge in front, a cleanly cut notch above the ectocondylar elevation, and between the two condyles there is a large cotyloid cavity for the precalcaneal knob. The slender fibula (Pl. XCI. fig. 1, *fb*) is three-fifths the length of the tibia; the patella (Pl. XCI. fig. 1, *p*) is rather larger. The separateness of the lower articular portion of the tibia of this bird was familiar to me in my early days, and the drawings made by me of these parts in the young Emu twenty-four years since "are alive to testify" to this. Afterwards, when writing upon the osteology of the *Balæniceps* (Trans. Zool. Soc. 1861, vol. iv. part 7, p. 343), I strongly doubted the merely epiphysial nature of this piece, and put this question: "Is it the homologue of the mammalian astragalus?" This question has now been definitively settled by Professor Gegenbaur (see his paper "Vergleichend-anatomische Bemerkungen über das Fussskelet der Vögel," Archiv für Anat. u. Phys. Jahrgang 1863, p. 455).

This apparent obliteration of the tarsal bones is a remarkable feature in the pelvic limbs of the bird; after all only two segments are found, one coalescing with the tibia and the other with the three main metatarsals; for the sesamoid bone occasionally found behind the joint is not an "os calcis," but a tendon-bone. At first sight, the tarsometatarse of the *Psophia* and that of the Kagu seem to have scarcely anything, except the superior size of the former, to distinguish them; but there are many important differences. The whole piece is much more feebly ossified in the Kagu than in the *Psophia*, and this to a degree that is very remarkable for a Bird, reminding the observer of the Penguin and of young birds generally. The ectotarsal and entotarsal keels behind the upper head of the bone are only united by membrane (Pl. XCII. fig. 11 *a*); they are connected by a bony bridge in *Psophia*: the Kagu and *Eurypyga* agree as to the condition of these parts.

The great "lower tarsal" is but feebly molten into the heads of the main metatarsals (Pl. XCII. fig. 11); and these three long bones keep their sutures for a long time, and have large "fenestræ" between them above—a very remarkable and interesting character. There is very little trace of these spaces in *Psophia*, *Eurypyga*, *Ocydromus*, and

Porphyrio. The posterior sharp edges of the metatarsus seen in these birds have scarcely any existence in that of the Kagu. As in these its congeners, the Kagu has the outer lower condyle connected with the middle condyle by a bony bridge, so that the considerable open space between these two, below, is divided into a fenestra and a notch. The condyles themselves (Pl. XCII. figs. 11 & 11 *b*) differ in the Kagu from those of its congeners; they are much more outspread (Reptilian) than in the *Psophia*, whilst in *Eurypyga* they are more compressed than even in *Porphyrio*, equalling what is seen in the Coot (*Fulica atra*), and approaching the condition of these parts in the Grebes (*Podiceps*). The small free metatarsal (Pl. XCI. fig. 1, *i. m.t*) is placed high up, as in the congeners of the Kagu; and the "hallux"[1] is of moderate length. The rest of the toes are slender, and rather long (Pl. XCI. fig. 1), the middle toe (*d.* 3) being more than an inch and a half shorter than the tarso-metatarse. In the *Psophia* the middle toe is only half the length of the shank; in *Eurypyga* the middle toe is nearly two-thirds the length of the shank; whilst in *Porphyrio* it is a quarter of an inch longer than the tarso-metatarse.

These variations are worth mentioning because of their zoological value; morphologically, however, they have much less import, as they relate mainly to the correlation of each type to its surroundings in actual life.

In summing up the affinities of the Kagu, I may say that my view of it is that it is a *generalized* Crane, that it is nearer of kin to *Eurypyga* than to *Psophia*—the latter coming near to the Balearic Crane, whilst *Eurypyga*, like the Kagu, makes a very near approach to the Night-Herons amongst the typical Ardeinæ. The Kagu is related to the Rails; but so, indeed, are all the Gruinæ; and Professor Huxley has, with great sagacity, put both these families into one group, and has called this group the "Geranomorphæ" (see Proc. Zool. Soc. 1867, p. 457).

EXPLANATION OF PLATES XCI. AND XCII.

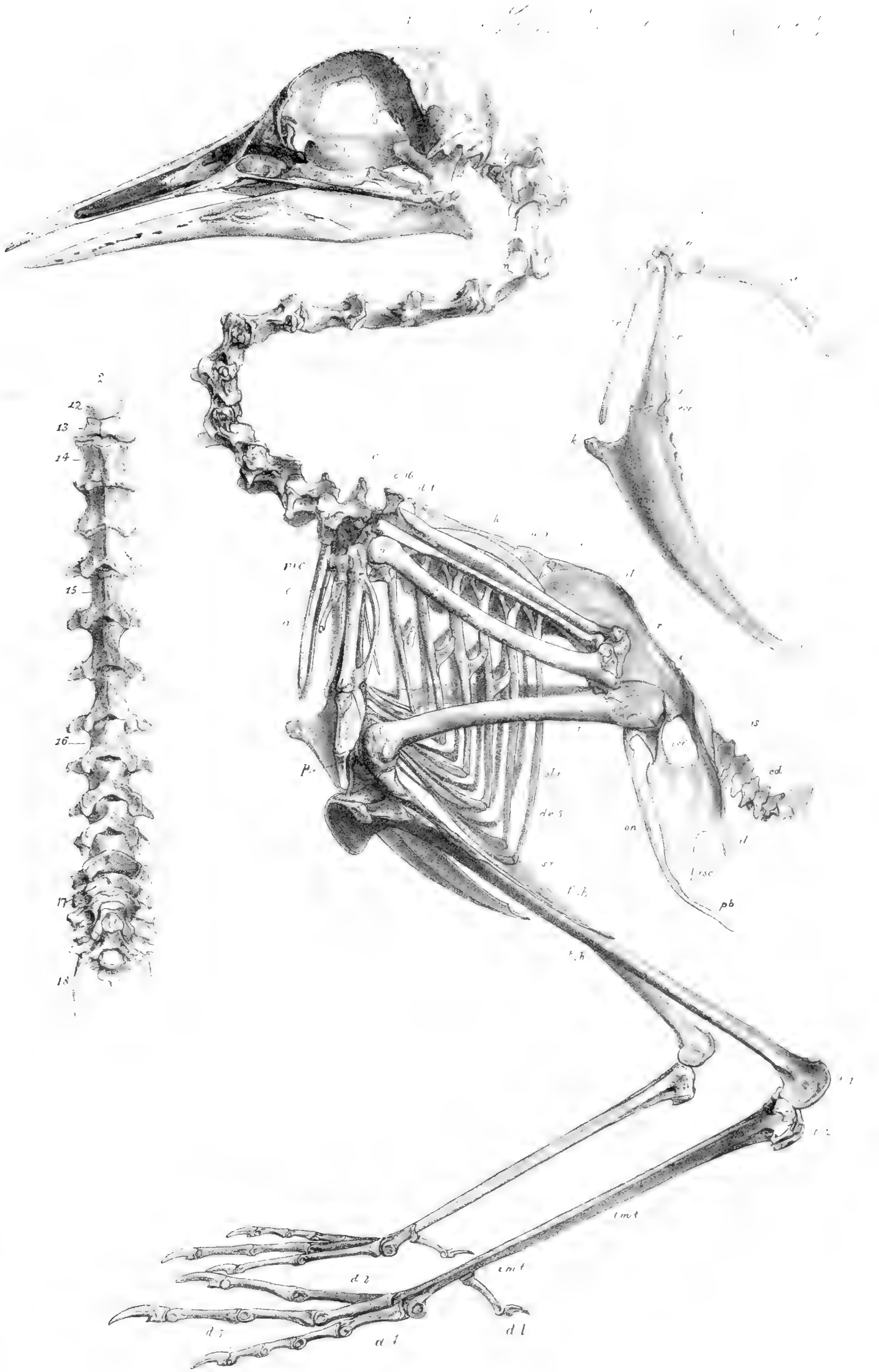
PLATE XCI.

Fig. 1. Side view of skeleton.
Fig. 2. Upper view of cervical vertebræ.
Fig. 3. Side view of sternum and shoulder-girdle.

[1] The hinder toe is evidently the true "hallux;" but in my former papers it was described as the second (*d.* 2), on the supposition that the spur of the Cock represented the innermost digit.

PLATE XCII.

Fig. 1. Upper view of skull.
Fig. 1 *a*. Upper view of lower jaw.
Fig. 2. Lower view of skull.
Fig. 3. Side view of ditto.
Fig. 3 *a*. Side view of lower jaw.
Fig. 4. End view of skull.
Fig. 4 *a*. End view of mandibles.
Fig. 5. Upper view of trunk and wings.
Fig. 6. Lower view of sternum and shoulder-girdle.
Fig. 7. Lower view of pelvis and tail.
Fig. 8. Upper view of os hyoides.
Fig. 8 *a*. Side view of ditto.
Fig. 9. Front view of os femoris.
Fig. 9 *a*. Upper view of ditto.
Fig. 9 *b*. Lower view of ditto.
Fig. 10. Front view of tibia.
Fig. 10 *a*. Upper view of ditto.
Fig. 10 *b*. Lower view of ditto.
Fig. 11. Front view of tarso-metatarse.
Fig. 11 *a*. Upper view of ditto.
Fig. 11 *b*. Lower view of ditto.
Fig. 12. Side view of atlas.
Fig. 12 *a*. Front view of ditto.
Fig. 13. Upper view of axis.
Fig. 13 *a*. Front view of ditto.
Fig. 13 *b*. Posterior view of axis.
Fig. 14. Upper view of third cervical vertebra.
Fig. 14 *a*. Lower view of ditto.
Fig. 14 *b*. Front view of ditto.
Fig. 14 *c*. Posterior view of ditto.
Fig. 15. Upper view of sixth cervical vertebra.
Fig. 15 *a*. Lower view of ditto.
Fig. 15 *b*. Front view of ditto.
Fig. 15 *c*. Posterior view of ditto.
Fig. 16. Upper view of ninth cervical vertebra.
Fig. 16 *a*. Lower view of ditto.
Fig. 16 *b*. Front view of ditto.
Fig. 16 *c*. Posterior view of ditto.
Fig. 17. Upper view of thirteenth cervical vertebra.
Fig. 17 *a*. Lower view of ditto.
Fig. 17 *b*. Front view of ditto.
Fig. 17 *c*. Posterior view of ditto.
Fig. 18. Side view of sixteenth (last) cervical vertebra.
Fig. 18 *a*. Posterior view of ditto.
Fig. 18 *b*. Anterior view of ditto.



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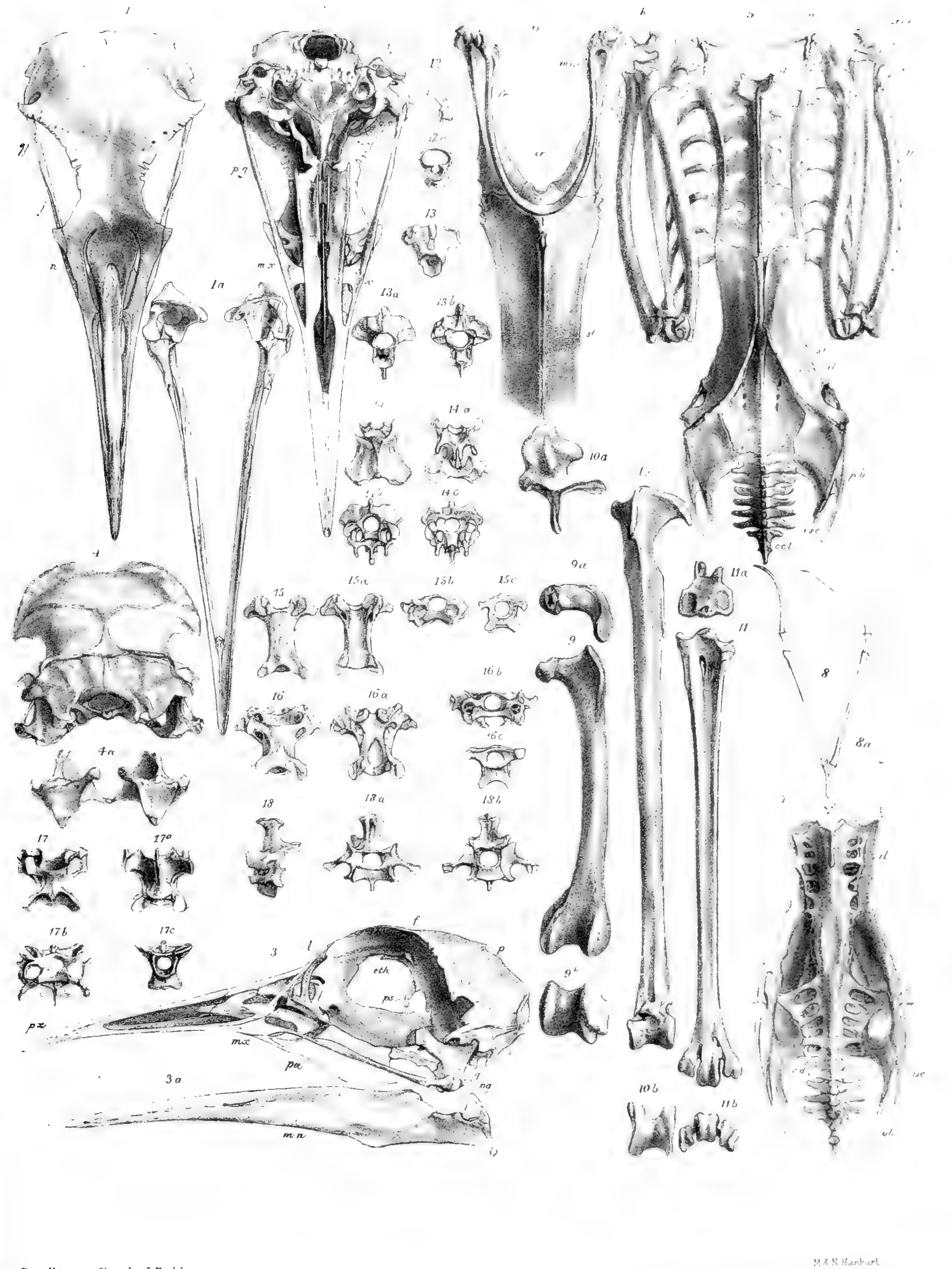

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