

S. 1. B. 8.

THIS BOOK MAY NOT BE PHOTOCOPIED

TRANSACTIONS
OF
THE ZOOLOGICAL SOCIETY
OF LONDON.

VOLUME VIII.



LONDON:
PRINTED FOR THE SOCIETY:
SOLD AT THEIR HOUSE IN HANOVER-SQUARE;
AND BY MESSRS. LONGMANS, GREEN, READER, AND DYER, PATERNOSTER-RROW.

1874.

75.
3 - 9.
1.

C O N T E N T S.

- I. *On Risso's Dolphin, Grampus griseus (Cuv.).* By WILLIAM HENRY FLOWER, F.R.S., F.R.C.S., V.P.Z.S., Hunterian Professor of Comparative Anatomy and Conservator of the Museum of the Royal College of Surgeons of England page 1
- II. *A List of the Birds known to inhabit the Island of Celebes.* By ARTHUR, Viscount WALDEN, F.R.S., President of the Society 23
- III. *Appendix to a List of Birds known to inhabit the Island of Celebes.* By ARTHUR, Viscount WALDEN, F.R.S., President of the Society 109
- IV. *On DINORNIS (Part XVII.): containing a Description of the Sternum and Pelvis, with an attempted Restoration, of Aptornis defossor, Ow.* By Professor OWEN, F.R.S., F.L.S., &c. 119
- V. *On the Form and Structure of the Manatee (Manatus americanus).* By Dr. JAMES MURIE, F.L.S., F.G.S., &c., late Prosector to the Zoological Society . . . 127
- VI. *On the Recent Ziphioid Whales, with a Description of the Skeleton of Berardius arnouxi.* By WILLIAM HENRY FLOWER, F.R.S., V.P.Z.S., Hunterian Professor of Comparative Anatomy, and Conservator of the Museum of the Royal College of Surgeons of England 203
- VII. *On the Organization of the Caaing Whale, Globiocephalus melas.* By Dr. JAMES MURIE, F.L.S., F.G.S., &c. 235
- VIII. *A Description of the Madreporaria dredged up during the Expeditions of H.M.S. 'Porcupine' in 1869 and 1870.* By Professor P. MARTIN DUNCAN, M.B. (Lond.), F.R.S., F.G.S., Professor of Geology to King's College, London, &c. . . . 303
- IX. *On the Osteology of the Marsupialia. (Part III.) Modifications of the Skeleton in the Species of Phascolomys.* By Professor OWEN, F.R.S., F.Z.S., &c. . . 345
- X. *On DINORNIS (Part XVIII.): containing a Description of the Pelvis and Bones of the Leg of Dinornis gravis.* By Professor OWEN, F.R.S., F.Z.S., &c. . . 361

- XI. *On DINORNIS (Part XIX.): containing a Description of a Femur indicative of a new Genus of large Wingless Bird (Dromornis australis, Owen) from a post-tertiary deposit in Queensland, Australia. By Professor OWEN, F.R.S., F.L.S., &c.* . . . 381
- XII. *On the Axial Skeleton of the Ostrich (Struthio camelus). By ST. GEORGE MIVART, F.R.S.* 385
- XIII. *On the Osteology and Dentition of Hylomys. By JOHN ANDERSON, M.D., Curator of the Indian Museum, and Professor of Comparative Anatomy in the Medical College, Calcutta* 453
- XIV. *Report on the Hydroida collected during the Expeditions of H.M.S. 'Porcupine.' By Professor G. J. ALLMAN, F.R.S.* 469
- XV. *On the Osteology of the Marsupialia. (Part IV.) Bones of the Trunk and Limbs, Phascalomys. By Professor OWEN, C.B., F.R.S., F.Z.S.* 483
- XVI. *Researches upon the Anatomy of the Pinnipedia.—Part III. Descriptive Anatomy of the Sea-lion (Otaria jubata). By Dr. JAMES MURIE, F.L.S., F.G.S., &c., late Prosector to the Society* 501

TRANSACTIONS

OF

THE ZOOLOGICAL SOCIETY.

I. *On Risso's Dolphin, Grampus griseus (Cuv.).* By WILLIAM HENRY FLOWER, F.R.S., F.R.C.S., V.P.Z.S., Hunterian Professor of Comparative Anatomy and Conservator of the Museum of the Royal College of Surgeons of England.

Read June 6th, 1871.

[PLATES I. and II.]

ON the 28th of February, 1870, an animal belonging to the Order Cetacea was taken in a mackerel-net near the Eddystone Lighthouse, and brought into Plymouth. It was afterwards sent to the Columbia Fish Market, London, was then exhibited in the Kingsland Road, where I first saw it on the 4th of March, and finally lodged at Mr. E. Gerrard's workshop, where the skin and skeleton were prepared for the British Museum, and where the very carefully executed drawings (Pl. I. figs. 1-3) which accompany this communication were made, by Mr. Sherwin, under my superintendence¹.

The animal was a female, and (as afterwards appeared from the condition of the bones) perfectly adult. Moreover there was evidence that she had recently given birth to a calf.

The principal dimensions were as follows (all the measurements are taken in a straight lines with calipers, unless otherwise stated):—

| | ft. | in. |
|--|-----|-----------------|
| Length, from anterior edge of upper lip to notch in middle of caudal fin | 10 | 6 |
| From upper lip to anterior edge of dorsal fin | 3 | 11 |
| From upper lip to anterior angle of eye | 1 | 1 $\frac{1}{4}$ |

¹ I have much pleasure in acknowledging the great facilities which Mr. Gerrard afforded me in examining both the specimens described in this communication.

2
↓

| | ft. | in. |
|--|-----|-----|
| From upper lip to blow-hole (following curve) | 1 | 7 |
| From upper lip to junction of anterior edge of pectoral fin with the body | 1 | 9 |
| From upper lip to angle of mouth | 0 | 10½ |
| From upper lip to anus | 7 | 0 |
| Length of eye-aperture | 0 | 1 |
| From posterior angle of eye to ear-aperture | 0 | ¾ |
| From angle of mouth to anterior angle of eye | 0 | ¾ |
| Pectoral fin, length from junction of anterior edge with body to tip | 1 | 11¾ |
| Pectoral fin, from junction of posterior edge with body to tip | 1 | 7 |
| Pectoral fin, breadth at base | 0 | 6 |
| Pectoral fin, greatest breadth | 0 | 6½ |
| Height of dorsal fin | 1 | 4 |
| Breadth of caudal fin | 2 | 5 |
| Vertical height of body, at the eye | 1 | ¾ |
| Vertical height of body, immediately behind the pectorals | 1 | 7 |
| Vertical height of body, immediately in front of dorsal fin | 2 | 0 |
| Vertical height of body at pudendal orifice | 1 | 3 |

In general form the animal more resembled a *Globicephalus* than any other Cetacean with which I am acquainted—so much so that I was at first inclined to refer it to that genus. The front part of the head was furnished with a similar rounded adipose protuberance, though developed to a less extent; and the pectoral fins had almost the same low position and narrow falcate form, though they were considerably less elongated; the dorsal fin, however, was higher. A better idea of the general form of the body can be obtained by an inspection of the figure (Pl. I. fig. 1) than by any description.

The crescentic aperture of the blow-hole, 1½ inch in width, was placed directly over the eyes. The minute external auditory meatus (no larger than a hole made by pricking the skin with a needle) was an inch lower than the eye-aperture, and ¾ inches behind its hinder angle.

From the blow-hole the upper contour of the head was continued at first nearly horizontally forward, then curved pretty rapidly downwards to form the nearly vertical anterior surface of the head. This was somewhat hollowed in the middle line, and expanded below into a thick, rounded, very short snout, which projected 1½ inch further forwards than the edge of the lower lip.

The lower jaw was narrowed in front. The opening of the mouth was directed slightly upwards towards the angle, but finally took a sweep downwards near the junction of the upper and lower lips. There were no traces of teeth in the upper jaw; but there was a deep narrow groove along the alveolar margin of the palate. In the lower jaw, near the anterior or symphyseal region, were three rather small teeth on each side, the apices

of which were worn quite flat. The hinder edge of the most posterior of these was $2\frac{1}{2}$ inches from the anterior edge of the chin; and the three occupied a space of 1.7 inch. The middle one was slightly larger than the others, the truncated crown being 0.3 of an inch in diameter, and projecting 0.2 of an inch above the level of the gum. The space between the right and left anterior tooth was 1.2 inch.

On the under surface of the body there was a deep median depression containing the vulva and anus, 8 inches in length, and bordered in its anterior portion by prominent labia. The nipples were each placed in a slit, 1 inch long, on the side of the median pudendal fissure, and $1\frac{1}{2}$ inch distant from it. The mammary glands were largely developed, the internal reservoir being filled with milk. This circumstance, combined with the dilated, vascular condition of the uterus, showed that the animal had recently given birth to a young one.

Perhaps the most noticeable external character was the very marked and peculiar coloration. The most prevalent tint was grey, varying in some parts to pure white, and in others to deep black; but the light parts of the head and anterior portion of the body had a yellowish wash, and the dark parts a slight bluish or purple tinge which varied much in different lights. The length of time that the animal had been out of the water may have modified these colours somewhat; but the general disposition of the light and dark shades, as shown in the figure, were evidently natural.

The head and the whole of the body anterior to the dorsal fin was generally of a lightish grey, variegated with patches of both darker and whiter hue. The eye was surrounded by a small oval patch of black. The lips were mottled with black. There was a large, nearly black, patch on the top of the head, extending backwards a short distance behind the blow-hole, and on each side towards, but not reaching, the eye. Both surfaces of the pectoral fin were nearly black, very finely mottled or dappled with grey, and becoming darker towards the tip. The neighbourhood of the axilla was of the same dappled colour. Behind the anterior edge of the dorsal fin the general colour of the surface, including the dorsal and caudal fins, was nearly black, though with a large light patch on the upper part of the side directly above the pudendal orifice. The middle of the belly, as far back as the pudendal orifice, was greyish white.

But what gave the most remarkable and characteristic appearance to the animal was the presence of conspicuous, but most irregular, light streaks and spots, scattered over the whole of the sides from the front of the head to about two feet from the end of the tail, where they ceased, at least on the lateral surfaces. These markings were naturally most conspicuous in those parts of the surface where the ground-colour on which they were placed was dark. The streaks or lines were of various lengths, and running in all directions in a most fantastic manner, some parallel, some crossing each other, and some forming sharp angles, zigzags, and scribble-like patterns. When most completely developed, and not interfered with by others, each linear marking was of a compound character, consisting of a very narrow, central white line, with an irregular, black,

mottled border, which, again, was separated from the general dark colour of the surface by another white line, so that there were three white and two black lines, altogether nearly half an inch in width. In some places the central white line was absent; and then the marking showed only a dark centre, bordered by white. There are also many round and oval patches of white, generally with a dark centre. On close inspection it was seen that these dark lines and patches were really formed by aggregations of minute black dots and fine linear streaks placed transversely to the main line, and that they depended altogether upon the disposition of the pigment in the cuticle, the peculiar coloration passing through its entire thickness.

Nothing but the drawing can convey any idea of the extraordinary and irregular manner in which these markings were distributed. Though there was a general correspondence between their arrangement on the two sides, there was no symmetry in detail. They were entirely absent from the dorsal, pectoral, and upper surface of the caudal fins, though on the under side of the right lobe of the latter were some broad, rather indistinct, white lines, parallel with the anterior border of the lobe, and following its curve. There were no corresponding markings on the other lobe.

The viscera generally, as far as I had an opportunity of examining them, appeared closely to resemble those of *Globicephalus*. The stomach was nearly empty, containing only a little fluid, and in its last compartment a single crystalline lens, apparently of a small Cephalopod.

Skeleton.—The condition of the bones showed that the animal was adult but not aged: all the epiphyses of the limb-bones were completely united with the shafts; and the disk-like terminal epiphyses of the bodies of the vertebræ were likewise joined with the rest of the bone, with the exception of a few in the lumbar region, which still remained distinct.

In general appearance the skeleton presents the same kind of resemblance to that of *Globicephalus* that the external figure of the animal does, the proportions of the different regions of the trunk being very similar; but as the vertebræ are more numerous, especially in the lumbar region, they are individually shorter from before backwards. The spinous and transverse processes are also longer and more slender, approaching in this respect *Delphinus* and *Lagenorhynchus*, and deviating greatly from *Orca* and *Pseudorca*.

The most noticeable peculiarity of the vertebral column, taken as a whole, is the very feeble development of the metapophyses.

The total number of vertebræ is 68, which may be divided into 7 cervical, 12 thoracic, 19 lumbar, and 30 caudal¹.

The seven cervical vertebræ are all firmly united together by the laminae of their arches and the spines; but the body of the seventh is quite distinct from the sixth, and that of

¹ Exactly the same numbers as those found by Fischer in a specimen of *Grampus griseus*, stranded in 1867, on the west coast of France. (*Annales des Sciences Naturelles*, 5th ser. viii. p. 363, 1867.)

the latter only imperfectly joined to the fifth. The bodies of the remainder are completely consolidated together. The spines of all seven are joined into a single conical mass, flattened in front, and compressed from side to side posteriorly. Indistinct traces of their original individuality may be seen on the sides of the laminae. The pedicles of the arches are all distinct, with interspaces for the passage of the nerves; but, with the exception of the first and seventh, they are scarcely thicker than pieces of cardboard. There is no foramen in the arch of the atlas for the passage of the suboccipital nerve, but merely a shallow groove. The transverse process of the atlas is directed nearly straight outwards, is stout, somewhat flattened from above downwards, and rounded at

Fig. 1.

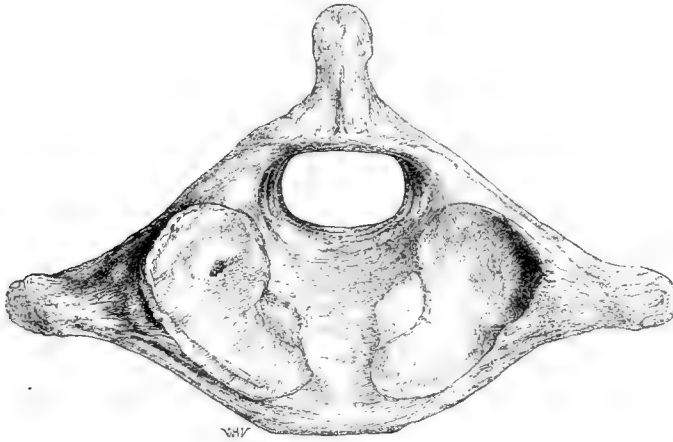
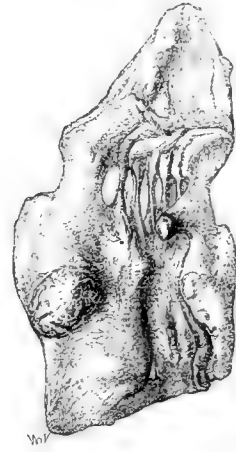
Anterior surface of cervical vertebrae. $\frac{1}{2}$.

Fig. 2.

Side view of cervical vertebrae. $\frac{1}{2}$.

the extremity; that of the axis forms a small but distinct tubercle, projecting somewhat backwards from the middle of the transverse process of the atlas; that of the seventh is long and slender, inclining forwards and downwards, its apex being but 0·2 of an inch behind the end of the transverse process of the axis, and extending as far laterally. The transverse processes of the intervening vertebrae are but slight triangular projections from the roots of the flattened pedicles of the arches. The side of the body of the seventh vertebra has a well-marked articular surface, which receives the head of the first rib. Slight rough elevations on the bodies of the vertebrae in front of this, and at a lower level, are all the indications shown of the inferior transverse processes so commonly met with in this region in the Cetacea. The dimensions of these vertebrae are¹:—

¹ The cervical vertebrae most closely resemble those of *Grampus griseus* figured by Van Beneden and Gervais (*Ostéographie des Cétacés*, pl. 54. figs. 8 & 8 a).

| | inches. |
|--|---------|
| Length of inferior surface of conjoined bodies | 2·4 |
| Length of conjoined arches | 2·2 |
| Height from inferior surface of atlas to apex of conjoined spinous processes | 5·4 |
| Breadth of articular surfaces of atlas | 4·7 |
| Breadth between tips of transverse processes of atlas | 7·7 |
| Breadth between tips of transverse processes of axis | 5·3 |
| Breadth between tips of transverse processes of seventh vertebra | 5·2 |
| Greatest breadth of spinal canal (inside arch of atlas) | 2·0 |
| Height of spinal canal at the same place | 1·4 |

The thoracic vertebræ are twelve in number. The body of the first is but 0·6 of an inch in length; they gradually increase from this to the fifth; but the remainder are very nearly equal, viz. 1·7 inch in length, and present no marked differences in breadth and height. Articular surfaces for the heads of the ribs are developed on the hinder edge of the base of the pedicle of the arch of the first five; and on the sixth there is a rough tubercle in the corresponding position. The spine of the first is very small and directed forwards; that of the second is equally low, but broader in the antero-posterior direction; that of the third is long and pointed, and sloping much backwards; the remainder increase gradually in length to the last, and become more upright in position; beyond the sixth they have a slight forward curve. The transverse processes arise in the anterior vertebræ high up on the sides of the arch; but, as in other true Dolphins, their position is gradually lowered until, before the termination of the thoracic region, they are transferred to the bodies of the vertebræ. In the first seven vertebræ they are of nearly equal length, but from the eighth to the twelfth they gradually increase. They all have articular surfaces at their extremities for the heads of the ribs, at first oval from above downwards, but gradually becoming elongated in the other direction. In the twelfth the surface is convex and very slightly marked. Zygapophyses are developed only as far as the articulation between the sixth and seventh. The metapophysial tubercles are slightly indicated on the third, near the outer end of the anterior edge of the transverse process; on the sixth and seventh they are prominent, conical, and close to the base of the process; on the eighth they become less marked, and begin to rise on the side of the arch; and they no longer exist as distinct processes on the eleventh, and thenceforth are only indicated by a slight bulging forwards of the anterior edge of the upper part of the arch, and do not reappear, as is usually the case, in the lumbar or caudal region¹.

The bodies of all the lumbar vertebræ are very nearly equal in length, viz. 1·4 inch.

¹ The metapophysies of the posterior thoracic region are much better developed in the skeleton of the "*Grampus rissoanus*," figured by Van Beneden and Gervais (*op. cit.* pl. 54, fig. 1), than in the present specimen.

In height they gradually increase from 2 inches (first) to 2·4 inches (nineteenth); in breadth they increase from 2·3 inches (first) to 2·4 inches (nineteenth) at the articular ends. The sixth, seventh, and eighth have the highest spines, viz. 6·4 inches from the upper surface of the body of the vertebra to the tip of the spine—the height of the first being 6 inches, that of the last 4·3 inches. The spines are long, slender, upright, and devoid of metapophyses. The transverse processes gradually diminish from the first (where the breadth of the vertebra between the tips of the processes is 11·2 inches) to the last (where the same measurement is but 7·5 inches); they are very nearly equal in antero-posterior breadth throughout, viz. 0·9 of an inch; and they arise from rather nearer the front than the hinder end of the body; but this is less marked in the posterior than in the anterior portion of the series.

I have, as usual, reckoned as the first caudal vertebra that which bears at the hinder end of its body the first chevron bone. The bodies of these increase in length from the first (which is 1·4 inch) to the sixteenth and seventeenth (which are 2 inches), after which they again diminish. In height they do not differ greatly, until beyond the eighteenth, when they rapidly decrease. They begin to diminish in breadth after the eleventh. The lateral compression characteristic of this part of the vertebral column of Cetacea continues until the twentieth vertebra; the twenty-second is the first of the series of broad, depressed, terminal vertebræ, the twenty-first being of transitional form. The spinal canal ceases at the nineteenth caudal vertebra. The transverse process is reduced to a low ridge on the fourteenth, and disappears altogether on the fifteenth. The vertical vascular canals first appear in the middle of the base of the transverse process of the fifth, though small, and on the right side only; on the sixth they are present on both sides, and they continue as far as the penultimate vertebra. The terminal vertebra is a small, triangular nodule, very inferior in width to that which precedes it.

The chevron bones present are twenty in number, all having the two lateral halves united. It is not improbable that some additional ones from the hinder end of the series may have been lost in macerating the skeleton. The first two are small, with no spines developed beyond the union of the laminae. The third shows a sudden increase in length, which augments in each succeeding one until the seventh, after which they diminish in length, but are more expanded in the antero-posterior direction.

There are twelve pairs of vertebral ribs, all of which, except the first three or four, are very slender. The anterior six pairs have long necks, reaching in each case to the articular surface on the side of the vertebra in front of that to which the tubercle is attached. The seventh presents, on both sides, a peculiar arrangement. The rib is not developed inwards beyond the tubercle, which articulates (as do all the posterior ribs) with the end of the transverse process of the corresponding vertebra; but, detached from the rib, and fused with the under surface of the transverse process of the vertebra, is a strong spiculum of bone 1·4 inch long, with its free end pointing forwards, downwards, and inwards, and reaching to within half an inch of the before-mentioned tubercle on

the base of the pedicle of the arch of the sixth vertebra. This obviously represents the neck of the seventh rib.

There are eight pairs of sternal ribs, the last being very rudimentary. The first pair articulate near the anterior extremity of the sternum, the second at the junction of the first and second segments of that bone, the third at the junction of the second and third segments, and the fourth and fifth to the hinder end of the third segment. The remainder are not directly connected with the sternum.

The various elements of the sternum are consolidated into a single bone, though traces of its original formation out of three segments can be seen, and the primordial median fissure is indicated by a slight longitudinal groove on its inner surface and a small foramen near the anterior part of the first segment or manubrium. The entire length is 11.2 inches. The greatest breadth of the first segment is 5.5 inches; the least breadth, at the middle of the second segment, is 1.7 inch. The manubrium is very slightly notched in the middle line in front; behind the attachment of the first pair of sternal ribs its lateral borders expand as usual into rough triangular processes, directed outwards and backwards. The hinder end of the posterior segment is deeply notched¹.

The pelvic bones are slender and styliform, 4.9 inches in length.

In general form the skull resembles the well-known figure of that of *G. griseus* in Cuvier's 'Ossemens fossiles,' pl. 223.

In plate 54 of the great work on the osteology of the Cetacea, now in progress, by Professors Van Beneden and Gervais, are beautifully executed and evidently most faithfully drawn figures of skulls, named respectively *Grampus rissoanus* and *Grampus griseus*, from specimens in the collection at Paris, doubtless the type specimens². There are certain obvious differences between these two figures, especially in the size of the nasal bones and the width and form of the rostrum; but whether these are more than individual differences it would be hard to say, without a comparison of a large series of specimens. It is to be noticed, however, that in all those points in which the figures differ, the present specimen resembles *G. griseus* rather than *G. rissoanus*; indeed the figure of *G. griseus* (fig. 7) is so close a representation of it, both as to form and size, that, except for a trifling difference in the shape of the anterior edge of the narial aperture, it might very well have been drawn from it.

In the flatness and breadth of the cranial part of the skull, and the wide expansion of the maxillæ above the orbits, it much resembles that of *Globicephalus*; but it differs in the rounded form and absence of elevation of the region behind the superior narial apertures, in the marked convexity of the præmaxillæ in front of these apertures, and

¹ This sternum appears narrower, in proportion to its length, than that of *Grampus griseus* figured by Van Beneden and Gervais (*op. cit.* pl. 54, fig. 9), but otherwise does not differ materially from it. It closely resembles the sternum of *Globicephalus*.

² Unfortunately the letterpress of this portion of the work has not yet appeared.

in the comparative narrowness of the rostrum. The general aspect of the upper surface somewhat recalls that of a Beluga.

There are no traces of alveoli in the maxillæ; but there is a slight depression in the usual situation of the upper teeth, with numerous openings of vascular canals. At the extreme tip of each præmaxilla is a conspicuous rounded foramen of the same nature¹.

The petrotympanic bones closely resemble those of *Globicephalus*, and are almost of the same size as those of an animal of that genus of nearly double the length of the present specimen.

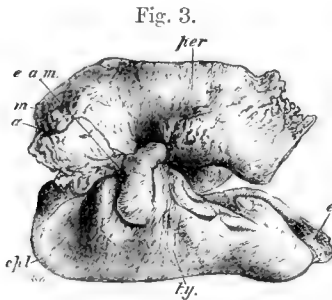


Fig. 3.

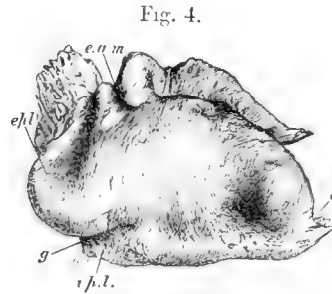


Fig. 4.

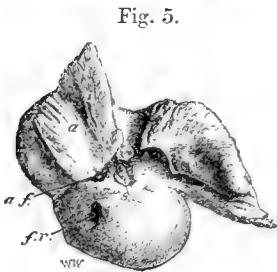


Fig. 5.

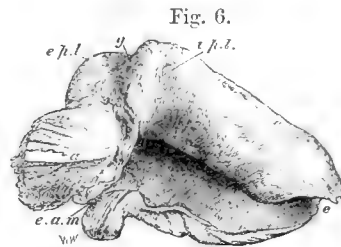


Fig. 6.

Fig. 3. Periotic and tympanic bones united, outer surface. Fig. 4. Periotic and tympanic bones united, under surface. Fig. 5. Periotic bone, under surface. Fig. 6. Tympanic bone, upper surface. All the natural size.

per, periotic; *ty*, tympanic; *m*, posterior end of the periotic, answering to the mastoid of ordinary mammals; *a*, principal articular surface between periotic and tympanic; *e*, fissure for Eustachian canal at anterior extremity of tympanic; *e a m*, external auditory meatus; *e p l*, external posterior lobe of tympanic; *i p l*, internal posterior lobe of tympanic; *g*, groove between these lobes; *f r*, fenestra rotunda in periotic; *a f*, aqueduct of Fallopius; *s*, stapes.

The thyro-hyals are ankylosed to the basi-hyal, but with distinct marks remaining of the original suture. The thyro-hyals are more flattened and less tapering at their free extremities than in *Globicephalus*; and the basi-hyal has not the same median prolongation in front for the attachment of the anterior cornua.

The principal dimensions of the skull are as follows (the measurements of the

¹ This is evidently the foramen thus described by Fischer, "En avant des intermaxillaires on voit deux petits trous où devaient être encastrées les incisives rudimentaires." He appears also to have taken the other vascular foramina in both upper and lower jaws for alveoli of rudimentary teeth (*loc. cit.* p. 367).

skull of the animal next to be described are also appended for convenience of comparison):—

| | Skull of adult. inches. | Skull of young. inches. |
|---|----------------------------|----------------------------|
| Entire length | 19·2 | 13·6 |
| Length of rostrum ¹ | 9·3 | 6·1 |
| Breadth of occipital foramen | 1·5 | 1·2 |
| Greatest height of occipital foramen | 1·9 | 1·7 |
| Breadth of occipital condyles | 4·5 | 3·2 |
| Greatest breadth of cranium (at parietal region, in temporal fossa) | 9·1 | 7·7 |
| Greatest breadth of skull (at zygomatic process of squamosals) | 12·9 | 9·0 |
| Breadth at anteorbital processes of frontals | 11·8 | 8·2 |
| Breadth of anterior narial apertures | 2·8 | 2·2 |
| Breadth of rostrum at base (bottom of anteorbital notch) | 7·7 | 5·6 |
| Breadth of rostrum at the middle | 4·4 | 3·3 |
| Length of tympanic bone | 1·8 | 1·6 |
| Mandible.—Length of ramus | 15·4 | 10·6 |
| Length of symphysis | 1·9 | 1·2 |
| Breadth at condyles | 11 | |
| Height at coronoid process | 4·3 | 2·7 |
| Hyoid.—Breadth between tips of thyro-hyals | 8·7 | |
| Basi-hyal.—Greatest antero-posterior length | 3 | |

The bones of the pectoral limb generally present a nearer approach to those of *Globicephalus* than any other Cetacean, or, rather, may be described as intermediate between that genus and *Delphinus* proper.

Of the two scapulæ figured by Van Beneden and Gervais, one of *G. rissoanus*, and the other of *G. griseus*, the present one most nearly resembles the latter in outline, especially in the form of the acromion; it is rather smaller, however, in all its dimensions, in which respect it is more like the former.

The humerus is immovably united with the radius and ulna. These bones are not so broad in proportion to their length as in *Globicephalus*.

The carpal bones are five in number, and form a close mosaic, three in the first and two in the second row, and have precisely the same arrangement as in *Globicephalus*. The pollex consists of a short, nearly square metacarpal, and a single, conical, tapering phalanx, reaching nearly to the end of the second metacarpal. It is certain that no other ossified phalanx was present in this digit on either hand—a circumstance which I note particularly, because in Gervais's figures², both of *G. griseus* and *G. rissoanus*, there

¹ Measured from a line drawn between the anteorbital notches.

² *Op. cit.* pl. 54. figs. 10 & 5.

is a small additional phalanx to the pollex, and one is also present in all the specimens of *Globicephalus* which I have examined.

As the bones of the digits have never been separated, there can be no doubt as to their correct number and position. The second digit is the largest, and has ten distinct ossifications including the metacarpal, the last being a rounded nodule rather smaller than a pea. The third has eight ossifications; its metacarpal is considerably longer than that of the second digit; and its proximal phalanges are rather broader, though more flattened and more compressed, especially at their posterior or ulnar edge, than are those of the second digit. The relative condition of the bones of these two digits thus agrees rather with Gervais's figure of the limb of *G. griseus* (fig. 11) than of *G. rissoanus* (fig. 6). The fourth digit is very short, and has but three ossifications; and the fifth is rudimentary, being mostly cartilaginous, with a nodular metacarpal bone at the base. The minute bone-specks represented in the terminal portion of the cartilages of these last two digits in Gervais's figure of *G. griseus* are not present.

The principal dimensions of the bones of the pectoral limb are as follows:—

| | inches. |
|--|---------|
| Scapula.—Height | 8·0 |
| Breadth | 11·0 |
| Length of acromion | 2·9 |
| Greatest depth of acromion | 1·9 |
| Length of coracoid process | 2·5 |
| Length from head of humerus to tip of second finger ¹ | 22·5 |
| Length of humerus | 4·4 |
| Length of radius | 5·2 |
| Length of ulna | 4·6 |
| Breadth of radius at distal extremity | 2·4 |
| Breadth of ulna at distal extremity | 1·9 |

About a month after the capture of this Dolphin (viz. March 31st) Mr. Gerrard gave me an opportunity of examining another specimen which he had bought at Billingsgate Market; but, as it had changed hands several times, he was unfortunately not able to obtain any trustworthy account of the place of its capture, though this was probably somewhere in the Channel. It was quite fresh at the time of my seeing it. This was also a female, but, as the condition of the bones afterwards showed, a very young animal.

Although very different from the former in the disposition of the surface colours, the other characters, especially those of the skeleton and dentition, are so closely similar that I have little doubt of its specific identity; and such being the case, it is within the bounds of probability that this might have been the identical young animal which

¹ Owing to the drying and contraction of the cartilages, this must be somewhat less than in life.

the former must have had near her at the time of her capture; or, as small herds of these Cetaceans generally travel in company, it might have been a member of the same band. There is no evidence, however, in the present case of more than these two individuals having been seen¹.

In general form the young animal closely resembles the old one; but the head is more rounded, the dorsal fin is not quite so high, and slightly more posterior in position, and the pectoral fin is decidedly shorter in proportion to the general size of the body.

These differences will be best appreciated by the following table of proportions, the entire length of the animal being in each case taken as 100:—

| | Young. | Adult. |
|----------------------------------|--------|--------|
| Length of pectoral fin | 16·4 | 18·8 |
| Breadth of caudal fin | 20·0 | 23·0 |
| Height of dorsal fin | 10·3 | 12·7 |

I think that the difference would be even greater, if in the entire length the caudal portion of the body could be excluded; for that this grows more in proportion than the head and trunk, seems to be shown by the relatively more advanced position of the dorsal fin in the adult. It is but natural to suppose that the locomotive appendages should be more highly developed in the full-grown than the new-born animal; and there is certainly a similar alteration with age (at least as regards the pectoral fin) in the allied genus *Globicephalus*.

I am indebted to Mr. Gerrard, jun., for the following dimensions, as well as for the drawing of the animal (Pl. I. fig. 4):—

| | ft. | in. |
|--|-----|-----|
| Length, in straight line from the upper lip to notch in middle of caudal fin | 6 | 1 |
| From the upper lip to anterior edge of dorsal fin (following curve) | 2 | 11½ |
| From the upper lip to anterior angle of eye | 0 | 9 |
| From posterior edge of dorsal fin to middle of tail | 2 | 10 |
| From posterior edge of dorsal fin to angle of mouth | 0 | 7¾ |
| Length of eye-aperture | 0 | 0¾ |
| Pectoral fin.—Length of anterior border | 0 | 10 |
| Length of posterior border | 0 | 7 |
| Height of dorsal fin | 0 | 7½ |
| Antero-posterior length of dorsal fin at base | 0 | 10 |
| Width of caudal fin | 1 | 2½ |
| Girth of body immediately in front of dorsal fin | 3 | 8 |

The upper parts and sides of the body were almost black, the lower parts nearly

¹ It is stated by the late Mr. Jonathan Couch, in 'Land and Water,' March 19th, 1870, that an animal of the same species was observed off the coast of Cornwall in the month of May 1869.

white, the junction between the two colours being very abrupt, passing from the angle of the mouth above the origin of the pectoral fin backwards to the vulva, behind which the whole of the surface was black. On the sides were several large longitudinally disposed nebulous washes of light grey, the most conspicuous of which was between the pectoral and dorsal fins; and the lateral surfaces of the last-named fin, especially near its base, were yellowish white. The upper lip, the front surface of the head, as high as the top of the vertical anterior wall of the adipose prominence, and the chin and throat were white, with a distinct yellow tinge. The pectoral fin was black on both sides, and showed none of that peculiar delicate mottling or dappling so conspicuous in the larger specimen. Both surfaces of the caudal fin were black. So much for the general ground-colour, upon which were laid certain markings of a somewhat similar character, though very different in number and in arrangement, to those of the adult animal. On each side of the body were six vertical whitish stripes, nearly symmetrically arranged, and almost equidistant, being about six inches apart. They did not extend quite to the middle line of the body above, and were lost below in the light colouring of the abdomen. These stripes were not so complex in structure as those of the adult specimen, being merely broad white lines, shading insensibly at the edges into the general dark colour of the surrounding cuticle, and with an obscure dark central line. In addition to these, however, there were three others, which, though short and straight, had exactly the same characteristic formation as the best-marked streaks of the other specimen, having a white central line, bordered first with black and then again with white. These were situated:—one on each side of the narrow part of the tail, close to the upper median ridge, just before the commencement of the lateral expansions of the caudal fin; and the third obliquely longitudinal, a little to the left of the middle line of the back, just in front of the dorsal fin. This last, especially, was extremely important, as, being asymmetrical, it showed the tendency to variation in colouring and surface-markings, and so helps to account for the great difference in these respects between the two specimens.

On each side of the upper lip were eight extremely short, whitish bristles, their tips only just projecting beyond the level of the cuticle, arranged in two rows, six in the lower and two in the upper row, as shown by the dots in the figure. There were no similar bristles on the under lip or chin.

The condition of the teeth was of extreme importance, as helping to establish the normal dentition of the species. There were no teeth visible above the gum in either jaw; and on a careful examination of the soft tissues between the surface and the bone, not a rudiment of any tooth could be found in the upper jaw, while in the lower jaw were the germs of seven teeth—four on the right and three on the left side, close to the symphysis. The crowns of these teeth were conical, pointed, and strongly curved. Calcification had extended rather below the base of the crown or neck of the tooth.

The *skeleton* presents all the signs of immaturity which might be expected in an

animal of so early an age; but in other respects it does not differ materially from that of the other specimen.

The total number of vertebræ is 69, being divided into 7 cervical, 12 dorsal, 20 lumbar, and 30 caudal; this gives one additional vertebra in the lumbar region, an individual variation by no means uncommon in the Cetacea.

The bodies of the first and second cervical vertebræ are united; but those of all the others consist of very thin plates still separable from each other, or in some cases, as between the fourth and fifth, united by a partial ankylosis in the centre of the disk. Except in the atlas and axis, the arches have not yet united with the bodies; but the spines are joined into two sets—one consisting of the first, second, and third, and the other consisting of the last four. The metapophyses of the posterior dorsal and anterior lumbar vertebræ are more developed than in the adult specimen, resembling those in Van Beneden and Gervais's figure of the skeleton of *G. rissoanus*. The chevron bones are twenty-one in number.

There are twelve pairs of vertebral ribs, of which the first six have necks; in the seventh the neck is represented by an unossified ligament. The sternal ribs resemble those of the adult in number and connexions. The three segments of the sternum are not united by bone; the last is divided in the middle line into two separate pieces.

The skull, as is usual with young animals, differs from that of the adult in the large size, globular form, and smooth outlines of the cerebral portion as compared with the rostrum. It much resembles that of a young *Globicephalus* of corresponding age, but can be at once distinguished by the convexity of the upper surface in front of the narial aperture. The under surface of the anterior portion of the maxilla has a well-marked, but narrow, longitudinal groove near the outer border, corresponding to the alveolar line of other Dolphins; but there are no distinct alveoli. The opening of the vascular canal at the apex of the præmaxilla is very distinct. In the anterior portion of the upper edge of the mandible is a deep narrow groove, $4\frac{1}{2}$ inches long, the anterior portion of which is dilated into a wide alveolar chamber (1·8 inch long on the right side and 1·5 inch on the left), divided by very imperfect septa into chambers for lodging the teeth, four on the right and three on the left side. The principal dimensions of the skull are given at p. 10.

The carpal bones and the phalanges, though of course far less developed, are the same in number as in the adult, except that the minute terminal ossifications of the second and third fingers of the latter were not yet apparent¹.

There can be no doubt that these two animals belong to a peculiar group of the Cetacea constituting the genus *Grampus* of Gray, of which two species are commonly

¹ Some notes upon the visceral anatomy and external characters of this individual have been given by Dr. Murie in the 'Journal of Anatomy and Physiology,' Nov. 1870, p. 118. The differences in Dr. Murie's description of the external surface from that given above, are probably due to changes resulting from the greater length of time that had elapsed between the death of the animal and his examination of it.

recognized as inhabiting the northern hemisphere (one having hitherto been met with only in the Atlantic, and the other only in the Mediterranean), and have been named respectively *G. griseus* (= *G. cuvieri*, Gray) and *G. rissoanus*¹.

The earliest account of both of these animals is contained in the 'Rapport fait à la classe des sciences mathématiques et physiques sur divers Cétacés pris sur les côtes de France,' by G. Cuvier (Annales du Muséum, tome xix. 1812).

The first is described from a drawing of the external characters, accompanied by the skeleton of the animal, sent to the Paris Museum from Brest. It is stated to have been $3\frac{1}{2}$ metres in length, to have had but four teeth in the lower jaw, "toutes très-usées et prêtes à tomber," and to be of a "grisâtre" colour, whence Cuvier bestowed upon it the name of *Delphinus griseus*. The skeleton (in a very imperfect condition) is still in the Museum at the Jardin des Plantes.

The drawing, reproduced at pl. 1 of the volume of the 'Annales,' obviously gives but a mere rude approximation to the true external form of the animal; but it must be remarked that there are numerous irregular scratch-like black lines on the face, around the eyes, on the dorsal and pectoral fins, and especially on the tail, which can scarcely have been put in by the artist without some foundation in nature, although they are not alluded to in the exceedingly brief description.

To continue the history of the various specimens which have been considered to belong to this species:—

In the middle of June 1822, four Dolphins were stranded near l'Aiguillon (la Vendée), and were described in some detail by D'Orbigny. F. Cuvier (Histoire Naturelle des Cétacés, 1836, p. 183), citing this account, speaks of them under the denomination of "Le Marsouin de d'Orbigny, *Phocæna griseus*," and recognizes their specific identity with the Brest specimen. The length of the full-grown individuals of this band is stated to have been ten feet (Fr.). "La teinte générale du dessus du corps et de la tête est d'un noir bleuâtre; le dessous est d'un blanc sale, qui se fond sur les côtes avec le noir." A figure of one of them is added to the description; but it is probably not to be depended upon as giving a correct outline of the animal, owing to the decomposed state of the bodies at the time they were examined. There were no traces of teeth in the upper jaw of either. A young specimen is said to have had eight teeth in the lower jaw, and the older ones from six to seven. The statement that "la mâchoire supérieure est plus longue et s'avance de quatre pouces au-delà de celle d'en bas," does not accord with the descriptions of other observers; but D'Orbigny's observations were made under difficulties.

In consequence of D'Orbigny's statement as to the colour, Dr. Gray changed the specific name from *griseus* to *cuvieri* (Ann. N. H. 1846).

¹ A third species (*G. richardsonii*, Gray) is founded on a lower jaw of unknown locality, and a skull from the Cape of Good Hope, which differs slightly from those above described. (Cat. Seals and Whales, Brit. Mus. p. 299, 1866.)

On April 12th, 1844, a Dolphin attributed to this species was stranded near Cageaux (Gironde)¹.

A skull is contained in the British-Museum collection, from the Isle of Wight, presented in 1845 by the Rev. C. Bury.

On July 22nd, 1867, a Dolphin was cast up by the sea on the shore of the Department of la Gironde, France, and taken to Arcachon, where, fortunately, it was examined by M. P. Fischer, who has given² an excellent, and evidently trustworthy, description of its external characters and skeleton, accompanied by a succinct history of the species, and of its relation to the so-called Risso's Dolphin, to which I shall afterwards have occasion to refer.

The specimen was young, measuring but 2·80 metres (9 ft. 2 $\frac{1}{4}$ in.). His description of the colour is as follows:—"Le corps est de couleur noire sur le dos et les flancs, blanche en dessous autour des parties génitales et de l'anus, d'un blanc teint de gris de fer en avant de la verge, blanche enfin au niveau et en avant de la base des nageoires pectorales. Le dessous de la tête et du cou est d'un gris noirâtre, marbré de taches blanchâtres, terminé en pointe noire dirigée vers le thorax; le dessus de la tête, le bord des lèvres, sont également marbrés de blanc sale. Les nageoires pectorales, caudale, et l'aileron dorsal, ont une coloration noire uniforme." The dental formula was $\frac{0-0}{4-4}$. There were sixty-eight vertebræ—seven cervical, twelve dorsal, forty-nine lumbar and caudal.

The second Dolphin alluded to above as having been brought into notice in Cuvier's 'Rapport' was known to him only by a notice and figure communicated to the Academy by M. Risso of Nice, the figure being reproduced in the same plate as that of the Grey Dolphin from Brest, and marked "*Delphinus aries?*" It was stated to be 3 metres long, and to have five teeth on each side of the lower jaw only. The figure shows numerous white lines on the surface, mostly in the longitudinal direction.

Delphinus (Phocaena) rissoanus, of Desmarest's Mammalogie (part 2, 1822), is founded on this description and figure.

Subsequently M. Risso published in his 'Histoire Naturelle de l'Europe méridionale,' 1826, tome iii. p. 23, a fuller description, under the name of "*Delphinus risso*, Cuv.," and a different figure (pl. 1. fig. 2), the accuracy of which may be estimated by that of the wretched caricature of the *Globicephalus* in the same plate.

The description runs thus:—

"*D. dorso lato; capite maximo, obtuso; maxilla superiore longiore.*

"Des mœurs douces, comme la zone tempérée qu'il habite, semblent être le partage de ce cétacé, qui n'approche de nos côtes que dans le temps des amours. Son corps est allongé, arrondi, renflé vers sa partie antérieure, diminuant insensiblement de grosseur

¹ Laporte: Actes de la Société Linnéenne de Bordeaux, 1853, t. xix. p. 215 (*vide* Fischer).

² "Note sur un Cétacé (*Grampus griseus*) échoué sur les côtes de France," Annales des Sciences naturelles, 5th ser. vol. viii. p. 363.

vers la queue, qui est déprimée; sa peau est mince, unie, de couleur grise, à nuances bleuâtres, traversée par des traits irréguliers et des raies inégales, droites ou flexueuses, blanchâtres; le ventre est d'un blanc mat; la tête fort grande; le museau arrondi, relevé en arc, obtus, percé vers la nuque par l'ouverture des évents; la bouche est ample, arquée; la mâchoire supérieure pourvue d'alvéole seulement, est plus avancée, et couvre l'inférieure, qui est garnie de chaque côté de cinq grosses dents coniques; aiguës, un peu courbées, distantes, fortement enchassés dans l'ossement de la mâchoire; ces dents sont solides, presque égales, d'un blanc jaunâtre, recouvertes d'un émail fort luisant; l'intérieur de la gueule est muni de tubercules émoussés; la langue est libre, unie sur ses deux bords; les yeux sont ovales oblongs, très-petits, avec l'iris doré; la nageoire dorsale, haute, élevée, à peu près en forme de triangle scalène, est située presque au milieu du dos; les nageoires paires sont grandes, épaisses, noirâtres; la caudale est forte, divisée en deux grands lobes par une échancrure assez profonde. Long. 3 mètres, larg. 1 mètre. Ség. Surface des eaux. App. Printemps, automne."

Another and somewhat better figure is given by Laurillard in Fr. Cuvier's 'Histoire Naturelle des Cétacés' (1836), taken from one stranded, with many others, in the Bay of Saint-Jean, near Nice, in June 1829. The length of these specimens is stated to have been about nine feet (French); and their peculiar colours are thus described by Laurillard:—"La couleur de ces dauphins différait suivant les sexes. Celle qui faisait le fond de la peau des femelles était un brun uniforme; les mâles, au contraire, étaient généralement d'un blanc bleuâtre; mais ce qui caractérisait les uns et les autres, c'étaient les singulières lignes semées irrégulièrement sur toutes les parties supérieures du corps, et qui ressemblaient, au premier coup d'œil, à des égratignures produites par des épines. Ces lignes, vues de près, se composaient de traces plus claires que le fond de la peau, et bordées d'une multitude de petites lignes perpendiculaires d'un brun foncé. De plus, les mâles, comme le montre la figure que nous donnons, avaient des taches irrégulières d'un brun foncé sous la moitié postérieure du corps, et les nageoires avaient la même couleur; mais la dorsale et la pectorale se trouvaient de plus ornées de lignes blanches. Deux lignes brunes garnissent le dessus et le dessous de la bouche, et un cercle de même couleur entoure l'œil." The name applied by F. Cuvier to these animals is "Le Marsouin Risso (*Phocæna rissonus*)."

A complete skeleton and a skull of animals from this shoal are preserved in the Paris Museum; the former is that above referred to as figured by Van Beneden and Gervais. The number of teeth is $\frac{0-0}{5-5}$.

Some time about 1854, a herd of these Dolphins came into Carry (Bouches-du-Rhône); and the skull of one of them which was killed is preserved in the Museum at Marseilles¹.

It thus appears that the so-called *Delphinus griseus* has been met with on five distinct occasions, the localities having been Brest, Aiguillon, Cajeaux, and Arcachon, on the

¹ P. Gervais, "Cétacés des côtes Françaises de la Méditerranée," Comptes Rendus, tome lix. 28th Nov. 1864.

west coast of France, and the Isle of Wight; and the so-called *Delphinus rissoanus* three times, always at Nice or the Mediterranean coast of France, and, as Fischer has particularly pointed out, whenever the date has been recorded, the occurrence has in both cases always taken place in the spring or summer (April to July). From this circumstance he concludes that this species (for after a comparison of the osteological and other characters he has come to the conclusion that they are one and the same) is migratory, visiting the shores of Europe in the summer and passing the winter either to the south towards the coast of Africa or to the west towards the American continent.

Although the present examples (occurring in the mouth of the channel so early as the end of February) may be thought somewhat to shake this conclusion, it may on the other hand prove to be merely a case of an unusually early arrival in our seas. Further observations can alone determine the question¹.

Identity of G. griseus and G. rissoanus.

It has been mentioned that Fischer came to the conclusion that the two species (*D. griseus* and *D. rissoanus*) ought to be reunited, as had also appeared probable to Cuvier²—a conclusion founded on the following considerations:—

“1°. Que le Dauphin de Risso apparaît dans la Méditerranée à la même époque que le *griseus* sur les côtes océaniques de France.

“2°. Que sa dentition ne diffère pas sensiblement de celle du *griseus*, puisqu'on peut établir la série suivante:—

$$\frac{0-0}{2-2}, \frac{0-0}{3-3}, \frac{0-0}{4-4} \text{ (griseus); } \frac{0-0}{5-5}, \frac{0-0}{6-6} \text{ (rissoanus).}$$

“3°. Que le nombre des vertèbres, des côtes, des phalanges, en un mot que tous les caractères ostéologiques sont identiques dans les deux espèces.

“4°. Que les seules différences relevées entre elles portent sur la coloration extérieure éminemment variable, et sur la forme plus ou moins ventrue du corps, qui peut tenir à l'embonpoint des individus ou à la distension de l'abdomen par des gaz après la mort.”

Gervais had previously expressed his opinion³ that “Le *D. griseus*, qu'on appelle quelquefois *Marsouin de d'Orbigny*, est très-peu différent du *D. rissoanus*; son système dentaire paraît néanmoins devoir l'en faire séparer;” and he gives the following diagnostic characters:—

“Dents supérieures caduques, les inférieures au nombre de cinq ou six paires, *Delphinus rissoanus*.

¹ It is possible that the Grampus, before mentioned, from the Cape of Good Hope, of which there is a skull in the British Museum, named *G. richardsonii*, may also prove to be of this species; if so, it would indicate that the South Atlantic may be its winter habitat. In size it perfectly agrees; but it is rather narrower in proportion to its length, and the anteorbital processes of the maxilla are more upturned at their edges, and less laterally and anteriorly expanded, and the anteorbital notch is less deep than in the other specimens. The teeth are $\frac{0-0}{4-4}$.

² Ossements fossiles, edit. 1836, tome viii. 2^{me} partie, p. 98.

³ Zoologie et Paléontologie Françaises, p. 301.

“Dents caduques; deux paires à la partie terminale de la mâchoire inférieure seulement, *D. griseus*.”

It now remains to be seen whether Fischer's opinion is strengthened or the reverse by the new materials afforded by the two specimens described in the first part of this communication.

As has just been shown, the differences hitherto noticed between the supposed species have resolved themselves into those of habitat, colour, and number of teeth.

1. According to the previously observed habitats of the two species or varieties, the present specimens should be referred to *D. griseus*, as all the examples of *D. rissoanus* hitherto met with have been from the Mediterranean.

2. According to the coloration, they should be *D. rissoanus*: but additional light is thrown upon this part of the subject by these two specimens; for they show conclusively how extremely variable the species is in this respect. This might be inferred from the absence of bilateral symmetry in the markings of each individual, shown most strongly in the adult example, where the markings were more profuse and complicated in character. Laurillard speaks of the ground-colour of the females being of a “uniform brown,” and therefore quite different from that of the two specimens now described. Then, again, with reference to *D. griseus*, it must be remembered that the three descriptions all differ somewhat as to the colouring, and, especially, that in the figure of the type specimen from Brest numerous distinct irregular linear markings are indicated (as previously mentioned). These with the general “grisâtre” colour would appear to show that it was more nearly allied in external characters to Risso's Mediterranean Dolphin than to the black-and-white specimens described by D'Orbigny. If all the specimens of alleged *D. griseus* had been uniform in colour, and all those of *D. rissoanus* had presented another characteristic coloration, there would have been more grounds for keeping them distinct; but from the facts before us it is safer to conclude that we have here an example, very rare among Mammals, of a species of variable and irregular coloration.

As to the teeth, the new specimens completely break down the specific distinction previously drawn; for, with the colouring of *D. rissoanus*, the adult one has the number of teeth assigned to *D. griseus*, viz. $\frac{0-0}{3-3}$; and that this is not the result of loss by age is satisfactorily proved by the young individual, in which the teeth had not even cut the gum. This last-named specimen was also extremely important, as presenting an undoubted case of original unequal number on the two sides, viz. three and four, showing that the exact number of teeth is a variable character; and it also set at rest the question as to whether the absence of teeth in the upper jaw is a congenital peculiarity, or arises, as had generally been supposed, from their loss at an early age.

It appears then necessary, until any better diagnostic characters are made out, to sink the specific name of *rissoanus* in that of *griseus*, though it may be convenient to apply the term “Risso's Dolphin” to the peculiarly marked variety which was first made

known to science by that naturalist, or even to keep it as a vernacular appellation for the entire species, and thereby continue to associate his name with it.

Systematic Position.—In Baron Cuvier's time this species, with a vast number of others now generically separated, was included in the genus *Delphinus*. Mons. F. Cuvier constituted of a group of short-nosed Dolphins the genus *Phocæna*, embracing with the species now under consideration the Common Porpoise, the Killer (*Orca gladiator*), the Round-Headed Dolphin (*Globicephalus melas*¹), and even the Beluga (*Histoire des Cétacés*, 1836).

The genus *Globicephalus*² was formed by Lesson³ for a still more restricted group, from which Dr. Gray has separated the present animal and its most immediate allies under the name of *Grampus*⁴.

My first impression, obtained from an inspection of the external appearance of the animal, was that it resembled *Globicephalus melas* so nearly as hardly to warrant generic separation. There was the same rounded form of forehead, and the same elongated pointed pectoral fins placed low down on the sides of the thorax. It is true that these were developed in a less exaggerated degree than in *Globicephalus*, and the dorsal fin was more anterior in position and more elevated; but such characters can hardly be considered generic, unless accompanied by other and more important structural differences. The teeth, again, have much the same size and form as those of *Globicephalus*, and are also confined to the anterior part of the jaws; and I was not then aware that the absence of maxillary teeth was congenital, but supposed that it was due to their being deciduous, a circumstance frequently observed in *Globicephalus* at a late period of life. Consequently in the preliminary notice of the capture of this specimen⁵ the generic name of *Globicephalus* was assigned to it.

After a closer examination of the characters, especially of the skeleton and teeth, of both forms, I am now inclined to think that they may fairly be treated as distinct although closely allied genera, and subjoin the following comparative table of diagnostic characters:—

GLOBICEPHALUS.—*Teeth* in both jaws, 9 to 12 on each side, confined to the anterior half of the rostrum and corresponding portion of the mandible; sometimes deciduous in old age.

Vertebre. C. 7, D. 11, L. 12 to 14, C. 27 to 29, total 58 or 59.

¹ This species was first correctly described and figured by Trail, under the name of *Delphinus melas* (Nicholson's Journ. xxii. 1809, p. 21). Cuvier, unacquainted with Trail's memoir, described and figured it again in the "Rapport sur divers Cétacés," frequently referred to above, as *Delphinus globiceps* (Annales du Muséum, t. xix. 1812). Lacépède's *Catodon svineval* (Hist. Nat. des Cétacés, 1804, p. 216) may have been founded on some vague idea of this animal; but the description is almost altogether inaccurate.

² Often spelt *Globiocephalus*.

³ Compl. de Buffon, i. 1828 (*vide* Agassiz, Nom. Zool.).

⁴ Zoology of 'Erebus' and 'Terror,' p. 30 (1846). *Grampus*, Gray, Spic. Zool. 2 (1828), was a heterogeneous group, comprising *Grampus griseus*, *Globicephalus melas*, *Delphinus acutus*, *D. heavisidii*, and *D. obscurus*.

⁵ P. Z. S. 1870, p. 128.

Skull. Rostrum and cranium proper of nearly equal length. Upper surface of rostrum very broad and flat¹, rounded in front. The præmaxillæ at the middle of the rostrum as wide as, or wider than, at the base, and very nearly or completely concealing the maxillæ in the anterior half of the rostrum. Upper surface of the præmaxillæ in front of the narial apertures strongly concave. Upper surface of the skull behind the narial apertures raised into a strong prominence, of which the nasal bones form the apex.

Manus very long and pointed, the number of phalanges (including the metacarpals) in the different digits being respectively I. 3-4, II. 13-14, III. 10, IV. 3, V. 1.

GRAMPUS.—*Teeth*, none in the upper jaw. In the mandible 3 to 7 on each side, confined to the anterior part of the ramus close to the symphysis.

Vertebræ. C. 7, D. 12, L. 19, C. 30, total 68.

Skull. Rostrum slightly shorter than cranium proper, its upper surface moderately broad and flat, slightly expanding laterally in front of the notch, then tapering gradually to the apex. The præmaxillæ not so wide at the middle of the rostrum as at the base. Upper surface of the præmaxillæ in front of the narial apertures convex. Upper surface of the skull behind the nasal apertures rounded.

Manus long and pointed, the number of phalanges (including metacarpals) in the different digits being I. 2, II. 10, III. 8, IV. 3, V. 1.

DESCRIPTION OF THE PLATES.

PLATE I.

Fig. 1. Adult female Risso's Dolphin, caught near the Eddystone Lighthouse, February 28th, 1870.

Fig. 2. Upper surface of the head of the same.

Fig. 3. Upper view of the tail of the same.

From drawings by Mr. R. W. Sherwin.

Fig. 4. Very young female Risso's Dolphin, bought in Billingsgate Market, March 30th, 1870.

From a drawing by Mr. E. Gerrard, jun.

All $\frac{1}{5}$ the natural size.

PLATE II.

Fig. 1. Side view of the skeleton of the adult Risso's Dolphin.

Fig. 2. Upper view of the same skeleton.

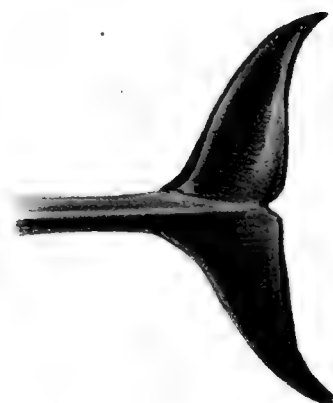
Fig. 3. The sternum of the same, from below.

Fig. 4. Skull of the young animal.

All $\frac{1}{8}$ the natural size.

¹ In the skulls of very young animals these special characteristics of the genus are but slightly developed, the rostrum being much more narrow in proportion to its length than in adults.



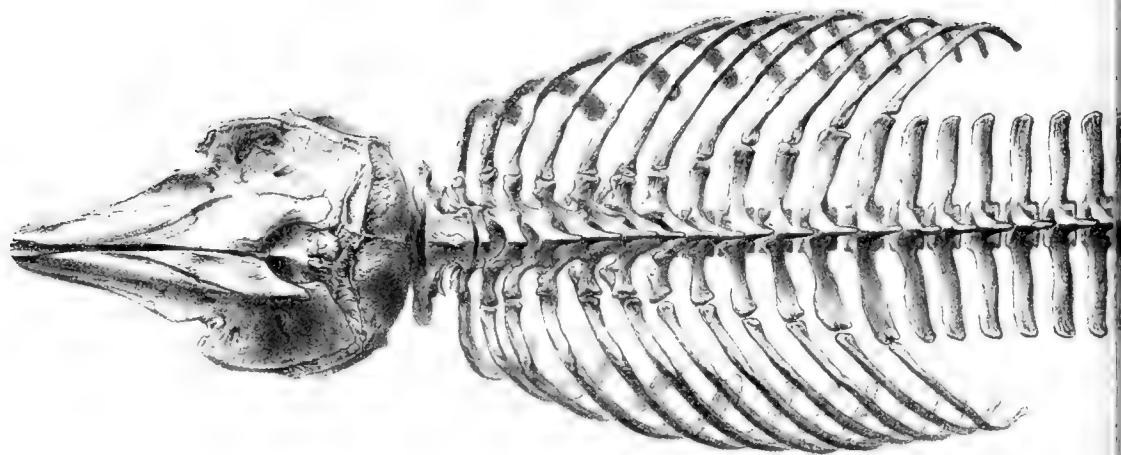
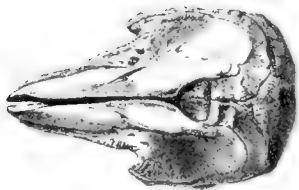
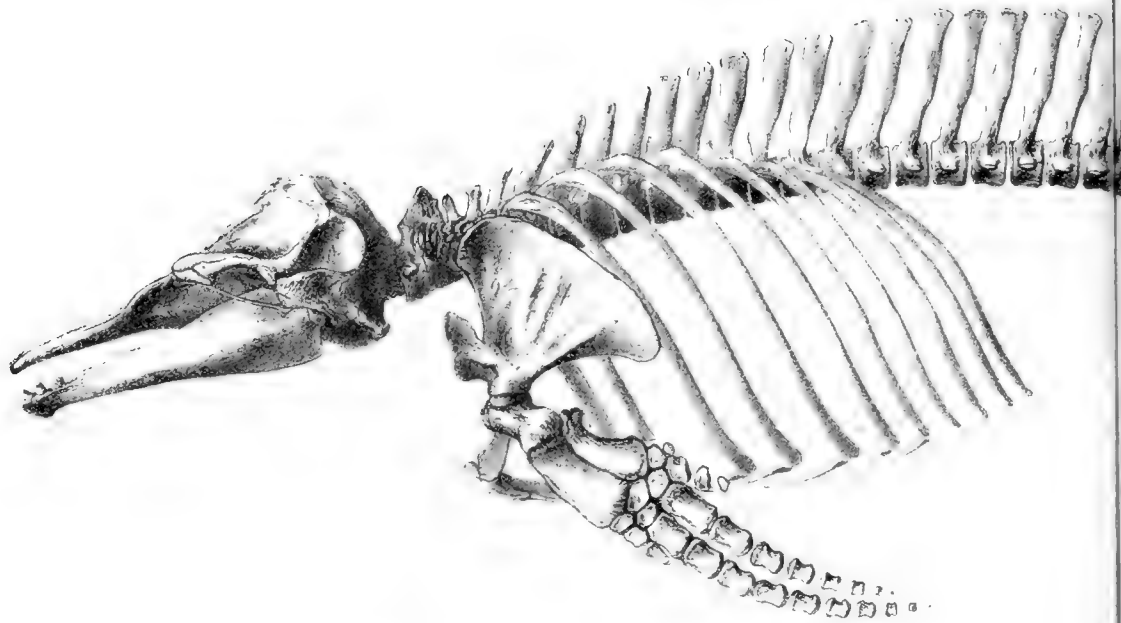


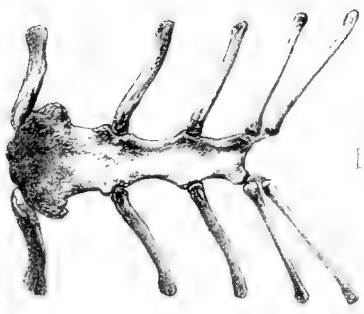
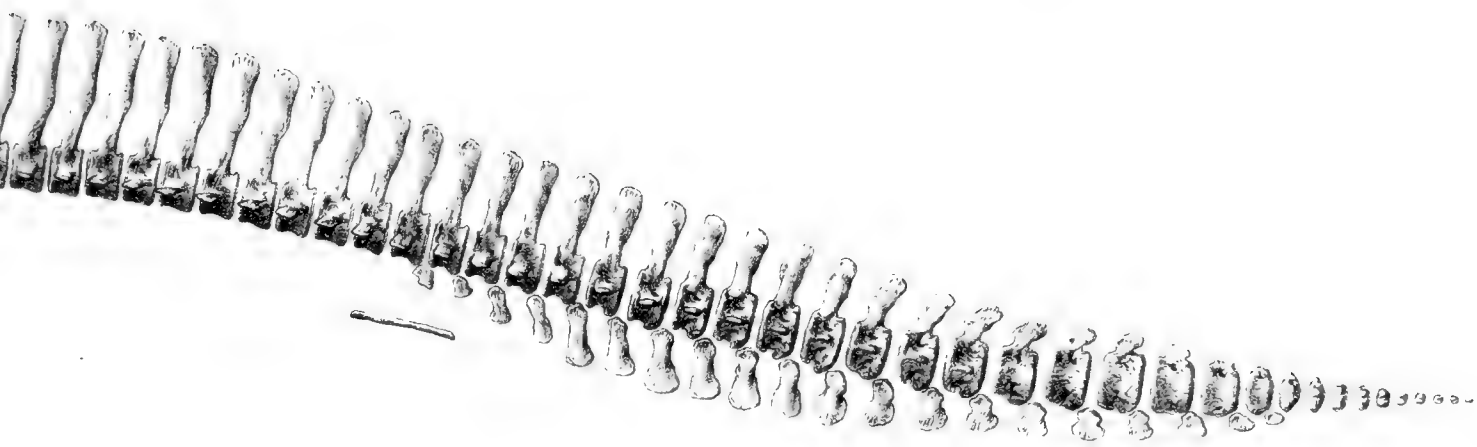


1000



1000







II. *A List of the Birds known to inhabit the Island of Celebes.* By ARTHUR,
Viscount WALDEN, F.R.S., *President of the Society.*

Read May 2nd, 1871.

[PLATES III. to X.]

SITUATED in the midst of the vast collection of islands which contribute to form the Malay archipelago, Celebes possesses an avifauna of a type peculiar to itself. The geographical position of the island and the leading characteristics of its fauna have been so clearly explained and depicted by Mr. Wallace¹, that it is almost unnecessary for me to add any observations of my own on these points.

This great naturalist has shown that the principal and most striking peculiarity of the fauna of Celebes is its individuality—a generalization fully supported by the evidence furnished by its birds; and it is the chief object of this paper to give a list of all the birds authentically recorded as inhabitants of Celebes, and to show in some detail the zoogeographical relations of its genera and species.

Our knowledge of the Celebean ornithology has been principally derived from the discoveries of the Dutch travellers Forsten, Von Rosenberg, and Bernstein, and from those of Mr. Wallace. Yet although the Dutch naturalists and our great English traveller ransacked those parts of Celebes they traversed or resided in, they all more or less covered the same ground. The larger portion of the island (fully two thirds of its area) still remains ornithologically unknown.

All the species yet described from Celebes appear to have been obtained from the districts of Macassar and Bonthain in the south, and from the districts of Gorontalo and Minahassa in the north. That part of the island which stretches north from about the fifth parallel S. lat. to the Gulf of Tontoli, and east thence to Limbotto, the lesser of the two eastern limbs of the island, the whole of the south-east limb, and all the central country from which these limbs extend seem to have never been explored by an ornithologist.

The group of islands of which Peling is the largest, and which are only separated from the Sula Islands by the Greyhound Straits, the Togian or Schildpad Islands in the Gulf of Tomini, the islands of Pagasane and of Bœton, and the island of Saleyer, with its train of smaller satellites almost connecting Celebes with Flores, are nearly wholly unknown. The Sanghir Islands in the north, and the Sula Islands to the east, although as yet only partially investigated, have been shown to possess some species identical with those found in Celebes; consequently they have been regarded by recent authors

¹ Malay Archipelago, vol. i. chap. xviii.

as forming along with Celebes a separate zoological subarea. But I propose in the following list to include only those species of birds which are known to inhabit the island of Celebes itself. A more definite and more accurate idea of the peculiarities of the Celebean ornithology will thus be presented, than if genera which occur in the Sula Islands were placed side by side with Celebean genera. If we threw together the ornithology of the Sula Islands with that of Celebes, we should find non-Celebean genera (such as *Criniger*, *Ceyx*, *Platycercus*, *Pachycephala*, and *Monarcha*) appearing in the list, and the really anomalous character of the Celebean avifauna actually existing on the main island would thereby be apparently greatly modified.

Mr. Wallace (*op. cit.* i. p. 425) has estimated the number of known Celebean species of birds at one hundred and ninety-one. I have only been able to add two more to that number; yet there are doubtless many more species represented by Celebean examples in the museums of Europe. On the other hand, many species have been described as possessing a Celebean origin which most assuredly do not occur in the island.

To give a clear idea of the geographical relation of the Celebean avifauna I have thrown its one hundred and forty-eight genera into tables, and classed them according to the regions and subregions they may be said to belong to. The geographical character of a genus has been determined according to the area which possesses the preponderating number of species. Thus *Artamus* is classed as an Australian genus, because at least thirteen species of it occur within the Australian region, while one only is peculiar to the Indian; *Arachnothera* as an Indian genus, although one species is found in New Guinea.

By means of these tables it will be seen that thirty-seven Indian genera occur in Celebes; of these, three are peculiarly Indo-Malayan.

TABLE I.—Showing the Indian genera found in Celebes.—N.B. Those peculiar to the Indo-Malayan subregion are marked with an asterisk.

| | | | |
|---------------|---------------|---------------|----------------|
| Poliornis. | Phœnicophaës. | Cyornis. | *Prionochilus. |
| Spilornis. | *Centrococyx. | Myiolestes. | Munia. |
| Polioaëtus. | Cranorrhinus. | Hypothymis. | *Padda. |
| Limnaëtus. | Lyncornis. | Æthopyga. | Acridotheres. |
| Neopus. | Pelargopsis. | Nectarophila. | Sturnia. |
| Lophospiza. | Callialcyon. | *Anthreptes. | Osmotreron. |
| Ephialtes. | Geocichla. | Arachnothra. | Gallus. |
| Loriculus. | Broderipus. | Dicaeum. | Erythra. |
| Yungipicus. | Trichostoma. | Arachnothera. | Rallina. |
| Mulleripicus. | | | |

The next table consists of the twenty-three Australian genera which are also Celebean. Two of these appear to be peculiar to the Australian subregion¹; of the remainder some are Papuan, and some extend into the Polynesian subregion.

¹ *Conf.* Sclater, P. Z. S. 1869, p. 125.

TABLE II.—Showing the Australian genera found in Celebes.—N.B. Those belonging especially to the Australian subregion are marked with a dagger (†); to the Papuan¹ with an asterisk (*).

| | | | |
|----------------|-------------|-----------------|----------------|
| *Teraspiza. | Collocalia. | *Chalcostetha. | *Lamprotreron. |
| *Erythrospiza. | †Scythrops. | *Zonœnas. | *Iotreron. |
| Cacatua. | *Dicrurus. | *Turacœna. | *Leucotreron. |
| *Tanygnathus. | Artamus. | *Calœnas. | Megapodius. |
| Trichoglossus. | Graucalus. | Phlogœnas. | †Hydralector. |
| Sauropatis. | Lalage. | *Myristicivora. | |

Eighteen Celebean genera may be considered common to the Indian and Australian regions, the proportion of species in each region being about equal. Some occur outside the limits.

TABLE III.—Showing the genera found in Celebes which are also common to the Indian and Australian regions.—N.B. Genera which do not occur in the Polynesian subregion are marked with an asterisk.

| | | | |
|--------------|----------------|---------------|-----------------|
| *Tachyspiza. | Cacomantis. | *Calornis. | *Geopelia. |
| *Haliastur. | *Macropteryx. | *Ducula. | *Carpophaga. |
| *Cuncuma. | *Hirundinapus. | *Macropygia. | *Excalfactoria. |
| *Baza. | *Pitta. | *Chalcophaps. | *Esacus. |
| *Eudynamis. | *Volvocivora. | | |

Fifty-eight are genera which are found within the limits of the Indian region and also beyond. Eight of these belong to the Rapaces, six to the Picariæ, two to the Gallinæ, twenty-five to the Grallæ, ten to the Anseres, and only seven to the Passeres. Nine of these fifty-eight genera are unrepresented in the Australian subregion.

TABLE IV.—Showing the genera represented in Celebes which likewise occur both within and beyond the limits of the Indian region.—N.B. Genera not occurring in the Australian subregion are marked with an asterisk.

| | | | |
|-----------------|---------------|--------------|-----------------|
| Tinnunculus. | Eurystomus. | Turnix. | Actitis. |
| *Hypotriorchis. | *Alcedo. | Eudromias. | Lobipes. |
| *Pernis. | *Buceros. | Ægialites. | Totanus. |
| Milvus. | Acrocephalus. | Charadrius. | Limosa. |
| Elanus. | Cisticola. | Strepsilas. | Tringa. |
| Circus. | *Budytes. | Himantopus. | Gallinago. |
| Athene. | *Pratincola. | Porphyrio. | Melanopelargus. |
| Strix. | *Monticola. | Hypotœnidia. | Falcinellus. |
| Hirundo. | Zosterops. | Rallina. | Ardea. |
| Merops. | Corvus. | Gallinula. | Herodias. |
| *Coracias. | *Turtur. | Numenius. | Ardetta. |

¹ The Papuan *Dicruri* are generically separable.

| | | | |
|--------------|----------------|--------------|----------------|
| Demiegretta. | *Querquedula. | Onychoprion. | Phalacrocorax. |
| Ardeola. | Mareca. | Pelecanopus. | Dysporus. |
| Nycticorax. | Dendrocygna. | Plotus. | Podiceps. |
| Butorides. | Hydrochelidon. | | |

The following nine genera are peculiar to the island of Celebes:—*Meropogon*, *Monachalcyon*, *Ceycopsis*, *Artamides*, *Gazzola*, *Streptocitta*, *Enodes*, *Scissirostrum*, *Megacephalon*. One genus is restricted to Celebes and the Sanghir Islands, *Cittura*; one to Celebes and Philippines, *Prioniturus*; and one to Celebes and Ceram, *Basilornis*.

Of these twelve genera, *Meropogon*, *Streptocitta*, and *Basilornis* belong to the non-Australian families; *Gazzola* to the almost universal Corvinæ; *Monachalcyon*, *Ceycopsis*, and *Cittura* are isolated genera of a family in which the Australian region is pre-eminently rich; *Enodes* and *Scissirostrum* have affinities with genera common to the Indian and Australian regions; *Megacephalon* is strictly Australian. The affinities of *Prioniturus* seem to be with Australian genera.

The total number of Celebean genera also found within the Indian region, but not in the Australian, is forty-eight¹.

The total number of Celebean genera also occurring in the Australian region, but not in the Indian, is twenty-three. If we compare these numbers, we find that Celebes contains twenty-five more Indian than Australian genera.

If we make the same comparison by orders, the following results are obtained:—

| | Indian region. | Australian region. |
|--------------------|-----------------|--------------------|
| Psittaci | 1 | 3 |
| Rapaces | 10 | 2 |
| Picariæ | 11 | 3 |
| Passeres | 20 | 5 |
| Columbæ | 2 | 8 |
| Gallinæ | 1 | 1 |
| Grallæ | 2 | 1 |
| Anseres | 1 | 0 |
| | Total | 48 23 |

So, while the Celebean Rapaces and Passeres contain a large majority of Indian genera, in the Psittaci and Columbæ Australian genera preponderate. *Loriculus* is classed as an Indian genus; yet until the zoogeographical positions of the Philippines and of Celebes are determined the zoogeographical characters of *Loriculus* cannot be established. Within the limits of the Philippine and Celebean areas, seven out of the thirteen known species occur. Another, *L. amabilis*, a representative form of the Celebean *L. stigmatus*, occurs in the Sanghir Islands, and is also Papuan, being found at Gilolo and Batchian.

¹ It is true that *Buceros*, *Alcedo*, *Budytes*, and *Pratincola* occur in some of the Papuan and Moluccan islands; but they cannot be regarded as genera belonging to the Australian region.

The remaining five, one of which (*L. flosculus*) is the Flores representative of the Javan *L. pusillus*, are peculiar to the Indian region. If, then, we cease to regard *Loriculus* as having an Indian origin, all the five genera of Psittaci known in Celebes are either Australian or peculiar. The Columbæ, while imparting a decided, it may even be affirmed an absolute, Australian character to the Celebean avifauna, as clearly indicate a very close Philippine affinity.

Among the Gallinæ, *Gallus* and *Megapodius* are severally representatives of equally important typical families, characterizing one the Indian, the other the Australian region. But Celebes and the Philippines¹ are the only areas where representatives of the Phasianidæ and Megapodidæ are associated.

Among the Picariæ, the presence of *Scythrops* can hardly be deemed sufficient to balance the two genera of Piciidæ, more especially if *Scythrops* be migratory in Celebes, as in Australia. But though three of the genera belonging to the Alcedinidæ are Indian, yet the great richness of the family in Celebes forms an important element in favour of the Australian nature of the Celebean ornithology.

But to obtain a still more complete conception of the zoogeographical characters of Celebean ornithology the following tables have been prepared, showing the principal Indian and Australian genera that do not occur in the island.

Notwithstanding the great preponderance of Indian genera, some entire families, and a large number of genera characteristic of, if not altogether peculiar to, the Indian regions are wanting in Celebes. For instance, the following important families are without representation:—Sittidæ, Trogonidæ, Megalaimidæ, Paridæ, Brachypodidæ, Pycnonotidæ, Laniidæ, and Alaudidæ.

And the great families of the Piciidæ and Timaliidæ are but poorly indicated—the first by two genera, the last by but a single genus. Among the Grallæ and Anseres, the Otididæ, Cursoriidæ, Glareolidæ and Gruidæ, and the Phœnicopteridæ, all families having representation in the Indian region, appear to be unknown in Celebes. The absence of the Vulturidæ is a feature in common with the whole Indo-Malayan region. The number of Anatidæ and Laridæ recorded from Celebes is so small that it seems probable that members of those families have been overlooked by collectors.

After excluding from the list of genera found in the Indian region all those that do not likewise possess an Indo-Malayan habitat, at least eighty-eight Indian genera are absent from Celebes; of these twelve are purely Indo-Malayan.

TABLE V.—Showing the principal Indian genera which are wanting in Celebes.
N.B. Purely Indo-Malayan genera are marked with a dagger.

| | | | |
|---------|-----------|-----------------|------------|
| Ierax. | Bulaca. | Batrachostomus. | Psarismus. |
| Ketupa. | Phodilus. | †Eurylaimus. | †Corydon. |

¹ It is as yet uncertain whether the Philippine *Gallus* inhabits the same islands as the Philippine *Megapodii*. *Gallus* is only known for certain to occur in Luzon.

| | | | |
|-----------------|---------------|---------------|-----------------|
| †Cymbirhynchus. | Iole. | Dissemurus. | Meiglyptes. |
| †Calyptomena. | Criniger. | Chaptia. | Hemicircus. |
| Harpactes. | Irena. | Bhringa. | Micropternus. |
| Ceyx. | Analcipus. | Pericrocotus. | Chrysocolaptes. |
| Nyctiornis. | Brachypteryx. | Hemipus. | Chrysophlegma. |
| Chalcococcyx. | Myiophonus. | Eumyias. | Tiga. |
| Dendrophila. | Mixornis. | †Philentoma. | Sasia. |
| Chalcoparia. | Malacopteron. | Tchitrea. | Rhopodytes. |
| Orthotomus. | †Macronus. | Leucocirca. | Coccytes. |
| Prinia. | Alcippe. | Cissa. | †Peloperdix. |
| Enicurus. | Timalia. | †Temnurus. | Arborophila. |
| Corydalla. | Megalurus. | Dendrocitta. | Perdicula. |
| Copsychus. | Garrulax. | Crypsirhina. | Pavo. |
| Cittocinclla. | Pomatorhinus. | Eulabes. | †Argusianus. |
| Phyllornis. | Pteruthius. | Ploceus. | Polyplectron. |
| Iora. | Parus. | Passer. | Euplocamus. |
| Hypsipetes. | †Platylophus. | Mirafra. | †Rollulus. |
| Ixos. | Lanius. | Palæornis. | Metopidius. |
| Brachypodius. | Tephrornis. | Megalaima. | Gallirex. |
| Pycnonotus. | Buchanga. | Xantholæma. | Hydrophasianus. |

The islands to the eastward of Celebes (the Papuan or Austro-Malayan region of Mr. Wallace) are characterized by a large number of peculiar genera. Of these at least forty-four are absent from Celebes. Besides the families of the Epimachidæ and the Paridiseidæ, important groups, such as *Podargus*, *Pachycephala*, and *Manucodia*, are all wanting. Nor does a single Papuan Muscicapine form occur in Celebes. Papuan genera belonging to the two great orders Psittaci and Columbæ, orders which are so largely developed in the Australian region, and in no part of that region to a greater extent than in its Papuan subregion, are found in Celebes. This fact is justly regarded as sufficient to stamp the ornithology of that island with a Papuan character. Yet among the Psittacidæ such essentially typical Australian genera (also Papuan) as *Lorius* and *Platyercus* do not extend to Celebes. And several peculiar Papuan types are there unknown. The Columbæ of the Papuan subregion are well represented in Celebes; yet, with one exception (*Phlogænas*), all the Papuan genera of the Gouridæ are missing¹.

By the annexed table it will also be seen that several remarkable Papuan forms belonging to another characteristic Papuan family (Alcedinidæ) are not found in Celebes.

¹ *Calænas* is a migratory form.

TABLE VI.—Showing the principal Austro-Malayan or Papuan genera which do not occur in Celebes.

| | | | |
|---------------|------------------|------------------|---------------------------|
| Henicopernis. | Meliphaga. | Mimeta. | Geoffroyius. |
| Podargus. | Anthochaera. | Rectes. | Charmosyna. |
| Ægotheles. | Philemon. | Cracticus. | Platyercus. |
| Eurystopodus. | Gerygone. | Pachycephala. | Psittacula (Cyclopsitta). |
| Choucalcyon. | Petroica. | Myiolestes. | Nasiterna. |
| Mellidora. | Peltops. | Manucodia. | Microglossum. |
| Cyanalcyon. | Machærirhynchus. | Ptilonorhynchus. | Dasyptilus. |
| Syma. | Arses. | Lycocorax. | Trugon. |
| Aleyone. | Monarcha. | Gymnocorvus. | Goura. |
| Myzomela. | Piezorhynchus. | Eos. | Henicophaps. |
| Entomophila. | Micrœca. | Lorius. | Casuarius. |
| Glyciphila. | Todopsis. | | |

The zoogeographical relationship of the Philippines and Celebes, as exemplified by their birds, has been adverted to by Mr. Wallace and other writers. Unfortunately the Philippine archipelago, with its twelve hundred islands, has been but imperfectly explored; while the localities of many, if not of all, the known Philippine species are but vaguely ascertained. Luzon, the island whose ornithology has been the most investigated, is the furthest off from Celebes, and has the large island of Mindanao and many of less importance intervening. The resemblance which exists between the Celebean and Philippine avifaunas rests on the occurrence of Papuan genera in Mindanao, and perhaps in South Luzon, which likewise occur in Celebes: *Cacatua*, *Tanygnathus*, *Phlogœnas*¹, *Hemiphaga*, and *Megapodius* may be cited. Two genera seem to be confined to Celebes and the Philippines—*Prioniturus* and *Pyrhocentor*; this last is only known from Mindanao. *Megapodius cumingi* (Gould) is stated by Camel (v. Martens, *op. cit.* p. 26) to be found in Mindanao and in Mindoro. The exact habitats of the other genera remain to be determined. The known Philippine genera of the Picariæ and Passeres are nearly all Indo-Malayan; but then they have mostly been as yet only obtained from the neighbourhood of Manilla. They include characteristic Indian genera unknown in Celebes. Such are, besides *Ilierax*, *Harpactes*, *Chrysocolaptes*, and several other Picidæ, *Xantholæma*, *Irena*, *Copsychus*, *Cittacincla*, *Tchitrea*, *Ixos*, *Hypsipetes*, *Parus*, and genera such as *Lanius* and *Turdus*.

That Mindanao contains a strong Indian element, however, is shown by the fact that *Xantholæma*, *Irena*, and *Copsychus* have been there obtained; *Irena* also occurs in the island of Panay. Thus enough is known of the Philippine ornithology to justify anticipation, when it is worked out, of highly interesting zoogeographical facts, but not sufficient to enable us to determine the degree of relationship between the avifauna of the Philippine and Celebean areas.

¹ *Phlogœnas luzonica* (Scop.), = *cruentata* (Gm.), is said by Buzeta to occur in the Calamines (*conf.* v. Martens, J. für O. 1866, p. 25).

The absence of the two genera *Criniger* and *Rhipidura* in Celebes constitutes one of the many peculiarities of its ornithology. *Criniger*, represented in the neighbouring Sula Islands by a peculiar species, possesses other representatives in many of the Moluccan islands and throughout the Indo-Malayan subregion.

Rhipidura is still more widely and largely represented in the whole Australian region, and in the Indo-Malayan subregion, having representatives in all the islands of the Malay archipelago, excepting Celebes and the Sula Islands.

Then, again, the presence of the two genera *Coracias* and *Myiaclestes* is equally remarkable; for they are both unknown in any part of the Indo-Malayan region, and only reappear on the mainland of Asia.

After rejecting all those species whose Celebean origin does not rest upon the most undoubted authority, I find that the number of birds inhabiting Celebes amounts to, at least, one hundred and ninety-three. Of this number sixty-five are peculiar to the island. Twenty more are found also in the Sula Islands, or the Sanghir group, making a total of eighty-five species peculiar to Celebes and the two groups just mentioned. Of the remaining one hundred and eight species, fifty-five have Indian affinities (that is, are elsewhere only found in the Indian region as opposed to the Australian), though many extend beyond the limits of the Indian region; fourteen are found in the Australian and not in the Indian region, and twenty-eight are common to both regions; eight more species seem to be confined to the Moluccan islands; and three, not included above, are doubtfully found beyond Celebes: these are *Elanus hypoleucos*, *Ephialtes menadensis*, and the Celebean form of *Iotreron melanocephala*.

PSITTACI.

PLYCTOLOPHIDÆ.

CACATUA, Vieillot.

1. CACATUA SULPHUREA (Gm.), S. N. ed. xiii. i. p. 330, "Moluccas" (1788), ex Brisson, Orn. iv. p. 206, no. 9; O. Finsch, Papag. i. p. 296.

Cacatua equatorialis, Temm., Wallace, P. Z. S. 1864, p. 280.

Hab. Tomini (*Forsten*); Flores, Lombok (*Wallace*).

Dr. O. Finsch regards the individuals inhabiting the islands of Flores and Lombok as belonging to this Celebean species. This is also Mr. Wallace's view (*l. c.*). Both authors concur in specifically separating the Timorese bird. On the other hand, Professor Schlegel continues to include the Timorese form (*C. sulphurea*, *apud* Wallace *l. c.*, = *P. buffoni*, O. Finsch, *op. cit.* p. 300). The eminent Professor also mentions that in the Celebean Cockatoo the iris is red, while in those of Flores, Timor, and Lombok it is of a darker red, often passing into brown (*conf.* Nederl. Tijdschr. 1866,

p. 319). Dr. O. Finsch (*l. c.* p. 298), on the contrary, says that he has seen undoubted Celebean examples with the iris almost black. Mr. G. R. Gray (Hand-list, no. 8395) enumerates *C. æquatorialis*, Temm., as the title of a second Celebean species of *Cacatua*: Temminck's title was given in fact to *C. sulphurea* (Gm.), and there is no evidence of two species of Cockatoo occurring in Celebes.

PSITTACIDÆ.

TANYGNATHUS, Wagler.

2. TANYGNATHUS MÜLLERI (S. Müller & Schlegel), Verhandl. Land- en Volkenk. p. 108, "Celebes" (1839).

Psittacus sumatranus, Raffles, Trans. Linn. Soc. xiii. p. 281, "Sumatra" (1822).

Tanygnathus albirostris, Wallace, P. Z. S. 1862, p. 336, "Celebes and Sula Islands."

Eclectus mülleri (Temm.), O. Finsch, Papag. p. 357; Schlegel, Nederl. Tijdschr. 1866, p. 185.

Hab. Macassar, Menado, Sula Islands (*Wallace*); Sanghir Islands (*Schlegel*); Sama Island (*Cuming*).

Professor Schlegel and Dr. O. Finsch affirm that the white-billed form (*T. albirostris*) represents only a phase of colouring, and is not a species distinct from the red-billed *T. mülleri*. The evidence which they have produced in support of this view (O. Finsch, Papag. ii. p. 361) is strong; and examples of both forms in my own collection appear to belong to the same species. Mr. Wallace, on the other hand, maintains that the two birds are distinct species, and recently has written to me that "*T. albirostris* is certainly distinct." While Dr. O. Finsch (*l. c.*) states that he has seen living examples in the Amsterdam Zoological Gardens with the white bill passing into the red bill of *T. mülleri*, Mr. Wallace informs us (*l. c.*) that the cry of *T. albirostris* is different from that of *T. mülleri*, and that the white-billed form "is universally recognized by the natives of Celebes as another bird." Between the highest authority on the *Psittaci* and the greatest field-naturalist of the day it is difficult to decide; and we must leave the question open for further investigation.

If the white-billed species prove distinct, it will have in strictness to take the title of *sumatranus* of Raffles. And if both forms prove to be the same species, the title of *mülleri* will have to fall. In his remarks on Raffles's title, Dr. O. Finsch (*l. c.*) has somewhat misunderstood Sir Stamford's words. That author distinctly left it to be understood that his *P. sumatranus* was an indigenous Sumatran species. That it is not an inhabitant of Sumatra seems to be quite established.

PRIONITURUS, Wagler.

3. PRIONITURUS PLATURUS (Kuhl), Consp. p. 43, "Nova Caledonia" (1820).

Psittacus setarius, Temm. Pl. Col. 15, "Timor," *errore* (October 7, 1820).

Prioniturus wallacei, Gould, Birds of Asia, pt. 14, "Celebes" (1862).

Hab. Menado, Macassar (*Wallace*).

Dr. O. Finsch in his great work (Papageien, ii. p. 395) has thoroughly disentangled the synonymy of this species, the true *habitat* of which Mr. Wallace was the first to discover. The existence of any species of the genus, much less of this one, in the island of Timor, is quite unauthenticated; nor has this bird been found in New Caledonia.

4. PRIONITURUS FLAVICANS, Cassin, Proc. Ac. Nat. Sc. Phil. vi. p. 73 (1853); Gould, Birds of Asia, pt. 14.

Hab. Tondano (*Försten*).

LORICULUS, Blyth.

5. LORICULUS STIGMATUS (Müller & Schlegel), Verhandl. Land- en Volkenk. p. 182, "Celebes" (1841); Schlegel, Dierentuin, p. 70, woodcut.

Hab. Gorontalo, Tondano (*Försten*); Macassar (*Wallace*).

6. LORICULUS SCLATERI, Wallace, P. Z. S. 1862, p. 336, pl. 38, "Sula Islands."

Hab. Sula Islands (*Wallace*); Celebes (*Von Rosenberg*, fide *Schlegel*, Nederl. Tijdschr. 1866, p. 186).

7. LORICULUS EXILIS, Schlegel, Nederl. Tijdschr. p. 185 (1865); O. Finsch, Papag. ii. p. 729, pl. 5.

Hab. North Celebes (*Schlegel*, fide *O. Finsch*); Menado (*Meyer*).

In the original description the origin of this species was omitted by Professor Schlegel.

TRICHOGLOSSIDÆ.

TRICHOGLOSSUS, Vigors & Horsfield.

8. TRICHOGLOSSUS ORNATUS (Linn.), Syst. Nat. ed. 12, i. p. 143. no. 19, "Asia" (1766), ex Edwards, pl. 174.

Hab. Macassar (*Wallace*); Minahasa (*Von Rosenberg*); Menado (*mus. nostr.*).

This species is also stated by S. Müller and Von Rosenberg to inhabit the island of Buton—an assertion on which Dr. O. Finsch (Papag. ii. p. 844) places little reliance.

9. TRICHOGLOSSUS MEYERI (Pl. IV.), Walden, Ann. N. H. series 4, vol. viii. p. 281, "Menado" (1871).

Hab. Menado (*Meyer*).

RAPACES.

FALCONIDÆ.

FALCONINÆ.

HYPOTRIORCHIS, Boie.

10. HYPOTRIORCHIS SEVERUS (Horsf.), Trans. Linn. Soc. xiii. p. 135, "Java" (1822); Wallace, Ibis, 1868, p. 5.

Falco aldrovandi, Reinw., Temm. Pl. Col. 128, "Java" (August 2, 1823).

Hab. Macassar, Salwatty; most probably occurs in every island of the archipelago (*Wallace*); Java (*Schlegel*); Nipaul (*Hodgson*); Himalayas (*Jerdon*); Ceylon (*Holdsworth*).

TINNUNCULUS, Vieillot¹.

11. TINNUNCULUS MOLUCCENSIS, Jacquin. & Pucheran, Voy. Pôle Sud, Zool. iii. p. 47, "Amboyna" (1853).

Cresserelle des Moluques, Hombr. & Jacquin. *op. cit.* Atlas, pl. 1. fig. 2 (July 1843); Schlegel, Faun. Jap. *Aves*, p. 3 (1842).

Hab. Celebes, all the Moluccas, Flores, Timor, and Goram (*Wallace*); Borneo (*Schlegel*); Java (*Bocarmé*); Menado (*mus. nostr.*).

The Javan *habitat* of this Kestrel seems to rest solely on the authority of the Vicomte de Bocarmé, as quoted by Professor Schlegel (*Mus. Pays-Bas, Falcones*, p. 28).

ACCIPITRINÆ.

LOPHOSPIZA, Kaup.

12. LOPHOSPIZA GRISEICEPS (Schlegel), *Mus. Pays-Bas, Astures*, p. 23 (1862), "Celebes;" Wallace, Ibis, 1864, p. 184, pl. 5.

Hab. Macassar, Menado (*Wallace*); Menado (*mus. nostr.*); Gorontalo (*Forsten*).

TERASPIZA, Kaup.

13. TERASPIZA RHODOGASTRA (Schlegel), Valkv. Nederl. Ind. pp. 21 & 60, pl. 12. figs. 5 & 6. *Nisus virgatus rhodogaster*, Schlegel, *Mus. Pays-Bas, Astures*, p. 32.

Hab. Celebes (*Wallace*); Menado (*mus. nostr.*); Gounong-Pello, district of Gorontalo (*Forsten*).

ERYTHROSPIZA, Kaup.

14. ERYTHROSPIZA TRINOTATA (Bp.), *Consp. Av.* i. p. 33, "Celebes" (1850).

Nisus trinotatus, Schl. *Mus. Pays-Bas, Astures*, p. 45; Valkv. Nederl. Ind. pp. 27 & 65, pl. 19. figs. 1, 2, 3.

Hab. Macassar, Menado (*Wallace*); Menado (*mus. nostr.*); Gorontalo (*Forsten*).

¹ It is a debatable question whether the generic title *Cerchneis*, Boie (1826), the type of which is *F. rupicolus*, Daud., should not be employed rather than that of *Tinnunculus*, Vieillot (1807), the type of which is *F. columbarius*, Linn.

ERYTHROSPIZA IOGASTRA (S. Müller), Verhandl. Land- en Volkenk. p. 110, "Amboyna" (1839?).
Accipiter hyogaster, S. Müller, Jacquin. & Pucheran, Voy. Pôle Sud. iii. p. 48, "Macassar."
Epervier océanien, Hombroun & Jacquin. *op. cit.* Atlas, pl. 2. fig. 1.

Jacquinet is our only authority for the occurrence of this species, as identified by Pucheran, in Celebes; but as his notes relating to localities are not always trustworthy, and as *A. iogaster* is not given from Celebes by either S. Müller, Professor Schlegel, or Mr. Wallace, I shall not include it in this list. In this instance Jacquinet's authority is doubly untrustworthy; for he identified *A. rufitorques*, Peale, with *A. iogaster*, and noted the two examples, which he figured (*l. c.*) as having been obtained in the Viti Islands and at Macassar. It is quite possible that *A. iogaster* does occur in Celebes; and it is difficult to determine the *A. cruentus*, Gould, *op. cit.* Schlegel, M. P.-Bas, *Astures*, p. 42, mâle adulte, Célèbes, Voy. de Reinwardt, "gorge d'un roussâtre uniforme," unless we refer it to *A. iogaster*. And yet, under *Nisus cruentus* (Valkv. Nederl. Ind. p. 61), Professor Schlegel does not allude to this specimen, nor does he give Celebes as a locality for *N. cruentus*.

TACHYSPIZA, Kaup.

15. *TACHYSPIZA SOLOËNSIS* (Horsf.), Trans. Linn. Soc. xiii. p. 137, "Java" (1822); Mus. Pays-Bas, *Astures*, p. 44.

Falco cuculoides, Temm. Pl. Col. livr. xxii. pls. 110, 129, "Java" (August 2, 1823).

Hab. New Guinea, Batchian, Sumatra, Malacca (*Wallace*); Java, Philippines (*Schlegel*); Menado (*mus. nostr.*); North Celebes (*Forsten*).

AQUILINÆ.

NEOPUS, Hodgson.

16. *NEOPUS MALAYENSIS* (Reinw.), Pl. Col. 117 (26th June, 1824), "Java, Sumatra."

Hab. Java, Sumatra (*Temminck*); most of the hilly and jungly districts of India (*Jerdon*); Simla (*mus. nostr.*); Nepaul (*Hodgs.*); Malacca (*mus. nostr.*); Celebes (*Bernstein*); Ceylon (*Layard*).

LIMNAËTUS, Vigors.

17. *LIMNAËTUS LANCEOLATUS*, Bp. Consp. Av. i. p. 29, "Celebes" (1850).

Spizaëtus cirratus, Schlegel, Mus. Pays-Bas, *Astures*, p. 9, ex Celebes.

Hab. Celebes (*Wall.*); Menado (*mus. nostr.*); Tondano (*Forsten*); Sula Islands (*Wallace*).

The example in my collection has been identified by Mr. J. H. Gurney as a young individual of the above species. Underneath pure white; thigh-coverts faintly fringed with pale fulvous; entire head and nape pale fulvous-white; remaining upper plumage hair-brown, darkest in shade at the end of each feather, unexposed portion of each

feather being pure white; minor and major under wing-coverts pure white, a few possessing a terminal light-brown spot or drop; axillaries immaculate white; major wing-coverts brown on outer, white, barred with brown, on the inner web; no trace of an occipital crest; bill exceedingly powerful, height from festoon to culmen being full five eighths of an inch. This bird closely resembles a Cingalese example of a young *S. cirrhatus*, Gm. (= *S. cristatellus*, Temm.) in my collection. The only points of difference in the Cingalese individual being, besides its smaller dimensions, a black occipital crest three inches and a half long, the major wing-coverts being mostly white, and the axillaries and thigh-coverts being white, largely dashed, freckled, and barred with a clear tint of pale rufous. In the Celebean bird the tarsal feathers incline to cover the insertion of the toes. Dimensions:—wing 16 inches, tail $11\frac{6}{8}$, tarsus $3\frac{1}{2}$, mid toe with claw $2\frac{1}{2}$, bill from gape 2.

POLIOAËTUS, Kaup.

18. POLIOAËTUS HUMILIS (Müll. et Schlegel), Verh. Ned. overz. Bez. *Aves*, p. 47, pl. 6, "Sumatra;" Wallace, *Ibis*, 1868, p. 14; Schlegel, Mus. Pays-Bas, *Aquila*, p. 18.

Hab. Celebes (*Wallace*); Sumatra (*Müller*); Malay peninsula (*Blyth*); Bengal (*Schlegel*).

CUNCUMA, Hodgson.

19. CUNCUMA LEUCOGASTER (Gm.), Syst. Nat. i. p. 257 (1788); Valkv. Neder. Ind. pl. 4. figs. 1, 2; Wall. *Ibis*, 1868, p. 15; Mus. Pays-Bas, *Aquila*, p. 14.

Hab. Malacca, Celebes, Gilolo, Batchian, Morty, Aru Islands (*Wallace*); Macassar (*mus. nostr.*); all over India, chiefly on the coast (*Jerdon*); Australia, Tasmania (*Gould*); Timor, Sumatra, Java, Ternate (*Schlegel*); Ceylon (*Layard*).

SPILORNIS, G. R. Gray.

20. SPILORNIS RUFIPPECTUS, Gould, P. Z. S. 1857, p. 222, "Macassar;" Schlegel, Valkv. Nederl. Ind. p. 72, pl. 23; Mus. Pays-Bas, *Buteones*, p. 27.

Hab. Menado (*mus. nostr.*); Celebes (*Wallace*); Tondano, Gorontalo (*Forsten*).

MILVINÆ.

HALIASTUR, Selby.

21. HALIASTUR LEUCOSTERNUS, Gould, P. Z. S. 1837, p. 138, "Australia;" Birds of Austr. i. pl. 4; Valkv. Nederl. Ind. pl. 4. fig. 3.

Hab. Celebes, all the Moluccas, New Guinea (*Wallace*); northern and eastern shores of Australia (*Gould*); Macassar (*S. Müller*); Goenong-Tello, district of Gorontalo, Tondano (*Forsten*).

MILVUS, Cuvier.

22. MILVUS AFFINIS, Gould, P. Z. S. 1837, p. 140; Birds of Austr. i. pl. 21; Wallace, Ibis, 1868, p. 16; Valkv. Nederl. Ind. pl. 20. fig. 1.

Hab. Macassar, Timor (*Wallace*); Australia (*Gould*).

I hesitate to include Sumatra within the range of this form, as that *habitat* rests only on the correct identification of a skeleton in the Leyden Museum.

ELANUS, Savigny.

23. ELANUS HYPOLEUCUS, Gould, P. Z. S. 1859, p. 127, "Macassar;" Wallace, Ibis, 1868, p. 17.

? *Elanus intermedius*, Schlegel, Mus. Pas-Bas, *Milvi*, p. 7 (1862).

Hab. Macassar (*Wallace*); and if the same as *E. intermedius*, Schlegel, North Celebes, Borneo, Java (*Schlegel*).

PERNIS, Cuvier.

24. PERNIS PTILORHYNCHA (Temm.), Pl. Col. livr. viii. pl. 44, "Java et Sumatra" (26th July, 1823); Verh. Ned. overz. Bezitt. *Aves*, p. 49, pl. 7, "Sumatra."

Pernis cristata, Cuv.¹ R. Anim. ed. 2, i. p. 335, "Java" (1829).

Var. *celebensis*, Schlegel, Valkv. Nederl. Ind. pl. 26. f. 4; Wall. Ibis, 1868, p. 17.

Hab. Celebes only, if distinct from Indian and Malayan species (*conf. Wallace, l. c.*).

In Mr. J. H. Gurney's opinion the Celebean *Pernis* should receive a distinct specific title; and Mr. Wallace writes that it is distinct. I have been unable to examine any examples.

BAZA, Hodgson.

25. BAZA MAGNIROSTRIS, G. R. Gray, List Birds Brit. Mus. 1844, p. 19, "Philippine Islands;" Kaup, Isis, 1847, p. 343; Schlegel, Nederl. Tijdschr. Dierk. 1866, p. 328; Schlegel, Vog. Nederl. Ind. Valkv. pp. 40, 75, pl. 28. f. 4, 5.

Pernis crassirostris, Kaup, Contrib. Orn. 1850, p. 77.

Hab. Philippines (*type*); Celebes, Sulu Islands (*Wallace*); Borneo (*Schlegel*).

Professor Schlegel (Valkv. p. 77) states that the types of *Lophotes reinwardtii*, Schlegel & Müller (Verh. Ned. overz. Bezitt. *Aves*, p. 37, pl. 5. figs. 1, 2, "Celebes"), were not obtained by Reinwardt in Celebes, and that the Dutch travellers have never obtained it in that island. The Professor, while identifying the Celebean *Baza* with the Philippine species, points out differences which may eventually prove sufficient to justify the Celebean bird being specifically separated from the Philippine.

In the 'Hand-list' Mr. Gray has introduced *B. reinwardtii* as a second Celebean

¹ It seems to have been overlooked that, although Cuvier discriminated this species in 1817, he only conferred a Latin title on it in 1829.

species. No authentic account of its occurrence in Celebes has as yet been published, while Professor Schlegel and Mr. Wallace restrict its range to Bourou, Ceram, and Amboyna.

BUTEONINÆ.

POLIORNIS, Kaup.

26. POLIORNIS LIVENTER (Temm.), Pl. Col. livr. lxxiv. pl. 438, "Java" (September 22, 1837); Schlegel, Mus. Pays-Bas, *Buteones*, p. 21.

Hab. Celebes (*Wallace*); Java, Timor (*Mus. Lugd.*); Macassar (*S. Müller*); Toungoo, Burma (*mus. nostr.*); Siam (*Gurney*).

27. POLIORNIS INDICUS (Gm.), Syst. Nat. ed. 13, i. p. 264. no. 68 (1789), ex Latham.

Javan Hawk, Lath. Gen. Syn. i. p. 34*. no. 8, 7d, "Java."

Falco javanicus, Lath. Gen. Hist. i. p. 163. no. 87, ex Lath. (1821).

Falco poliogenys (Temm.), Pl. Col. livr. lv. pl. 325, "Ile de Luçon" (February 28, 1825).

Buteo pyrrhogenys, Schlegel (*lapsu calami*), Faun. Jap. *Aves*, p. 21, pl. 7B, "Japan."

Astur barbatus, Eyton, Ann. Nat. Hist. xvi. p. 227, "Malacca" (1845).

Buteo pygmæus, Blyth, J. A. S. B. 1845, p. 177, "Tenasserim provinces," *op. cit.* 1850, p. 339.

Hab. Menado (*mus. nostr.*); Gilolo (*mus. nostr.*); Luçon (*Dussumier*); Japan (*Schlegel*); Morty Isl., Sanguir Isl. (*Mus. Lugd.*); Java (*Latham*); Malacca (*Eyton*); Tenasserim Prov. (*Blyth*).

The designation *F. indicus*, Gm., is rejected by Professor Schlegel (*Mus. Pays-Bas, Buteones*), on the ground of its being undeterminable. Gmelin gave that title to the *Javan Hawk*, described by Latham from an individual which flew on board a vessel off the coast of Java. Mr. J. H. Gurney informs me (*in epist.*) that, having compared Latham's description with the three Asiatic species of *Poliornis*, he agrees with the late Mr. Strickland (and consequently with Mr. G. R. Gray, List B. Mus. p. 68, 1848) in identifying it with *F. poliogenys*, Temm. "Latham's description agrees in all respects," continues Mr. Gurney, "except that he speaks of five transverse bars on the tail, and I have not seen more than four, and in one specimen only three." My Celebean and Gilolo examples only possess three bars. But in the 'Fauna Japonica' Professor Schlegel states that this species has four or *five* caudal bands.

Mr. Blyth tells me that he considers his *B. pygmæus* to be the same as *F. poliogenys*, Temm., and that Mr. Eyton's description of *Astur barbatus* sufficiently applies to *B. pygmæus*.

CIRCUS, Lacépède.

28. CIRCUS ASSIMILIS, Jardine & Selby, Illustr. Ornith. ii. pl. 51, *juv.*, "New Holland" (1826); Schlegel, Mus. Pays-Bas, *Circi*, p. 9; Valkv. Nederl. Ind. pl. 20. figs. 2, 3.

Circus jardinii, Gould, P. Z. S. 1837, p. 141, "New South Wales;" Wallace, Ibis, 1868, p. 19, *adult*.

Hab. Celebes (*Wallace*); Menado (*mus. nostr.*); Gorontalo (*Forsten*); Macassar

S. Müller); New South Wales (*Gould*); Central Polynesia, if identical with *C. approximans* (*Peale*); Viti islands (*Finsch and Hartlaub*).

Professor Schlegel (*l. c.*) mentions that the Macassar example in the Leyden Museum, a female in first plumage, obtained by S. Müller, perfectly agrees with the figures of *C. assimilis* as given by both Jardine and Selby and by Mr. Gould. But *C. assimilis*, J. & S., and *C. assimilis*, J. & S. *apud* Gould (B. Austr. pl. 26), are two distinct species, both inhabiting Australia, but with different ranges, *C. assimilis*, J. & S., being the young bird of *C. jardinii*, Gould, pl. 27, and *C. assimilis*, J. & S. *apud* Gould, pl. 26, being a distinct species ranging into New Zealand, but not occurring in South Australia, and named *C. gouldi*, Bp. Consp. p. 34, ex Austr., and Rev. de Zool. 1850, p. 491, "de la Nouvelle Hollande." *C. gouldi*, Bp., was described by its author (*vide* Schlegel, *l. c.*) from specimens in the Leyden Museum, "acquis comme provenant de la Patagonie;" and Professor Schlegel identifies them with *C. macropterus*, Vieill. Mr. J. H. Gurney is of opinion that they are not *C. macropterus*, that the types came from Australia, as twice over stated by Prince Bonaparte, and not from South America, and that they are identical with *C. assimilis*, J. & S. *apud* Gould, *nec* J. & S. *C. assimilis*, J. & S., = *C. jardinii*, Gould, Mr. Gurney informs me, has alone been obtained in Celebes. *C. wolff*, Gurney, P. Z. S. 1865, p. 823, pl. 44, ex New Caledonia, and which Messrs. Finsch and Hartlaub (Centr. Polyn. p. 7) identify with one of the two Australian Harriers (for they confound the two), Mr. Gurney assures me is a perfectly distinct species.

STRIGIDÆ.

ATHENE, Boie.

29. ATHENE PUNCTULATA (Quoy et Gaim.), Voy. Astrolabe, Zool. i. p. 165, pl. i. f. 1, "Celebes" (1830); Mus. Pays-Bas, *Striges*, p. 29.

Hab. Macassar (*Wallace*); Menado (*Schlegel*).

30. ATHENE OCHRACEA (Schlegel), Nederl. Tijdschr. Dierk. 1866, p. 183, "Negrilamá, Celebes" (1866).

Hab. Celebes (*Rosenberg*).

I refer this species to *Athene* with some doubt, never having seen an example. The description reads like that of a *Ninox*. One specimen only, and that of a female, seems to be known. Professor Schlegel (*l. c.*) remarks that it resembles generally his *Noctua philippensis*¹, but that it has a longer tail, and that the style of colouring differs.

¹ Nederl. Tijdschr. Dierk. 1866, p. 183, = *Ninox philippensis*, Bp. Compt. Rend. xli. p. 655 (1855)?

EPHIALTES, Keyserling & Blasius.

31. EPHIALTES MAGICUS (Schlegel), Faun. Jap. *Aves*, p. 25, "Amboyna, Celebes" (1842);
Bp. Consp. p. 46; Schlegel, Mus. Pays-Bas, *Oti*, p. 22.

Ephialtes leucospila, G. R. Gray *apud* Wall. Ibis, 1868, p. 25.

Hab. Amboyna (*S. Müller*); Gorontalo (*Forsten*).

The range of the Celebean species referred to the above title has not as yet been ascertained; and its right to that title even has yet to be proved. *Otus magicus* is the MS. title given by S. Müller to a Scops Owl inhabiting Amboyna. Professor Schlegel (Faun. Jap.) seems to have identified the Celebean bird with that of Amboyna; for there is no note in the Mus. Pays-Bas of Celebean examples obtained by S. Müller. Unfortunately, as Müller never published a description, his title cannot be fixed on the Amboyna bird. If Professor Schlegel is right in considering the Amboyna and Celebean species identical, there can be no question that their title must stand *E. magicus*. But this view is not adopted by Mr. Wallace, who identifies (*l. c.*) the Celebean species with the Papuan *E. leucospila*, G. R. Gray, and leaves *E. magicus* as the title of the Amboyna and Ceram forms. Mr. J. H. Gurney is doubtful whether *E. leucospila* can be separated from *E. magicus*, but has had no Amboyna examples for comparison. He has kindly sent me the following note on the subject:—"The Norwich Museum has ten specimens of *Ephialtes leucospila*, but only one of *E. magicus* as limited by Mr. Wallace. This specimen does not differ from some of those of *E. leucospila* more than they do amongst themselves; and I am therefore disposed to agree with Professor Schlegel in thinking that the two are not really separable, unless it be right to separate the different phases of *E. leucospila*, which appear to vary somewhat in measurement, and also a good deal in the relative darkness of their markings. In the following list of the Norwich specimens I begin with the darkest and finish with the lightest, and I also give the length of the tarsus and of the wing from the carpal joint to the tip:—

| | Wing. | Tarsus. | |
|---|-------|---------|--|
| E. LEUCOSPILA. | | | |
| No. 1. East Gilolo ¹ | 7" 6" | 1" 3" | Very dark. Mr. Gray's type specimen. Dark and rufous. |
| 2. Morty Island | 7 0 | 1 2 | |
| 3. Morty Island | 6 6 | 1 2 | Intermediate in colour between the darkest and lightest extremes, and all nearly alike. |
| 4. Morty Island, ♀ | 7 0 | 1 2 | |
| 5. Gilolo | 6 9 | 1 2 | |
| 6. Ternate, ♂ | 7 0 | 1 2 | |
| 7. Batehian, ♀ | 7 0 | 1 2 | |
| 8. Celebes, ♀ | 7 6 | 1 3 | |
| 9. Bouru, ♂ | 7 5 | 1 3 | Much paler, and nearly alike. |
| 10. Bouru, ♀ | 7 5 | 1 3 | |
| E. MAGICUS. | | | |
| 1. Ceram | 7 2 | 1 3 | Rather more mottled on the back than the specimen of <i>E. leucospila</i> , but comes very near to no. 8. |

¹ Erroneously given in P. Z. S. 1860, p. 345, as 6" 6".

“If the races are separable, I should think that probably the birds from Ceram, and Amboyna also (according to Wallace), and perhaps those from Celebes, should stand as *E. magicus*, and those from Morty, Gilolo, Ternate, and Batchian as *E. leucospila*, from which the pale-coloured birds from Bouru *may* be also separable. But the differences are too slender to form a basis for specific distinction, and very probably are not constant.”

Mr. G. R. Gray (Hand-list, i. p. 46) treats these forms as distinct species, but makes them both to be inhabitants of Celebes.

32. *EPHIALTES MENADENSIS* (Quoy et Gaimard), Voy. Astrolabe, Zool. i. p. 170, pl. 2. fig. 2, “Menado” (1830); Schlegel, Mus. Pays-Bas, *Oti*, p. 20; Wallace, Ibis, 1868, p. 25.

Hab. Gorontalo (*Forsten*); Macassar, Menado, Island of Flores (*Wallace*).

Dr. Hartlaub (Faun. Madagasc.) identified the Madagascar brown form, *Scops madagascariensis*, Grandid., with the Celebean *E. menadensis*, but retained *S. rutilus*, Pucher. (Archives du Mus. iv. pl. 22), as a distinct species. Professor Schlegel (Rech. s. l. Faun. Mad.) concurs with Dr. Hartlaub, but besides points out that *S. rutilus* is nothing but the rufous phase. Mr. J. H. Gurney (Ibis, 1869, p. 452) admits the identity of the two Madagascar forms, but considers the Madagascar to be a larger local race of the Celebean *E. menadensis*, and (*in epist.*) “would be disposed to rank it as one for which a specific name is convenient.” One of Forsten’s Celebean examples (Mus. Pays-Bas, *l. c.*), “teintes tirant fortement au roux,” leads us to expect that *E. menadensis* will yet be found in Celebes exhibiting the rufous livery of *S. rutilus*, Pucher. The Flores habitat rests solely on the authority of Mr. Wallace. Celebean examples only are contained in the Leyden Museum.

NINOX, Hodgson.

33. *NINOX JAPONICUS* (Bp.), Consp. i. p. 41 (1850), ex Schlegel, Faun. Jap. pl. 9. *Noctua hirsuta japonica*, Schlegel, Nederl. Tijdschr. 1866, p. 182.

Hab. Celebes (*Von Rosenberg*); Japan, China (*Schlegel*).

The occurrence of a species of *Ninox* in Celebes was first made known by Professor Schlegel (*l. c.*). One example, collected by Von Rosenberg, is stated by the Professor to be absolutely identical with Japanese and Chinese individuals. A second Celebean example, obtained by the same collector, Professor Schlegel considers to be more nearly related to the *Ninox* of continental India. A third example, sent from the island of Sanghir, the same author regards as most nearly resembling the Bornean form *Athene borneensis*, Bp., but with larger dimensions. The range of the subgenus *Ninox* is extensive. Its members are found in Ceylon, which furnished the type of *Strix hirsuta*, Temm.; in Southern and Central India, *S. lugubris*, Tickell; in the Himalayas, *N. nipalensis*, Hodgs., whence they extend eastward and north-eastward to Japan, where

they become *A. japonica*, Bp. To the southward they are found in Bengal, Burma, and Cochin China. In the Malaccan peninsula they bear the title of *A. malaccensis*, Eyton, in the Andamans, *N. affinis*, Tytler; while of the Indo-Malayan Islands, Sumatra contains the type of *S. scutulata*, Raffles; Borneo, *A. borneensis*, Bp.; and the Philippines, *N. philippensis*, Bp. (Compt. Rend. xli. p. 655, 1855). A skeleton in the Leyden Museum is our only evidence of Java possessing a species of this group, to which *A. florensis*, Wallace, ex Flores, appears also to belong. The Madagascar *N. madagascariensis*, Bp., so closely resembles the Indian *Ninox*, that Dr. Hartlaub (Faun. Madagasc.) considers that it can hardly be separated as even a local race (*conf.* J. H. Gurney, Ibis, 1869, p. 453). Enough has been said to show that all the local varieties have yet to be rigidly compared with one another before the exact title of the Celebean *Ninox* can be absolutely determined.

STRIX, Linnæus.

34. STRIX ROSENBERGI, Schlegel, Nederl. Tijdschr. iii. p. 181, "Celebes" (1866); Wallace, Ibis, 1868, p. 26.

Hab. Molido, Boni, Gorontalo (*Rosenberg*); Menado (*mus. nostr.*); Macassar (*Wallace*).

A very distinct and fine species.

PICARIÆ.

PICIDÆ.

MULLERIPICUS, Bonaparte.

35. MULLERIPICUS FULVUS (Quoy et Gaimard), Voy. Astrol. i. p. 228, pl. 17. f. 2, ♂, "Celebes" (1830); Malh. Monogr. i. p. 53, pl. 14. f. 1, ♂, f. 2, ♀.

Hab. Macassar, Menado (*mus. nostr.*).

The affinities of this interesting species are nearer to *M. pulverulentus* (Tem.) than to the group of large black-and-white species represented by *P. javensis*. Malherbe (*l. c.*) erroneously referred *P. fulvigaster*, Drap. (Dict. Sc. Nat. viii. p. 621, ex Java), to this species, instead of to *P. javensis*, ♂, Horsf. (1822), = *P. horsfieldii*, ♂, Wagler (1827), = *P. leucogaster*, Reinw. (1830).

YUNGIPICUS, Bonaparte.

36. YUNGIPICUS TEMMINCKII (Malherbe), Rev. Mag. Zool. 1849, p. 529, "Celebes;" Malh. Monogr. i. p. 155, pl. 36. f. 3, ♀.

Hab. Celebes (*Mus. Lugd.*); Macassar (*Wallace*).

Founded on a single example of a female in the Leyden Museum. Allied to *Y. kisuki*, but considered a good species by Temminck and Bonaparte.

Prince Bonaparte (Consp. i. p. 129) described a specimen of a Woodpecker, *Picus sanguineus*, Lichtenst. (Cat. Hamb. p. 17), which was wrongly labelled in the Leyden Museum as coming from Celebes, under the title of *Venilia albertuli*.

MEROPIDÆ.

MEROPS, Linnæus.

37. *MEROPS PHILIPPINUS*, Linn. Syst. Nat. ed. 13¹ (Vindob.), i. p. 183. no. 5 (1767), ex Brisson.

Apiaster philippensis major, Brisson, Orn. iv. p. 560, "Philippine Islands."

Hab. Menado (*mus. nostr.*); Indian region.

Examples of the Bee-eater, usually referred to Brisson's Philippine species, from North-east India, Candeish, Malabar, Coorg, Ceylon, Sumatra, and Java, are undistinguishable; and my Celebean specimens do not appear to differ.

In the Hand-list, no. 1208, Mr. G. R. Gray keeps the species which inhabits India, Ceylon, Java, Flores, Lombok, and Timor separate from the Philippine bird, and refers it to *Merops daudini*, Cuvier. Cuvier bestowed this title (*Règne Anim.* i. p. 442) on Levaillant's *Guépier daudin* (pl. 14). Levaillant distinctly states that he described his species from examples brought from the Philippines by Sonnerat and Poivre. The title of *Merops daudini* therefore applies to a Philippine species, and cannot be used for the Indian species even if the Indian bird really does differ.

38. *MEROPS ORNATUS*, Latham, Ind. Orn. Suppl. p. xxxv, "New Holland" (1801); Wallace, Ibis, 1860, p. 147; P. Z. S. 1862, p. 338.

Hab. Celebes (*Wallace*); Java (*mus. nostr.*); Flores, Lombok, Timor, Sula Islands, Sumbawa, Ternate, Mysol, New Guinea (*Wallace*); Gilolo (*Bernstein*); New South Wales, South Australia (*Gould*); Clarence River, Port Albany (*mus. nostr.*).

Sula-Island examples perfectly agree with Australian. The Philippine Bee-eater referred to this species by Von Martens (*J. für Orn.* 1866, p. 17), seems to belong to another species allied to *M. viridis*, Linn.

MEROPOGON, Bonaparte.

39. *MEROPOGON FORSTENI* (Temm.), Bp. Consp. i. p. 164, "Celebes" (1850); Schlegel, Mus. Pays-Bas, *Merops*, p. 8; Meyer, *J. für O.* 1871, p. 231.

Hab. Tondano (*Forsten*); Rurukan (*Meyer*).

Mr. Wallace failed in obtaining this species (Ibis, 1860, p. 142).

¹ In the twelfth edition ("Holmiæ") the title of this species was omitted by the printer's mistake.

CORACIIDÆ.

CORACIAS, Linnæus.

40. CORACIAS TEMMINCKII (Vieillot), N. Dict. Sc. Nat. xxix. p. 435, "l'Inde" (1819), ex Levaillant, Hist. Nat. Promér. & Guép. iii. Suppl. p. 46, pl. G; Schlegel, Mus. Pays-Bas, *Coraces*, p. 138; Wallace, Malay Archipel. i. p. 337.

Coracias papuensis, Quoy et Gaimard, Voy. de l'Astrol. Zool. p. 220, pl. 16, "Dorey," *errore* (1830).
Hab. Kema (*Forsten*); Gorontalo, Modelido (*Von Rosenberg*); Menado (*mus. nostr.*); Macassar (*Wallace*).

In the 'Hand-list,' no. 899, Mr. G. R. Gray extends the range of this species to the Sula Islands. Mr. Wallace is unable to confirm this statement, but writes to me that it is probable. I have failed in finding any confirmation among the Dutch writers.

EURYSTOMUS, Vieillot.

41. EURYSTOMUS ORIENTALIS (Linn.), S. N. ed. 12, i. p. 159, ex Briss.; Schlegel, Mus. Pays-Bas, *Coraces*, p. 139.

Eurystomus pacificus (Lath.), ap. Wallace, P. Z. S. 1862, p. 339.

Hab. Limbotto, Gorontalo, Bongka, Ayer-pannas, Boné (*Von Rosenberg*); Menado (*mus. nostr.*); Indian region.

The *Eurystomus* of Celebes belongs to the Asiatic and not to the Australian type, *E. pacificus* (Lath.). It is not to be distinguished from Ceylon and Indian examples.

ALCEDINIDÆ.

DACELOININÆ.

MONACHALCYON, Reichenbach.

42. MONACHALCYON PRINCEPS (Forsten), Mus. Lugd.; Bp. Consp. i. p. 154, "Celebes," adult; Schlegel, Vog. Ned. Ind. *Ijsvogels*, pl. 7. f. 1, 2, 3.

Dacelo cyanocephalus, Forsten, Mus. Lugd.

— *monachus*, Temm. Mus. Lugd.

Monachalcyon monachus, Sharpe, Mon. Alcedinidæ, pt. xi. no. 87.

Hab. Kema, Menado (*Forsten*).

Mr. Sharpe, in his excellent Monograph, has adopted the specific title of *monachus*, given by Temminck to the very young bird. I have preferred, in the absence of any recognized rule in such a case, to use the title bestowed by Forsten on the fully adult bird.

Ceram and Ternate are cited by Mr. G. R. Gray (Hand-list, no. 1068) as additional *habitats* of this remarkable species; it appears, however, to be a purely Celebean bird.

SAUROPATIS, Cabanis.

43. SAUROPATIS CHLORIS (Bodd.), Tabl. Pl. Enl. p. 49 (1783), ex Buff.; Sharpe, Monogr. pt. xii. no. 102.

Alcedo collaris, Scopoli, Fl. Faun. Insub. ii. p. 90 (1786), ex Sonn.

Hab. Macassar (*Wallace*).

The geographical distribution of this species will be found fully given by Mr. Sharpe (*l. s. c.*).

44. SAUROPATIS SANCTA (Vig. & Horsf.), Trans. Linn. Soc. xv. p. 206, "New Holland" (1825); Sharpe, Monogr. p. xii. no. 104.

Mr. Sharpe (*l. c.*) has not included Celebes within the range of this species; but Mr. Wallace has informed me that he obtained it, as well as *S. chloris*, at Macassar.

45. SAUROPATIS FORSTENI, Temm. Bp. Consp. i. p. 157, "Celebes" (1850); Schlegel, Mus. Pays-Bas, *Alcedines*, p. 37; Schlegel, Vog. Ned. Ind. *Ijsvogels*, p. 29, pl. 11. f. 1; Sharpe, Monogr. pt. xii. no. 103.

Hab. Gorontalo (*Forsten*).

The type specimen, an adult female, preserved at Leyden, is the only individual known. In Prince Bonaparte's diagnosis Professor Schlegel (*l. c.*) substitutes the words "*subtus nigrescens*" for "*subtus alba*." Mr. Sharpe informs me that "it is close to *H. chloris*, of which perhaps it is only an accidental variety."

Todiramphus funebris (*Forsten*), Bp. (*l. c.*), is from Gilolo, and not from Celebes, nor has *Alcedo diops*, Temm., been found there since Temminck described the species.

CALLIALCYON, Bonaparte.

46. CALLIALCYON RUFA (*Wallace*), P. Z. S. 1862, p. 338, "Sula Islands and Celebes."

Halycon coromanda (Lath., pt.), Sharpe, Monogr. pt. ix. no. 69.

Hab. Celebes, Sula Islands (*Wallace*); Macassar (*Wallace*).

The Celebean *Callialcyon* is the largest and most brilliantly coloured of the group. In both these respects it differs; and I therefore do not hesitate to retain Mr. Wallace's title.

CITTURA, Reichenbach.

47. CITTURA CYANOTIS (Temm.), Nouv. Rec. livr. xlv. pl. 262, "Sumatra" (!), *errore* (March 27, 1824); Sharpe, Monogr. pt. ii. no. 10, "Celebes;" Wallace, Ibis, 1860, p. 142.

Hab. Kema (*Forsten*); Celebes (*Wallace*); Menado (*mus. nostr.*).

The true *habitat* of this species was made known by Professor Schlegel some seven years ago (Mus. Pays-Bas); and to Mr. Wallace we owe not only a confirmation of the fact, but interesting notes on the habits of the bird. It is not improbable that the differences whereon Mr. Sharpe founded his *C. sanghirensis* will prove to be common to the Celebean bird in certain phases of plumage.

CEYCOPSIS, Salvadori.

48. CEYCOPSIS FALLAX (Schlegel), Nederl. Tijdschr. Dierk. 1866, p. 187, "Celebes;" Sharpe, Monogr. part v. no. 37.

Hab. Edges of creeks in the mountainous parts of Celebes (*Schlegel*); Menado (*mus. nostr.*).

Tanyiptera riedelii, J. Verreaux, N. Arch. du Mus. ii. Bulletin, p. 23, pl. 3. f. 1 (1866), is not a Celebean bird. See P. Z. S. 1872, p. 1.

ALCEDININÆ.

PELARGOPSIS, Gloger.

49. PELARGOPSIS MELANORHYNCHA (Temm.), Pl. Col. 391, "Celebes" (10th June, 1826); Sharpe, Monogr. pt. ix. no. 66.

Hab. Celebes (*Reinwardt*); Menado (*mus. nostr.*); Sula Islands (*Wallace*).

ALCEDO, Linnæus.

50. ALCEDO MOLUCCENSIS, Blyth, J. A. S. B. xv. p. 11, "Moluccas" (1846); Cat. Calc. Mus. no. 215, p. 49, "Celebes, Moluccas;" Sharpe, Monogr. pt. x. no. 74.

Alcedo minor moluccensis, Schlegel, Mus. Pays-Bas, *Alcedines*, p. 8; Schlegel, Vog. Ned. Ind. *Ijvogels*, p. 5, pl. 1. f. 4, 5.

Hab. Gorontalo (*Forsten*); Celebes, Bouru, Gilolo, Flores (*Wallace*); Salawati, Ceram, Batchian, Mysol, Amboina (*Von Rosenberg*).

It was probably Celebean examples of this species which Temminck mistook for the common European Kingfisher (Pl. Col. 272, note).

51. ALCEDO ASIATICA, Swainson, Zool. Illustr. 1st ser. i. pl. 50, "some part of India" (1820-21); Sharpe, Monogr. pt. x. no. 75.

Alcedo meninting, Horsf. Trans. Linn. Soc. xiii. p. 172, "Java" (1822); Temm. Nouv. Rec. pl. 239. f. 2, "Java and Sumatra;" Schlegel, Vog. Ned. Ind. *Ijvogels*, p. 6, pl. 3. f. 2, 3.

Hab. Indo-Malayan region, Macassar (*Wallace*); Gorontalo (*Von Rosenberg*); Lombock (*Wallace*).

CYPSELIDÆ.

MACROPTERYX, Swainson.

52. MACROPTERYX WALLACHI (Gould), P. Z. S. 1859, p. 100, "Macassar."

Hab. Celebes, Sula Islands (*Wallace*); Macassar, Menado (*mus. nostr.*).

This species is closely allied to *M. klecho*, but differs in being considerably larger and in having the crown of the head, the shoulder-coverts, the edgings of the quills, and the upper surface of the rectrices of a deeper shade of blue-green. Dimensions of wing in *M. wallacii*, seven inches and a quarter; in *M. klecho*, six inches and a quarter.

COLLOCALIA, G. R. Gray.

53. COLLOCALIA ESCULENTA (Linn.), Syst. Nat. ed. 12, i. p. 343. no. 2 (1766), ex Rumph. Herb. Amb.; Wallace, P. Z. S. 1863, p. 384.

Collocalia hypoleuca, G. R. Gray, P. Z. S. 1858, p. 170, "Aru Islands;" Hand-list, no. 749; Ann. Nat. Hist. 3rd ser. vol. xvii. p. 120.

Hab. Celebes, Timor, Moluccas, Aru Islands (*Wallace*).

Notwithstanding the reasons advanced by Mr. G. R. Gray (*l. c.*), Mr. Wallace's arguments in favour of this species being the true *Hirundo esculenta*, Linn., appear to me to be decisive. Rumphius does not speak of "the concealed white spots on the tail-feathers as if there were one on each" (Gray, *op. cit.* p. 126). On the contrary, by the expression "only when the feathers are separated the white spots become visible," Rumphius leaves it to be inferred that all the white spots are concealed, and therefore that the middle pair of tail-feathers are immaculate. The statement of Linnæus that "all the tail-feathers are spotted with white," is an inaccurate rendering of the description given by Rumphius.

54. COLLOCALIA FUCIPHAGA (Thunberg), Act. Holm. xxxiii. p. 151, pl. 4, "Java" (1772); Wallace, P. Z. S. p. 384.

Collocalia nidifica, var., G. R. Gray, Ann. Nat. Hist. 3rd ser. vol. xvii. p. 119; F. Moore, Cat. Mus. E. Ind. Co. i. p. 98.

Hab. Macassar (*Wallace*); Java (*H. esculenta*, ap. Horsf.); Sumatra (*H. esculenta*, ap. Raffles); Bourbon, Mauritius (var. *francica*, Gm.); Neilgherries (*H. unicolor*, Jerdon, = *C. concolor*, Blyth); Malabar coast and Western Ghauts (*Jerdon*); Ceylon (*Layard*); Darjeeling (*Tickell*); Assam (*H. brevirostris*, McClelland); Bootan (*Pemberton*); Sikim (*Blyth*); the whole of the Malay islands (*Wallace*).

The further limits of this species depend on the true value of *H. vanicorensis*, Quoy & Gaim., = *M. leucophæa*, Peale.

HIRUNDINAPUS, Hodgson.

55. HIRUNDINAPUS GIGANTEUS (V. Hasselt): Pl. Col. livr. xli. pl. 364, "Java" (27th August 1825).

Chatura gigantea, var. *celebensis*, Sclater, P. Z. S. 1865, p. 609, "Menado."

Hab. Java (*type*), Sumatra, Celebes (*Mus. Lugd.*); India (*Jerdon*); Ceylon (*Layard*).

Dr. Sclater (*l. c.*) points out differences which distinguish the Celebean *Hirundinapus* from typical Javan and Sumatran examples. As one of these distinctions he mentions "a well-marked narrow white patch on the front on each side of the nostrils." Dr. Sclater also alludes to the Celebean bird as "a very distinct form." The white frontal marks are also found in the Indian bird, while in a Penang specimen, along with other slight differential characters, Dr. Jerdon (B. of Ind. i. p. 173) found the white frontal patches wanting. This Penang individual thus agreed with the type as described by Temminck.

But it seems possible that the absence and presence of the white frontal spots only denote phases of plumage. If not, the Indian bird will belong to a different species, while the Celebean may be either the same as the Indian (in itself highly improbable), or represent a third form.

CAPRIMULGIDÆ.

LYNCORNIS, Gould.

56. *LYNCORNIS MACROPTERUS*, Bp. Consp. i. p. 62, "Celebes" (1850); Wallace, Ibis, 1860, p. 141.

Hab. Menado (*Wallace*).

BUCEROTIDÆ.

BUCEROS, Linnæus.

57. *BUCEROS EXARATUS*, "Reinw.," Temm. Nouv. Recueil, livr. xxxvi. pl. 211, ♀, "Celebes" (2nd August, 1823); Schlegel, Mus. Pays-Bas, *Buceros*, p. 10. (Pl. V. fig. 1, ♂; fig. 2, ♀.)

Hab. Tondano (*Forsten*); Menado (*mus. nostr.*); appears to be restricted to the north-eastern parts of Celebes.

The male is distinguished from the female by having the throat, cheeks, ear-coverts, sides of neck, and superciliary stripes springing from base of mandible white. In my examples the white supercilium has light ferruginous-brown feathers intermixed. In dimensions the female appears to be somewhat smaller. The example I note from is marked by the collector "female," while the entirely black individuals are marked "males." According to Professor Schlegel (*l. c.*) the subject of Temminck's plate was a female; and, together with Salomon Müller, he describes the male as having the throat and sides of the head white.

As this curious form does not belong to any of the established subdivisions of the family, I leave it for the present in the old Linnæan genus. It is certainly not a *Hydrocissa*, as classed by Prince Bonaparte. It belongs to the group of Hornbills, in which the casque and the true maxilla are completely blended together, the prolongation of the casque forming, in old birds, the apex of the maxilla.

CRANORRHINUS, Cabanis.

58. *CRANORRHINUS CASSIDIX* (Temm.), Pl. Col. 210, ♂, "Celebes" (2nd August, 1823). *Buceros cassidix*, Temm.; Schlegel & Müller, Verhandl. Zool. Aves, p. 24, pl. 4 bis, ♀; Schlegel, Mus. Pays-Bas, *Buceros*, p. 9; Wallace, Malay Archip. i. p. 364.

Hab. Tondano (*Reinwardt*); Menado (*mus. nostr.*); district of Maros, Macassar (*Wallace*).

The types of the two plates above cited came from Tondano. In the old males the

colouring of the neck is pale tawny, with scarcely any of the bright ferruginous tint exhibited by the younger birds. Thus the dark chestnut-brown feathers on the crown, occiput, and nape appear more isolated, the much paler hue of the neck-plumage forming a greater contrast. In other respects there are no characters whereby the younger may be distinguished from the older birds, save the somewhat smaller general dimensions, and the form, proportion, and adjuncts of the bill. After the full plumage has been acquired, the bill still passes through three very distinct stages of structure. In the younger (fig. 1) the casque looks more like an inflation of the

Fig. 1.

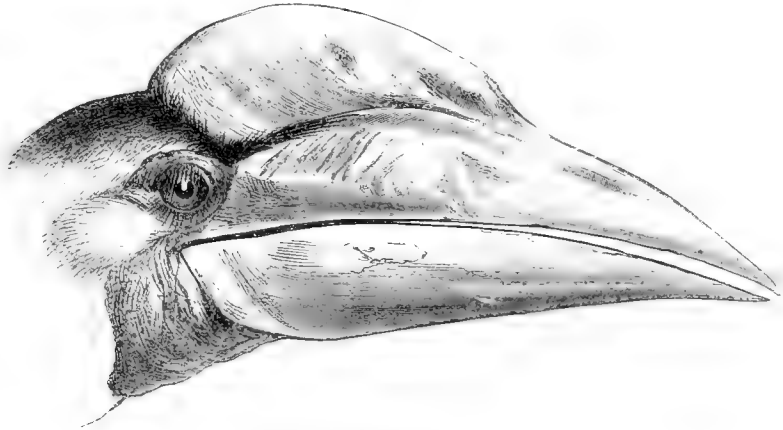
*Cranorrhinus cassidix*, ♂ juv.

Fig. 2.

*Cranorrhinus cassidix*, ♂ jun.

culmen than a separate part of the maxilla, so little is it detached. It is swollen posteriorly, and already reaches to above the eye. Anteriorly it falls rapidly towards

the culmen without exhibiting an erect edge. The cutting-edges of the mandibles are not broken or serrated. In the mature bird the bill measures two inches more than in the younger; yet in the younger bird the mandibles are as high, or are higher, throughout their length than in the fully adult; or, in other words, in the latter the bill

Fig. 3.

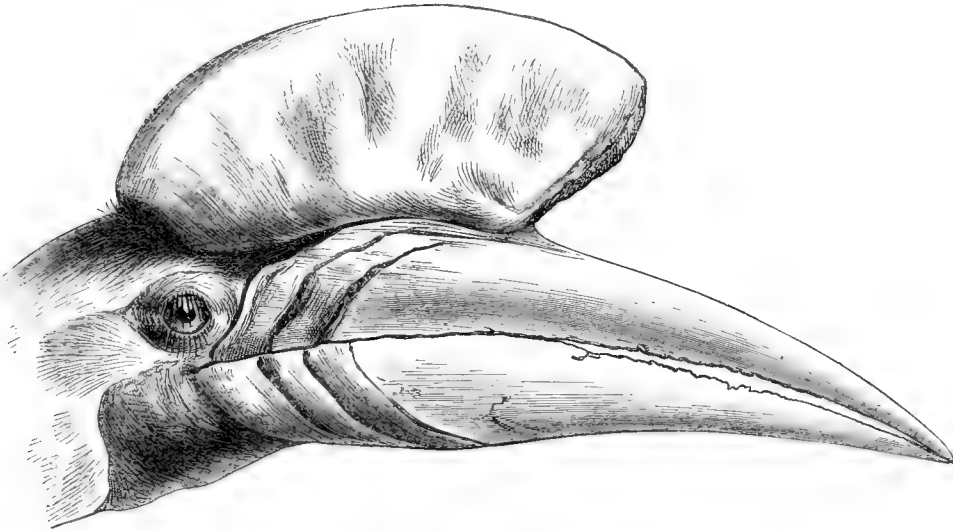
*Cranorrhinus cassidix*, ♂ ad.

Fig. 4.

*Cranorrhinus cassidix*, ♀.

is prolonged at the expense of its height. In this stage there are no traces of the basal lateral plates. The walls of the mandibles are quite smooth, without any indications

of lateral folds. But the position which is occupied by the lateral plates in older individuals is indicated by a dingy reddish brown colour.

In the next stage (fig. 2, p. 48) the bill measures about one inch longer, and has acquired the form which exists in the old bird; but the cutting-edges are unbroken. The casque is more inflated, appears more detached from the culmen, and reaches further back on the crown of the head. In front it stands up at a right angle to the culmen, and is much compressed. A thin, smooth plate has grown on the basal half of the two mandibles; but there are no traces of folds or grooves. The substance of these plates seems to be secreted from the walls of the mandibles.

In the fully adult bird (fig. 3, p. 49) the commissure is serrated, notched, and broken. The casque extends back past the line of the eye. Anteriorly it is less compressed than in the previous stages, although not so much swollen as the posterior portion. The anterior edge stands at an acute angle to the culmen. The casque displays five distinct folds or, rather, undulations. At the base of the mandibles the lateral plates are much thickened. On each side of the maxilla they are divided by a single, deep, diagonal groove into two equally broad flat folds. On the sides of the mandible there are two grooves thus forming three similar folds.

In the adult female (fig. 4, p. 49) the commissures are much broken and serrated. The casque is smaller, the anterior edge rising at a right angle to the culmen. It is also divided into five almost equal undulations or folds. The basal plates are divided both on the mandibula and maxilla into three broad flat bands. In a second example of a female (*mus. nostr.*) a third band has been partially arrested in its development, the groove being partly obliterated. While the female has certainly three flat bands at the base of both the mandibles, it will be interesting to know whether the male has never more than two at the base of the maxilla. In Temminck's plate (*l. c.*) the male is figured with only two; while in that given by Schlegel and S. Müller (*l. c.*) the female is figured with three both above and below. The following dimensions are taken from Menado examples in my collection. The bill is measured in a straight line from the gape to the apex.

Dimensions.

| | Wing. | Tail. | Bill. | Circumference of casque. | | Casque. |
|--------------------------|------------------|------------------|-----------------|--------------------------|-------------------|--------------------|
| | inches. | inches. | inches. | Outer. inches. | Inner. inches. | Height. inches. |
| Male, young | 16 $\frac{1}{2}$ | 11 $\frac{1}{4}$ | 6 $\frac{3}{4}$ | 5 $\frac{1}{2}$ | 4 | 1 $\frac{1}{2}$ |
| Male, intermediate | 17 $\frac{1}{4}$ | 14 | 7 $\frac{3}{4}$ | 5 $\frac{1}{2}$ | 3 $\frac{1}{4}$ | 2 $\frac{1}{4}$ |
| Male, adult | 17 $\frac{1}{4}$ | 14 | 8 $\frac{3}{4}$ | 7 $\frac{1}{2}$ | 3 $\frac{1}{4}$ | 3 $\frac{3}{4}$ |
| Female, adult | 15 | 12 | 7 $\frac{1}{4}$ | 5 | 3 $\frac{1}{4}$ | 2 |

It will be seen that the bill increases in length after the wings and tail have reached their maximum. The inner circumference of the casque is greater in the youngest than in the adult. The anterior part of the casque, at its union with the culmen,

appears to become absorbed, and to retreat as the bird increases in age; or, as the anterior edge becomes more and more perpendicular to the culmen, it perhaps wears off, or is broken off. This can be traced in one example—the indent or hollow from which the fore part of the casque sprung, and in which it was attached to the culmen, a groove shaped like a V, three quarters of an inch long, not being filled up.

Buceros sulcatus, Temm., from the Philippines, and *B. corrugatus*, Temm., from Borneo, belong to the same genus.

CUCULIDÆ.

SCYTHROPINÆ.

SCYTHROPS, Latham.

59. SCYTHROPS NOVÆ-HOLLANDIÆ, Lath. Ind. Orn. i. p. 141, "Nova Hollandia" (1790); Schlegel, Mus. Pays-Bas, *Cuculi*, p. 36; Temm. Pl. Col. 290.

Cuculus præragus, Reinw. MS., ex Celebes.

Hab. Menado, Macassar (*mus. nostr.*); Kema (*Forsten*); Ceram, north coast (*Mus. Lugl.*); Ceram, south coast, adult males, April (*Hoedt*); Obi-major, adult male, 29th of June, Batchian, adult male and female, end of June, a male, 8th of September (*Bernstein*); Flores (*Wallace*); New South Wales, between October and January (*Gould*); Cape York (*mus. nostr.*).

Two individuals from the vicinity of Menado are, in their colouring and markings, almost identical with an example from Cape York. The dimensions of the wing and tail also agree. But the bill of the Menado male, measured from the nostril, is full two inches and three quarters in length, and that of the female two and five eighths, whereas that of the Cape-York bird is only two inches and a quarter. In form the bill of the Celebean bird differs from that of the Cape-York example. In the latter the culmen is rounded, smooth, and broad, and there is only one lateral channel or groove present. This starts from above the nostril, and runs in a line more or less parallel with the culmen. In the Menado male the culmen, on leaving the forehead, forms a distinct narrow ridge; on each side of it is a depression or shallow valley, formed and bounded by a second ridge, below which again is the channel observable in the Cape-York bird. In the bill of the Menado female the culmen is sharper and still more clearly defined; and the lateral channels, while being deeper, are prolonged nearly to the apex of the maxilla¹. The type of structure is essentially that of the bill in some species of the Bucerotidæ.

We know nothing of this form out of Australia. In that country it is migratory. Its geographical distribution in the archipelago, as at present known, is anomalous; for it occurs in Flores, and is not recorded from Lombock or Timor. It has been found in Batchian, but not in Gilolo; in Ceram, but not in Bourou.

¹ A Macassar example, since obtained, presents a similar structure.

PHÆNICOPHAINÆ.

PHÆNICOPHÆS, Vieillot.

60. PHÆNICOPHÆS CALORHYNCHUS (Temm.), Nouv. Rec. livr. lix. pl. 349, "Celebes" (25th of June 1825); Wallace, Malay Archip. ii. p. 340.

Le Malcoha à bec peint, Less. Complém. de Buffon, ii. p. 618, pl. —. fig. 1.

Hab. Gorontalo (*Forsten*); Menado, Macassar (*mus. nostr.*).

MM. Verreaux proposed (*Rev. & Mag. Zool.* 1855, p. 356) to restrict Vieillot's generic title *Phœnicophaës* to a small group consisting of this species, of *P. curvirostris*, Shaw, *P. erythrognathus*, Temm., and a fourth species, *P. æneicaudus*, Verr., not since obtained. And they suggested a new generic title, *Alectorops*, for the reception of *Cuculus pyrrhocephalus*, Forster. But, as Forster's Ceylon Malkoha is the type of *Phœnicophaës*, this arrangement cannot be recognized.

Dr. Cabanis (*Mus. Hein.* iv. p. 85), concurring in the propriety of separating the Ceylon species from the others, retained it, Vieillot's type species, in *Phœnicophaës*, and proposed *Rhamphocoeyx* for the small Indo-Malayan group. The grounds for this separation are the great extent of naked space surrounding the eye, the abnormal colouring of the plumage, the form of the bill, and the position and shape of the nostrils in *P. pyrrhocephalus*. The naked space is certainly more extended than in *P. curvirostris* or *P. erythrognathus*; but then *P. calorhynchus* has the ophthalmic region almost entirely clothed. The colouring of the plumage differs principally in that white replaces the rufous of *P. curvirostris* and *P. erythrognathus*, thus evincing an affinity to *Rhopodytes*, Cab. (*Zanclotomus* of Indian authors, but not of Swainson). The tail is tipped with white instead of rufous; but the upper plumage in all three is green. In *P. calorhynchus* green is entirely absent, and the tail is uniform in colour. In colouring *P. calorhynchus* is as much an isolated species as *P. pyrrhocephalus*. The form of the bill in all four species is very similar; but the position and shape of the nostrils is different in each of the four. The nostril of *P. pyrrhocephalus* (fig. 8) is placed in a narrow, depressed, lengthened, oval slit, which runs almost parallel with the commissure, yet slightly descending. Its situation is almost on the edge of the commissure, and at an unusual distance from the base of the maxilla. In *P. curvirostris* (Shaw) (fig. 6) the nostrils are set at the commencement of a deep narrow groove or channel. In *P. erythrognathus*, Bp.¹ (fig. 7), the nostril is a simple round hole. The nostril of *P. calorhynchus* (fig. 5) is an elongated slit, like that of *P. pyrrhocephalus*, but running quite parallel with the commissure, and not so near its edge; nor is it as advanced from the base of the maxilla. The position and shape of the nostrils in these four species is so peculiar and distinctive, that the species could be determined from a fragment of the maxilla alone. The striking difference in the shape of the nasal opening of the Javan *P. curvirostris* and Sumatran, Moluccan, and Bornean *P. erythrognathus* (forms which

¹ *Consp.* i. p. 98.

are otherwise difficult to recognize as distinct species) is very remarkable. The four species form a natural group which cannot be consistently subdivided, unless *P. calorhynchus* be also made the type of a separate genus. Within the limits of *Phœnicophaës* I am also inclined to include *Melias diardi*, Less., and also *Cuculus sumatranus*, Raffles

Fig. 5.



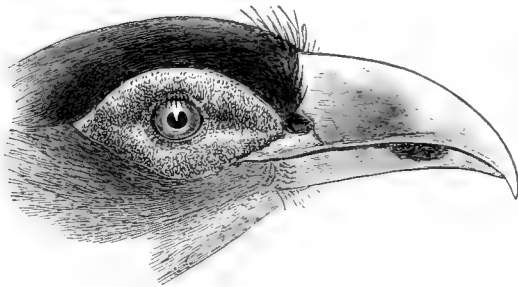
Phœnicophaës calorhynchus.

Fig. 6.



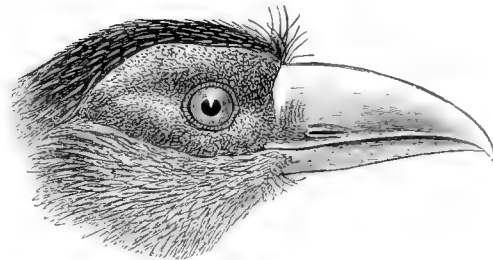
Phœnicophaës curvirostris.

Fig. 7.



Phœnicophaës erythrognathus.

Fig. 8.



Phœnicophaës pyrrocephalus.

CUCULINÆ.

EUDYNAMIS, Vigors & Horsfield.

61. EUDYNAMIS MELANORHYNCHA, S. Müller, Verhandl. p. 176 ; Schlegel, Mus. Pays-Bas, *Cuculi*, p. 20 ; Walden, Ibis, 1869, p. 344.

Hab. Kema, Tondano, Gorontalo (*Forsten*); Menado (*mus. nostr.*).

CACOMANTIS, S. Müller.

62. CACOMANTIS LANCEOLATUS, S. Müller, Verhandl. p. 178.

Hab. Macassar (*Wallace, mus. nostr.*); Java (*type*).

The synonymy of the species usually comprised in *Cacomantis*, S. Müller, is still so entangled, that a few general remarks on the Plaintive Cuckoos of the Indian and Australian regions are necessary to enable us to establish the identity of the Celebean member of the genus.

In India there are two species: 1, *C. passerinus* (Vahl), without any rufous in the adult plumage; 2, *C. tenuirostris* (Gray, apud Jerdon), with a rufous belly. Both pass through an hepatic phase. *C. passerinus* (Vahl) chiefly inhabits western and south-western India and Ceylon; *C. tenuirostris*, Gray, ap. Jerdon, frequents Bengal and the countries to the eastward, including Burma. In Bengal the two species are said to meet and interbreed. *C. passerinus* (Vahl) has no representative; but *C. tenuirostris*, Gray, ap. Jerdon, is represented in the Malay peninsula by *C. threnodes*, Cab.; in Borneo by *C. borneensis*, Bp.; in the Philippines by *C. merulinus* (Scopoli) *verus*; and in Java by *Cuculus flavus*, Gm., apud Horsf., S. Müller, &c., = *Cacomantis merulinus*, Scop., ap. Cab., and *Polyphasia merulina*, Scop., ap. Horsf. & Moore. The Javan bird, in the hepatic stage, is probably the *C. lanceolatus*, S. Müller. When fully adult it has the head, nape, throat, and breast pale ashy; the remaining lower parts fulvous, more or less inclining to rufous; the caudal bands are white; and the quills unicolorous. In the young and in the transition stage these bands, which are broad, equidistant, and unbroken, are rufous, and the quills are either all or partly rufous-banded. This description will apply more or less to all the races above alluded to.

C. sepulchralis, S. Müller, is the title of a third very distinct species, which inhabits Java. When adult it may be at once recognized from *C. merulinus* of Java by its longer bill, and from all the races of that species by its much longer wings and tail, by the chin, cheeks, and ear-coverts *only* being pale ashy, the head dark grey, the upper surface bronze-green, and by the whole under surface, the chin excepted, being ruddy fulvous. The white markings on the rectrices are fewer, smaller, and chiefly consist of triangular edge-spots, and not of bands running right through. In transition plumage this is in all probability the *C. pyrogaster*, Drapiez. *C. sepulchralis*, S. Müller, belongs to the group which includes *C. flabelliformis*, Lath., *C. dumetorum*, Gould, and *C. insperatus*, Gould, from Australia, also several races of small Cuckoos of the Austro-Malayan archipelago, as *C. assimilis*, G. R. Gray, Aru Islands, *C. infaustus*, Cabanis, Mysol, and some undetermined species in Goram, Batchian, Morty, and Salawati, likewise *C. simus*, Peale, Feejee Islands, *C. castaneiventris*, Gould, Cape York, and *C. bronzinus*, G. R. Gray, in New Caledonia. No member of this group has been identified as inhabiting Continental Asia; yet the Bengal specimen, stated by Dr. Jerdon (B. of Ind. i. p. 335) to have the rufous extending to the chin, may belong to it.

A fourth group of Plaintive Cuckoos is represented by *C. tymbonomus*, S. Müller, from Timor; to it belongs the *C. pallidus* (Lath.) of Australia, and an undetermined species from Waigiou. In *C. tymbonomus* the upper surface is pale olive-brown, inclining to ashy on the head and rump; the under surface is paler and more cinereous; under tail-coverts tawny, or pallid rufous; middle pair of rectrices immaculate, but broadly tipped with brown; the remainder tipped with white, and partially toothed on the inner webs with white. This species and its allies also pass through a rufous phase.

C. sonnerati, Lath., founded on Sonnerat's *Petit coucou des Indes* (Voy. Indes, ii. p. 211), from its being more or less rufous at all ages, and a small species, has been often confounded with either one or other of the foregoing. Its Javan representative, but slightly differing, is the *C. pravatus*, Horsf., = *C. fasciolatus*, S. Müller, = *C. rufovittatus*, Drapiez. The group is also represented in Sumatra, Malacca, Borneo, and Ceylon. This form, raised to generic rank by Dr. Cabanis (*Penthoceryx*), has the bill long, broad at the base, and uncompressed throughout its entire length, the maxilla overlapping the mandibula. In old birds the rufous and dark brown bands of the upper plumage are washed with bronze-green. From the chin to the under tail-coverts each feather is white, traversed by usually three narrow, dusky, irregular lines; the white interspaces being three or four times as broad as the dusky lines. A uniform transverse striated appearance is thus imparted to the under plumage, never found in any other group of the small Asiatic Cuckoos. The middle pair of rectrices are, according to age, either almost entirely dark brown with a bronzy gloss, or else have both sides of the shaft dark brown, indented with bright rufous. The lateral rectrices are never evenly barred through, are always bright rufous with dark cross marks, have a white or else a pale fulvous terminal spot and a penultimate broad dark brown band. Many of the frontal plumes are white at their base and in the centre—a character alone sufficient to distinguish this group from any of the Plaintive Cuckoos in hepatic plumage.

C. infuscatus, Hartl., is either another type of the Plaintive Cuckoos, or else it belongs to the same subsection of *C. passerinus*; or it may prove to be only a phase of *C. simus*.

A Macassar specimen, collected by Mr. Wallace, appears to belong to the group of which *C. merulinus* is typical. It has six of the secondary quills with rufous bars, part of the unmoulted hepatic dress; otherwise it is undistinguishable from Javan examples of *C. lanceolatus*. The lateral rectrices are, as in that species, broadly barred with pure white. It is, however, a larger bird, with wings and tail somewhat longer. Wing $4\frac{1}{8}$, tail $4\frac{6}{8}$.

CENTROPODINÆ.

PYRRHOCENTOR, Cabanis.

63. PYRRHOCENTOR CELEBENSIS (Quoy & Gaimard), Voy. Astrol. Zool. i. p. 230, pl. 20, "Menado" (1830).

Centropus bicolor, Cuvier, Mus. Paris, *vide* Pucheran, Rev. et Mag. Zool. 1852, p. 472; Lesson, Tr. p. 137 (1831).

Hab. Menado (*mus. nostr.*); Gorontalo (*Forsten*).

I cannot find that Cuvier ever published his title of *C. bicolor*. A second species of this subsection inhabits the Philippines (*P. univirufus*, Cab.). But it is not unlikely that

Cabanis's species is the same as *C. melanops*, Less. ex Cuv., said to have been obtained by the Paris Museum from Java (*conf.* Pucheran, *op. cit.* p. 473). *C. melanops* is certainly not a Javan bird; and though Professor Schlegel has identified it with *C. rufipennis*, Illiger, it belongs to a different group of Coucals. Notwithstanding the opinion of the learned Professor, of Prince Bonaparte, who made it equal to *C. medius*, Müller, and Dr. Cabanis, Mr. Cassin appears to have correctly identified it with *C. nigrifrons*, Peale. *C. ateralbus*, Less., ex New Ireland, is a closely allied form.

In *P. celebensis*, the fully adult bird loses the bright yellow-rufous chin-, throat-, neck-, and breast-plumage of the younger bird. These parts become very pale fulvous, and contrast with the dark chestnut of the remaining lower region. In this state Cuvier's title of *bicolor* is applicable. The young bird is bright rufous throughout; and, judging by analogy, the Philippine *P. unirufus*, Cab., is the young bird of *C. melanops*, Less., = *C. nigrifrons*, Peale.

CENTROCOCCYX, Cabanis.

64. *CENTROCOCCYX AFFINIS* (Horsf.), Trans. Linn. Soc. xiii. p. 180, "Java" (1821).

Centropus medius, Bernst. Nat. Tijdschr. Ned. Ind. xxi. p. 27; J. für Orn. 1860, p. 269.

— *rectunguis*, Strickl., ap. Schlegel, Mus. Pays-Bas, *Cuculi*, p. 69.

Hab. Macassar (*mus. nostr.*); Java (*mus. nostr.*).

The red-and-black Coucals of the Indian region form a natural and well-defined group; and I concur with Dr. Cabanis in the propriety of separating them from the African genus *Centropus*. Notwithstanding the labours of Dr. Cabanis and Professor Schlegel, the species are far from being clearly established. Examples of two species from Celebes are in my collection, and would, were I to follow Professor Schlegel, be referable to *C. rectunguis*, Strickl., a title made by the learned Professor to include most of the smaller Asiatic Coucals and even an African species. An examination of a considerable series of this group has led me to conclusions widely differing from those contained in the Catalogue of the Leyden Museum.

The difficulties which meet a student of the genus *Centrococcyx* arise from the general resemblance in the plumage of its members, the blue, the green, or the purple hue of the black portion, and the deeper or less intense shades of the rufous not being sufficiently striking and well marked, except in perfect plumage, to be relied on as distinguishing characters. We also find in the Coucals, as in other natural groups the members of which are numerous, the colouring of the adult in one species representing, more or less, the transition colouring of the young of another species. Thus the dingy greenish brown hue of the rectrices in an immature *C. rectunguis* changes to glossy dark green in the next stage, and is again converted into deep blue in the adult bird. But in the common Indian Crow-Pheasant the colour of the rectrices is arrested at the green stage, and green remains the hue of that part of the plumage in the fully adult bird. A complete series of fully adult examples from all parts is consequently essential

before characters founded on the colouring can be relied on. Another source of difficulty is the extreme variability of the plumage in the first and second years, the young wearing a livery greatly resembling in general characters the adult garb of Australian *C. phasianus* and its allies. It is likely that this variability is more apparent than real, and that each species, as in *Eudynamis* for instance, has special phases of immature plumage peculiar to itself. Happily certain characters are always present whereby typical specific groups can be separated from one another. The most important are the dimensions and the form of the bill. Three distinct groups of Asiatic Coucals can thus be separated; and as Java is the only known locality where all three are represented, we may use the Javan species as standards:—

First, *C. bubutus*, Horsf., as the type of the large species, such as:—*C. sinensis*, Stephens, ex China; *C. rufipennis*, Illiger, India and Ceylon; *C. eurycercus*, A. Hay, Malacca; *C. borneensis*, Bp., Borneo; and the very distinct *C. chlororhynchus*, Blyth, ex Ceylon. This group appears to be unrepresented in Celebes; nor has it been discovered in the Philippines or in Formosa.

The second group comprises species smaller in size, with short, but proportionally very high bills, the diminished length of the bill making it appear disproportionately broad at the base. The Javan representative is *C. affinis*, Horsf. An identical form inhabits Flores; and a somewhat larger species is found in Ceram, which, if the same as the Amboyna *Centrococcyx*, must stand as *C. medius*, Bp., ex Müller. A Macassar individual, collected by Mr. Wallace, although in young plumage, bill pale flesh-colour, and plumage streaked and mottled, so closely resembles Javan *C. affinis* in dimensions and form of the bill, that I cannot separate it.

The third group consists of the smallest species, represented in Java by *C. javanensis*, Dumont, = *C. lepidus*, Horsf. In these the bill is a miniature resemblance of that of the second group. The upper tail-coverts are highly developed, or, in other words, they are the tail-coverts of the *C. affinis* group. *C. bengalensis*, Gm., of India; *C. viridis*, Scop., of the Philippines; *C. moluccensis*, Cab., ex Bernst., of Ternate, very near to *C. javanensis*, but with a proportionately longer tail; and *C. dimidiatus*, Blyth, = *C. lignator*, Swinh., of Formosa and China, come within these limits. Malaccan and Banjar-massing individuals scarcely differ from the Javan species; and judging from the measurements given by Professor Schlegel, representatives occur in Ceram, Sambawa, Bangka, Sumatra, and Amboyna.

A Celebean example of a young bird, with a pale bill and buff-streaked plumage, offers no distinctive characters, either in its proportional dimensions or in the form of the bill, whereby it can be separated from *C. javanensis*. Yet it must be recollected that the adult bird may present characters more than enough to stamp it as distinct. *C. rectunguis*, Strickland, a perfectly distinct species, as yet only known from Malacca, is a miniature *C. rufipennis*. By its external structure it belongs to the first group. The bill is long and much compressed. The wings are short and much rounded, the

seventh quill, if any thing, the longest. The claw of the hallux is short, and therefore appears straight; in character, it is the claw of the large species, shortened in proportion to the size of the bird. In the second and third groups the hind claws are not proportionately diminished, and therefore appear disproportionate when compared with those of the large species. The upper surface of the tail is a deep, rich, almost purple blue. The nape is glossy violet-blue, contrasting with the duller green-black of the head. The adolescent plumage possesses characters peculiar to the species. From this it will be seen that it has no characters in common with the members of the second and third groups. It does not appear to be contained in the Leyden Museum.

The following is a synopsis of the smaller Asiatic Coucals, together with the dimensions of the individuals I have had access to. *Cuculus tolu*, Gm., ex Madagascar, seems to belong to the Asiatic and not to the African section of *Centropodinae*.

A.

1. *Centrococcyx affinis* (Horsf.), Trans. Linn. Soc. xiii. p. 180, "Java" (1821).

Cuculus tolu, Gm., ap. Raffles, Trans. Linn. Soc. xiii. p. 285, is either the Sumatran form of this species or else of *C. javanensis*.

Hab. Java, Sumatra (?), Celebes, Flores.

2. *Centrococcyx medius* (Bp.), ex Müller, Consp. i. p. 108, "Amboyna" (1850).

Professor Schlegel applies this title to the Amboyna species. Prince Bonaparte includes the Javan form.

Hab. Amboyna, Ceram.

B.

1. *Centrococcyx javanensis* (Dumont de Ste. Croix): Dict. Sc. Nat. xi. p. 144, "Java" (1818).

Centropus lepidus, Horsf. Trans. Linn. Soc. xiii. p. 180, "Java" (1821).

Centropus pumilus, Less. Traité, p. 136, "Java" (1831).

Lesson described partly from the example on which Dumont founded the title of *javanensis*. My Bornean example is smaller than Javan individuals.

Hab. Java, Malacca, Banjermassing, Celebes.

2. *Centrococcyx viridis* (Scop.), Del. Fl. Faun. Insub. ii. p. 89 (1786), "Philippines," ex Sonn.

Centropus philippensis, Cuv. R. An. i. p. 426 (1817), ex Pl. Enl. 824, "Philippines."

Corydonix pyrrhopterus, Vieill. Enc. Method. iii. p. 1353, ex Pl. Enl. 824, "Philippines" (1823).

Centropus molkenboeri, Bp. Consp. i. p. 108, descr. orig. (1850), "Philippines."

In the first edition of the Règn. An., Cuvier erroneously quotes Pl. Enl. 884. In the edition of 1829 this error is corrected. Vieillot founded his species on Pl. Enl. 225—also

an obvious error. I am not acquainted with this species. It is admitted as perfectly distinct by Professor Schlegel.

Hab. Philippines.

3. *Centrococcyx moluccensis*, Cab., ex Bernst. Mus. Hein. iv. p. 113 (1862), "Tinor" (Timor?).

The types of Bernstein's MS. title *moluccensis*, in the Berlin Museum, were from Ternate. Is Tinor a misprint for Timor or Tidore?

Hab. Ternate.

4. *Centrococcyx bengalensis* (Gm.), Syst. Nat. ed. 13, i. p. 112 (1788), "Bengal," ex Brown, pl. 13.

Corydonix maculatus, Vieill. Enc. Meth. iii. p. 1353 (1823), ex Brown, pl. 13.

Centropus pygmaeus, Hodgs. Gray's Zool. Misc. p. 85 (1844), "Nipaul."

Centropus viridis, Scop., ap. Blyth, Jerdon, Horsf. & Moore, and Swinhoe.

The following titles are usually associated with this species:—*Polophilus lathami*, Leach, Zool. Misc. pl. 56, described from a British Museum specimen; locality unknown. The species is undeterminable, Leach's plate and description being insufficient.

Centropus rufinus, Cuv. R. An. (1817), p. 426, and *Polophilus rufus*, Stephens, Gen. Zool. *Aves*, ix. p. 44 (1815), titles founded on Levaillant's 221st plate (Ois. d'Afr.), would take precedence of *C. affinis*, Horsf., if, as suggested by Professor Sundevall, Levaillant figures the Javan bird (Krit. Framst. p. 48). Dr. Cabanis deems it more probable that the "Lesser Indian Coucal" formed the subject of Levaillant's plate. From the figure it is impossible to decide which of these two opinions is correct; while Levaillant's mendacious account only tends to mislead us.

Hab. Bengal, Mysore, Central India, Burma.

5. *Centrococcyx dimidiatus* (Blyth), J. A. S. B. 1842, p. 945, "Chusan."

Centropus lignator, Swinhoe, Ibis, 1861, p. 48, ex Formosa, Amoy, Hong Kong.

Centropus viridis (Scop.), ap. Swinhoe, P. Z. S. 1863, p. 266, "South China, Formosa;" Ibis, 1870, p. 235, "Hainan."

It is not as yet satisfactorily determined whether the Chinese Lesser Coucal is a distinct species—and if not, whether it is the same as *C. viridis* (Scop.) or *C. bengalensis* (Gm.).

Hab. South China, Hainan, Formosa (*Swinhoe*).

Dimensions.

| | Wing. | Tail. | Tarsus. | Bill. | Claw. | |
|--|---------|---------|---------|---------|---------|---|
| | inches. | inches. | inches. | inch. | inch. | |
| <i>C. affinis</i> , <i>Horsf.</i> | 7·000 | 9·750 | 1·8750 | 0·6825 | 1·125 | Java. Not quite adult. |
| ” ” | 6·875 | 9·375 | 1·7500 | 0·6250 | 1·250 | Macassar. ♀ young. |
| ” ” | 6·750 | 9·625 | 1·7500 | 0·6825 | 1·125 | Flores. Moulting into adult plumage. |
| <i>C. medius</i> , <i>Bp.</i> , ex Müll. | 7·875 | 10·000 | 2·1250 | 0·7500 | 1·375 | North Ceram. ♀ adult. |
| <i>C. javanensis</i> , <i>Dumont</i> | 6·250 | 7·875 | 1·5000 | 0·6250 | · . . . | Java. Not quite adult; claw broken. |
| ” ” | 5·875 | 7·250 | 1·5000 | 0·6250 | · . . . | Banjarmassing. Adult; hind claw broken. |
| ” ” | 5·375 | 6·875 | 1·5625 | 0·5625 | 0·875 | Penang. Very young. |
| ” ” | 6·125 | 8·375 | 1·7500 | 0·6250 | 1·125 | Malacca. Adult. |
| ” ” | 6·000 | 8·625 | 1·5625 | 0·6250 | 1·125 | Macassar. Young. |
| ? <i>C. moluccensis</i> , <i>Cab.</i> | 6·125 | 9·000 | 1·6250 | 0·6250 | 1·000 | Timor. Moulting into adult plumage. |
| <i>C. bengalensis</i> , <i>Gm.</i> | 6·500 | 8·000 | 1·2500 | · . . . | 1·000 | Jerd. Birds of Ind. i. p. 351. |
| <i>C. rectunguis</i> , <i>Stricke.</i> | 6·375 | 9·000 | 1·7500 | 1·0000 | 0·625 | Malacca. Adult. |
| ” ” | 5·875 | 8·375 | 1·7500 | 0·9375 | 0·625 | Malacca. Young. |

65. *CENTROCOCYX JAVANENSIS* (Dumont de Ste. Croix), Dict. Sc. Nat. xi. p. 144 (1818),
“Java.”

Centropus lepidus, Horsf. Trans. Linn. Soc. xiii. p. 180 (1821), “Java.”

Centropus pumilus, Less. Traité, p. 136 (1831), “Java;” Pucheran, Rev. Mag. Zool. 1853, p. 56.

Centropus affinis, Horsf., ap. Bernst. Nat. Tijdschr. Ned. Ind. xxi. p. 27; J. für Orn. 1859. p. 185,
1860, p. 269.

Hab. Macassar, Java, Malacca, Banjarmassing (*mus. nostr.*).

An interesting account of the habits and nesting of this species in Java, and of the peculiar structure of its spinal column, has been given by Bernstein (*J. für O. l. c.*); also detailed observations on parts of its internal anatomy, and of that of *C. affinis* (Horsf.), by the same author, in the Tijdschrift (*l. c.*). The skeleton of the Celebean bird will have to be compared with that of the Javan before the absolute identity of the two species can be established.

PASSERES.

ORIOOLIDÆ.

BRODERIPUS, Bonaparte.

66. *BRODERIPUS CORONATUS* (Swains.): An. in Menager. p. 342 (1837), “Java.”

Oriolus horsfieldii, Bp. Consp. p. 348 (1850), “Java.”

Oriolus galbula, ap. Horsf. Trans. Linn. Soc. viii. p. 152, “Java.”

Oriolus hippocrepis, Wagler, part., Syst. Av. *Oriolus* (1827).

Oriolus indicus, Schlegel, Mus. Pays-Bas., *Coraces*, p. 102.

Hab. Java (*mus. nostr.*); Macassar, Menado (*Wallace*); Bougka, Gorontalo (*Von Rosenberg*).

I have compared two Macassar male examples collected by Mr. Wallace with a large series of Javan individuals, and have failed in detecting any valid specific differences. The black-naped Orioles, before attaining their full plumage, pass through a stage wherein the two centre rectrices retain the olive-green hue found in younger birds, while they have already put on the black feathers which surround the head, and the full bright adult yellow plumage of the entire under surface, the crown, the neck, and the rump, the plumage of the back alone showing immaturity by traces, more or less, of dingy greenish-yellow. It would seem that the central pair of olive-coloured rectrices are not moulted and replaced by a pair of new black feathers, but rather that the olive-green hue changes gradually into black, commencing from near the tips, which are pure yellow at the earliest stage, and thence passing upwards. In adult Javan examples the lesser wing-coverts are tipped with yellow, thus forming a conspicuous yellow speculum. But in Javan examples in the stage of plumage above described, these yellow tips are frequently absent, or only commencing to be developed. The two Macassar examples are in the intermediate stage of plumage described above: one has no yellow tips to the lesser wing-coverts; in the other they are just appearing. Whether in perfect plumage the yellow alar bar is wanting, as in the *Sula B. frontalis*, has yet to be ascertained. In the mean time I shall retain the Macassar Oriole under the title of the Javan bird. The Macassar species is somewhat larger. Wing $5\frac{6}{8}$, tail $4\frac{4}{8}$, bill $\frac{7}{8}$.

The only Menado example I have been able to examine is in the intermediate stage of plumage, with green middle rectrices and no alar bar. It differs in that the black coronal ring does not unite at the nape, the yellow of the crown being thus confluent with that of the nape. As indications of the complete black circle in *Broderipus* appear in the earliest stages of plumage, this break in the coronal ring cannot be a sign of nonage. The dimensions differ from those of the southern form. Wing $5\frac{2}{8}$, tail $4\frac{5}{8}$, bill $\frac{7}{8}$. It possibly represents a distinct species.

TURDIDÆ.

GEOCICHLA, Kuhl.

67. *GEOCICHLA ERYTHRONOTA*, Sclater, Ibis, i. p. 113, "Macassar" (1859). (Pl. VI. fig. 2.)

Hab. Macassar (*Wallace*).

This species and *G. interpres* (Kuhl) form a section of the genus which perhaps deserves a subgeneric title.

Turdus avensis, J. E. Gray, Griffith, Anim. Kingd. Birds, i. p. 530, pl. —, named from an Indian drawing, is either *G. interpres* or else an unknown Burmese representative form.

TIMALIIDÆ.

TRICHOSTOMA, Blyth.

68. TRICHOSTOMA CELEBENSE, Strickland, Contr. Ornith. 1849, p. 128, pl. —, "Celebes."

Hab. Macassar (*Wallace*).

A species of the above genus, collected by Mr. Wallace, is referred, with some doubt, to the bird figured and described by the late Mr. Strickland. The chin and throat are white; the rest of the under surface is washed with pale ferruginous faintly tinged with brown. The upper plumage and wings are dark olive-brown, the loose plumes of the lower back being tinged with rusty, and the upper tail-coverts being distinctly rust-coloured. The outer edges of the rectrices are rusty brown. Loes and cheeks dingy white. Wing $2\frac{7}{8}$, tail $2\frac{3}{8}$, tarsus 1.

While evidently belonging to the genus *Trichostoma*, this species differs structurally from *T. bicolor* (Lesson) of Sumatra and Malacca, by having the rictal bristles but slightly developed and the tail proportionally short.

PITTIDÆ.

MELANOPITTA, Bonaparte.

69. MELANOPITTA FORSTENI (Bp.), Consp. i. p. 256, "Celebes" (1850).

Pitta melanocephala, Forsten (nec Wagler), Schlegel & S. Müller, Verhandl. Zool. Aves, p. 19, "Tondano;" Westerman, Bijdr. i. pt. 6. p. 46, pl. 2; Schlegel, Vog. Ned. Ind. *Pitta*, p. 5, pl. 2. f. 1.

Brachyurus forsteni, Bp. Elliot, Monogr. p. 83, pl. 24; Wallace, Ibis, 1864, p. 106.

Hab. Kema, Tondano (*Forsten*).

ERYTHROPITTA, Bonaparte.

70. ERYTHROPITTA CELEBENSIS (Forsten), Schlegel & S. Müller, Verhandl. Zool. Aves, p. 18, "Tondano;" Westerman, Bijdr. i. p. 6. p. 46, pl. 3; Schlegel, Vog. Ned. Ind. *Pitta*, p. 17, pl. 4. fig. 4; Wallace, Ibis, 1864, p. 106.

Brachyurus celebensis (Forst.), Elliot, Monogr. p. 67, pl. 17.

Hab. North Celebes (*Forsten*).

This species was found to be scarce by Mr. Wallace (Ibis, 1860, p. 142). When remarking that three species of *Pitta* inhabited Celebes, Mr. Wallace (*l. c.*) was probably misled by Bonaparte's Conspectus, wherein *P. mülleri*, Bp., is stated to be from Celebes instead of Borneo.

SAXICOLIDÆ.

MONTICOLA, Boie.

71. MONTICOLA SOLITARIA (P. L. S. Müller), Syst. Nat. Suppl. p. 142. no. 46 (1776), ex Buffon, Pl. Enl. 564. f. 2.

Le Merle solitaire de Manille, Montb. Hist. Nat. Ois. iii. p. 363. no. 1, descr. orig. ex Sonnerat; Pl. Enl. 636, ♂; 564, f. 2, ♂ vel ♀ adolesec.

Turdus manilla, Boddaert, Tab. Pl. Enl. 636 (1783).

Merula solitaria philippensis, Briss. Orn. ii. p. 272, no. 32, "Ins. Philipp." descr. orig. ex Poivre (avis juv?).

Le Merle solitaire des Philippines, Montb. op. cit. p. 364, no. 2; Pl. Enl. 339, ex Brisson, no. 32¹.

Turdus philippensis, P. L. S. Müller, op. cit. p. 145. no. 59, ex Buffon, Pl. Enl. 339 (1776).

Turdus philippensis, Bodd. op. cit., ex Buffon, Pl. Enl. 339 (1783).

Turdus eremita, Gm. Syst. Nat. 13th ed. i. p. 833 (1788), ex Brisson, no. 32.

Merula solitaria manillensis, Brisson, op. cit. p. 270. no. 31, "Manilla," descr. orig.

Turdus manillensis, Gm. op. cit. p. 833 (1788), ex Brisson, no. 31.

Turdus manillensis, auct.; Schlegel, Faun. Jap. *Aves*, p. 67.

Hab. North Celebes (*Forsten*); Philippines (*type*); China, Formosa, Japan (*Swinhoe*).

There seems little doubt that the *Merle solitaire de Manille* and the *Merle solitaire des Philippines* of Montbeillard are the same species in different phases of plumage. This was Montbeillard's own opinion (*op. cit.* p. 365). The most recent authors, however, have continued to treat them as distinct.

PRATINCOLA, Koch.

72. PRATINCOLA CAPRATA (Linn.), Syst. Nat. ed. 12, i. p. 335. no. 33, "Luzon" (1766), ex Brisson, Orn. iii. p. 440.

Hab. Macassar (*Wallace*); Philippines (*mus. nostr.*); common all over India (*Jerdon*); Tongoo (*mus. nostr.*); Aracan (*Blyth*); Java (*Horsfield*); Nipaul (*Hodgson*); Moulmein, Lombock, Timor, Flores (*mus. nostr.*); Simla (*Beavan*); Coorg, Candeish (*mus. nostr.*).

An example of a young male individual of this species was collected by Mr. Wallace at Macassar. It in no way differs from Philippine specimens in my collection.

Examples from the localities above cited agree well in their dimensions. Those from Candeish are larger, but not so large as the Ceylon *P. atrata*, Blyth.

¹ Montbeillard's account contains internal evidence sufficient to prove that it was compiled from Brisson's description. The plate (339) appears also to have been drawn from Brisson's description only. This will explain the unnatural colouring of the head.

SYLVIIDÆ.

ACROCEPHALUS, Naumann.

73. ACROCEPHALUS ORIENTALIS (Bp.), *Consp. i. p. 285 (1850), ex Schlegel.*

Salicaria turdina orientalis, Schlegel, *Faun. Jap. Aves*, p. 50, pl. 21, "Japan."

Acrocephalus magnirostris, Swinh. *Ibis*, 1860, p. 51, "Amoy, Shanghai."

Hab. Celebes (*Schlegel*); Menado (*mus. nostr.*); Japan (*Schlegel*); China (*Swinhoe*).

Two examples of a large Reed-Warbler from Menado agree best with Amoy individuals. I therefore provisionally refer them to the Chinese species. They, however, differ from my examples of *A. orientalis* (Amoy), *A. brunnescens* (Coorg), and *A. arundinaceus* (Linn.) (Holland), in having the rectrices conspicuously tipped with dirty white. The proportion of the quills in these examples does not exactly coincide with the proportions existing in the other species alluded to; nor do the dimensions completely agree.

| | Bill. | Wing. | Tail. | Tarsus. |
|---|-------|---------|---------|---------|
| | inch. | inches. | inches. | inch. |
| <i>A. arundinaceus</i> (Linn.) | ·4375 | 3·5625 | 3·250 | 1·0000 |
| <i>A. brunnescens</i> (Jerd.) | ·5625 | 3·4375 | 3·250 | 1·1250 |
| <i>A. orientalis</i> (Bp.) | ·5625 | 3·2500 | 3·000 | 1·1250 |
| <i>Acrocephalus</i> , sp., ex Cashmere..... | ·6250 | 3·4375 | 3·500 | 1·1875 |
| " " Menado | ·5625 | 3·4375 | 3·000 | 1·1250 |

A. arundinaceus (Linn.). First long primary nearly as long as second, which is longest; third shorter than first.

A. brunnescens (Jerd.). First much shorter than third and fourth, which are longest. In one example the third is longest; in another the fourth is longest.

A. orientalis (Bp.). Second longest, third nearly equal to second, first equal to fourth.

Ex Menado. Second longest, first nearly equal to third, first longer than fourth.

Ex Cashmere. Second equal to fourth, third longest; first somewhat shorter than second and fourth, which are nearly equal to third.

The Cashmere example seems to belong to a distinct species, and differs from *A. brunnescens* of Southern India in its longer and stouter bill, longer tail, and in the upper plumage being darker brown.

CISTICOLA, Kaup.

74. CISTICOLA CURSITANS (Franklin), *P. Z. S.* 1831, p. 118.

Sylvia cisticola, Temm. *Man. d'Orn. i. p. 228 (1820).*

Cisticola schanicola, Bp. *Birds of Europe*, p. 12 (1838).

Hab. Macassar (*Wallace*). For complete range *cf.* Von Heuglin, *Orn. N.-O. Afr.* pp. 269, 270.

A Macassar example of a male *Cisticola*, kindly lent to me by Mr. Wallace, I am unable to distinguish from Assamese and Daccan individuals of *C. cursitans*. It is labelled *C. lineocapilla*, Gould, with the note, "tail rather more distinctly marked." Wing $1\frac{7}{8}$, tail $1\frac{1}{16}$. The range of this tiny species is very extensive.

MOTACILLIDÆ.

BUDYTES, Cuvier.

75. BUDYTES VIRIDIS (Gm.), Syst. Nat. ed. 13, i. p. 962 (1788), "Ceylon," ex Brown, pl. 33.

Hab. Menado (*mus. nostr.*).

One example, in winter plumage. Olive-green above. Upper part of breast sulphur-yellow; rest of under surface pure white, some of the ventral and under tail-coverts dashed with sulphur-yellow. Supercilium conspicuous, broad, and pure white. Agrees perfectly with examples from continental India.

Motacilla flavescens, Stephens, Gen. Zool. *Aves*, x. p. 559, is enumerated in the 'Hand-list' by Mr. G. R. Gray as a distinct species, with the habitats of the Moluccas, Celebes, Timor, and Java assigned. Stephens gave this title to Buffon's "Bergeronnette de l'île de Timor," Hist. Nat. v. p. 275. Buffon's bird belongs to that phase of plumage of *B. viridis* (Gm.) in which the superciliary stripe is yellow, the upper plumage ash-coloured, and the under yellow.

HIRUNDINIDÆ.

HIRUNDO, Linnæus.

76. HIRUNDO GUTTURALIS, Scopoli, Del. Fl. Faun. Insubr. ii. p. 96. no. 115, ex Sonn. (1786).

L'Hirondelle d'Antique, Sonn. Voy. Nouv. Guin. p. 118, pl. 78.

Hirundo panayana, Gm. Syst. Nat. i. p. 1018, ex Sonn. (1788).

Hab. Menado (*mus. nostr.*); Indian region.

Celebean examples agree with specimens from India, Japan, China, Java, Malacca, and Morty Island. In one the crown is ashy brown, the forehead albescent. The black pectoral band is present, and the chin and throat are dirty rufous; on the outer tail-feathers the white mark is in the form of a diagonal oval drop. An example of an adult bird has the head steel-blue; forehead, chin, and throat deep rufous, as in the European *H. rustica*, the rufous breast being bounded by the usual black pectoral band. Wing $4\frac{1}{2}$ inches.

Whether this and the other races of Chimney-Swallows which inhabit the Malay archipelago and Eastern Asia are or are not of the same species as the European bird, they undoubtedly belong to Sonnerat's *Hirondelle d'Antique*.

77. *HIRUNDO JAVANICA*, Sparrman, Mus. Carls. pl. 100, "Java" (1789).

Hab. Indo-Malayan region.

Mr. Wallace informs me that he found this species common at Macassar, "building its mud nests in verandas in the town."

MUSCICAPIDÆ.

CYORNIS, Blyth.

78. *CYORNIS RUFIGULA*, Wallace, P. Z. S. 1865, p. 476, "Menado." (Pl. VII. fig. 3.)

Hab. Menado (*Wallace*).

MYIALESTES, Reichenbach.

79. *MYIALESTES HELIANTHEA* [(Wallace), P. Z. S. 1865, p. 476, "Menado. (Pl. VII. fig. 1.)

Hab. Menado (*Wallace*).

This is a representative form of *M. cinereocapilla* (Vieill.), differing from that species by wanting the ashy head, nape, throat, and breast of the Indian bird. The head is subcrested.

HYPOTHYMIS, Boie.

80. *HYPOTHYMIS PUELLA* (Wallace), P. Z. S. 1862, p. 340, "Sula Islands and Celebes." (P. VII. fig. 2.)

Hab. Sula Islands and Celebes (*Wallace*).

The azure Flycatchers form a natural section consisting of several very closely allied species, which have yet to be worked out. The group is characteristic of the Indian as distinguished from the Australian region; and Boie's generic title is here adopted in preference to classing *M. azurea*, Bodd., and its allies with the Australian *Myiagra rubeculoides*, Vig. & Horsf., and its allied species.

81. *HYPOTHYMIS MANADENSIS* (Quoy et Gaimard), Voy. Astrol. Zool. i. p. 176, "Menado" (1830), pl. 3. fig. 3.

Hab. Menado (*Quoy et Gaim.*).

Prince Bonaparte (Coll. Delattre, p. 81) refers this form to *Hypothymis*, where I place it with doubt, being unacquainted with the species.

Butalis hypogrammica, Wallace, Ibis, 1862, p. 350, is recorded from Celebes by Mr. G. R. Gray (Hand-list, no. 4814). Mr. Wallace cannot assure me positively that it occurs in that island. But as it is a summer visitant in China, and was obtained in Ceram and Morty Island by Mr. Wallace, it is not unlikely to be a winter resident in Celebes. *Hemichelidon griseosticta*, Swinhoe, is undoubtedly the same species; and that title takes precedence (Ibis, 1861, p. 330).

ARTAMIDÆ.

ARTAMUS, Vieillot.

82. ARTAMUS MONACHUS, Temm. ; Bp. Conspectus, i. p. 343, "Celebes" (1850); Wallace, P. Z. S. 1862, p. 340; Ibis, 1860, p. 141. (Pl. VI. fig. 1.)

Hab. Mountain districts of North Celebes, as well as the Sula Islands (*Wallace*).

The diagnosis by Mr. Wallace was taken from Sula examples. Neither does it, nor do Sula individuals (*mus. nostr.*) altogether agree with the description given by Prince Bonaparte (*l. c.*).

83. ARTAMUS LEUCORHYNCHUS (Linn.): Mantissa Plant. p. 524, ex Brisson, "Manilla" (1771).

Lanius manillensis, Briss. Ornith. ii. p. 180, "Manilla," descr. orig. (1760).

— *leucorhynchus*, Gm. S. N. ed. 13, i. p. 305, ex Brisson (1788).

— *dominicanus*, Gm. *op. cit.* p. 307, ex Sonnerat, Voy. Nouv. Guin. p. 55, pl. 25.

? *Lanius leucogaster*, Valenc. Mém. du Mus. vi. p. 27, "Timor" (1820).

Artamus leucopygialis, Gould, P. Z. S. 1842, p. 17, "Australia."

— *papuensis*, Temm. ; Bp. Consp. i. p. 344, "Nov. Guinea, Timor."

Leptopteryx leucorhynchus (Linn.) ; Horsf. Linn. Trans. xiii. p. 244, "Java."

Lanius leucorhynchus, Linn. ; Raffles, Linn. Trans. xiii. p. 306, "Sumatra."

Artamus leucogaster (Valenc.) ; Wallace, P. Z. S. 1863, p. 28; Walden, P. Z. S. 1866, p. 555; Beavan, Ibis, 1867, p. 324.

— *leucorhynchus*, Wallace, Ibis, 1860, p. 141.

Hab. Timor, Flores, Lombock, Bouru, and the whole archipelago from Sumatra to New Guinea, Celebes (*Wallace*); Sumatra (*Raffles*); Java (*Horsfield*); Andamans (*Beavan*); Cape York, Moreton Bay, Queensland, Mysol, Menado, Manilla, Andamans, Java (*mus. nostr.*).

I am unable to distinguish individuals of the white-bellied Swallow-shrike inhabiting the Philippines, Andamans, Java, Lombock, Mysol, Australia, and Celebes. In coloration they appear to be absolutely identical. In dimension, with the exception of the large Celebean form, they vary but little. I have therefore included all under the oldest title given by Linnæus to the Philippine bird. The Celebean is much the largest, and ought, perhaps, to receive a separate specific name. Mr. Wallace (P. Z. S. 1863, p. 485) entitles the Timor bird *A. leucogaster*, var.; but it was from Timor specimens that Valenciennes described *A. leucogaster*.

A. mentalis, Jard. (Fidjee Islands), and *A. melaleucus* (Forsten), a good species (New Caledonia), belong to this group. *A. monachus* (Temm.) ought, perhaps, to be also included.

Dimensions of Artamus leucorhynchus.

| | Wing. | Tail. | Tarsus. | Bill from forehead. | Bill from nostril. |
|-------------------|---------|---------|---------|------------------------|-----------------------|
| | inches. | inches. | inch. | inch. | inch. |
| Manilla | 5·250 | 2·625 | ·625 | ·7500 | ·5000 |
| Lombok | 5·250 | 2·750 | ·625 | ·8125 | ·5625 |
| Mysol | 5·250 | 2·625 | ·625 | ·7500 | ·5625 |
| Queensland | 5·375 | 2·625 | ·625 | ·6875 | ·5625 |
| Cape York | 5·250 | 2·625 | ·625 | ·6875 | ·5000 |
| Moreton Bay | 5·125 | 2·750 | ·625 | ·6875 | ·5000 |
| Java | 5·250 | 2·500 | ·625 | ·7500 | ·5625 |
| Andamans | 5·125 | 2·500 | ·5625 | ·6875 | ·5000 |
| Menado | 5·625 | 3·000 | ·625 | ·8750 | ·5625 |

CAMPEPHAGIDÆ.

GRAUCALUS, Cuvier.

84. GRAUCALUS ATRICEPS, S. Müll. Verhand. Land- en Volk. p. 190, "Celebes" (1839-44); Hartlaub, J. für Orn. 1864, p. 437.

Hab. Celebes (*S. Müller*); Ceram, Sumbawa, Flores (*Hartlaub*).

In his admirable monograph, Dr. Hartlaub (*l. c.*) describes from a Ceram male and a Sumbawa female. It is not stated whether they were compared with Celebean individuals, I therefore include these localities with some doubt. Mr. Wallace (*P. Z. S.* 1863, p. 485) notes only one *Graucalus* as inhabiting Flores, *G. personatus*, S. Müller.

85. GRAUCALUS LEUCOPYGIUS, Bp. Consp. i. p. 354, "Celebes" (1850); Hartlaub, J. für Orn. 1864, p. 443.

Hab. Macassar (*Hartlaub*); Macassar, Menado (*mus. nostr.*).

86. GRAUCALUS TEMMINCKII, S. Müller, Verhand. Land- en Volkenk. p. 191, "North-eastern Celebes" (1839-44); Hartlaub, J. für Orn. 1864, p. 446.

Hab. Gorontalo (*Forsten*, fide *Hartlaub*).

This is a most remarkable form, and seems to be rare. In 1864 only one example was contained in the Leyden Museum. Another, a male, is preserved in the British Museum. The types (for S. Müller also described the female, *l. c.*) were obtained by Forsten in North-eastern Celebes. Mr. Wallace (*P. Z. S.* 1862, p. 342) has added the Sula Islands to its range, on S. Müller's authority. I have failed in finding any statement of S. Müller to that effect.

VOLVOCIVORA, Hodgson.

87. VOLVOCIVORA MORIO (S. Müller), Verhandel. Land- en Volkenk. p. 189, "Celebes" (1839-44); Hartlaub, J. für Orn. 1865, p. 155. (Pl. VIII. fig. 1.)

Edoliosoma melanolaema, G. R. Gray, Hand-list, no. 5099, "Celebes" (1869).

Hab. Tondano, Gorontalo (*Hartlaub*); Macassar (*mus. nostr.*).

This and several Indo-Malayan and Papuan species are classed by Dr. Hartlaub (*l. c.*) under *Campephaga*, Vieillot, the type of that genus being the African *Campephaga nigra*, Vieill. This species, in its turn, Dr. Hartlaub transfers to Lesson's genus *Lanicterus*. I venture, however, to refer the Celebean bird to *Volvocivora*, Hodgs., as it is nearly allied to the type of that genus, *Lanius silens*, Tickell (1833), = *Ceblepyris lugubris*, Sundev. (1837), = *Volvocivora melaschistos*, Hodgs. (1837).

On examination I find that *Edoliosoma melanolaema*, a title published without description, refers to S. Müller's species; while the *E. morio*, of the Hand-list, no. 5097, appears to be *C. fimbriatus*, Temm. The British-Museum examples of the last are noted from Celebes; but that locality requires further confirmation.

LALAGE, Boie.

88. LALAGE LEUCOPYGIALIS, n. s. (Pl. VIII. fig. 2.)

Hab. Menado (*mus. nostr.*).

S. Müller, Hartlaub, O. Finsch, and others have hitherto included Celebes within the range of the *Lalage* of Java, *Turdus dominicus*, P. L. S. Müller, = *T. terat*, Bodd., = *T. orientalis*, Gm. Two examples of a *Lalage*, one of an adult male, and the other of an adult female, received by me from Menado, are to be readily distinguished from the Javan bird by having the lower back and rump pure white, the long upper tail-coverts only being grey. In this respect the Celebean *Lalage* agrees with *L. melanoleuca* (Blyth) from the Philippines; but that species is without a white supercilium (*fide* Hartl. J. für Orn. 1865, p. 163).

This is probably the *L. leucopygialis* of Mr. Gray's Hand-list; but as no description is given, his title cannot be noticed.

The *Lalage* which inhabits South-eastern Borneo differs from the Javan form in its longer wing and broader though not longer bill.

| | Wing. | Tail. | Tarsus. | Bill from nostril. | |
|------------------------------|------------------|------------------|----------------|-----------------------|--------------------------|
| Java. ♂ adult | inches. 3·375 | inches. 3·000 | inch. ·7500 | inch. ·500 | <i>L. dominica.</i> |
| Banjarmassing. ♂ adult | 3·750 | 3·250 | ·7500 | ·500 | " " |
| Menado. ♂ adult | 3·500 | 3·125 | ·6875 | ·500 | <i>L. leucopygialis.</i> |
| Menado. ♀ adult | 3·500 | 3·125 | ·6875 | ·500 | " " |

Lalage aurea (Temm.), Pl. Col. livr. lxiv. pl. 382. fig. 2, "Timor" (21st December 1825); Bp. Consp. i. p. 355; Coll. Delattre, p. 78; Hartlaub, J. für Orn. 1865, p. 168.

This species is stated to occur in Celebes by Bonaparte and Dr. Hartlaub. Mr. Wallace, however, is of opinion that it cannot be considered a Celebean bird.

ARTAMIDES, Hartlaub.

89. ARTAMIDES BICOLOR (Temm.), Pl. Col. livr. xlvi. pl. 278, "Sumatra" (!) (June 26, 1824); S. Müller, Verh. Land- en Volk. p. 191, "Celebes;" G. R. Gray, Handlist, no. 5091, "Banda, Celebes, Sumatra."

Hab. Menado (*mus. nostr.*).

Salomon Müller (*l. c.*) expressly states that this species inhabits Celebes, and neither Sumatra nor Banda.

DICRURIDÆ.

DICRURUS, Vieillot.

90. DICRURUS LEUCOPS, Wallace, P. Z. S. 1865, p. 478, "Celebes."

Hab. Macassar, Menado (*Wallace*).

Closely resembles *D. pectoralis*, Wallace, of the Sula Islands, but is somewhat larger in all its dimensions. The irides are stated by Mr. Wallace to be invariably milk-white, while in the Sula species and in all others known they are red.

The type of Vieillot's genus *Dicrurus*, *Corvus balicassius*, L., appears to stand alone; and it will be perhaps necessary to form a separate genus for the reception of all the Austro-Malayan Dicruridæ, whose affinities seem to be with *Chibia*, Hodgs.

NECTARINIIDÆ.

NECTARININÆ.

ARACHNOTHERA, Temminck.

91. ARACHNOTHERA —? —?

Arachnothera longirostra (Lath.), S. Müller, Verhandl. Zool. Aves, p. 69, ex Celebes.

I have not had an opportunity of examining an example of the Celebean *Arachnothera*, and am therefore unable to determine its correct title.

ANTHREPTES, Swainson.

92. ANTHREPTES MALACCENSIS (Scopoli), Del. Fl. et Faun. Insub. ii. p. 90. no. 62 (1786); Walden, Ibis, 1870, p. 47. no. 38.

Hab. Celebes (*Wallace*); Menado (*mus. nostr.*); Java, Sumatra, Borneo, Malacca

(*S. Müller*); Sula Islands, Flores (*Wallace*); Aracan, Tenasserim (*Blyth*); Labuan (*Motley & Dillwyn*); Banjermassing (*Sclater*); Siam (*Gould*); Cambodia (*Walden*).

This must be a common species in the neighbourhood of Menado, judging from the number of examples sent from that locality.

CHALCOSTETHA, Cabanis.

93. CHALCOSTETHA PORPHYROLÆMA (*Wallace*), P. Z. S. 1865, p. 479, "Macassar;" *Walden*, *Ibis*, 1870, p. 46. no. 35.

Nectarinia aspasia (*Less.*), *Schlegel & S. Müller*, *Verhand. Zool. Aves*, p. 58, "Macassar" (?).

Hab. Macassar (*Wallace*).

ARACHNECHTHRA, Cabanis.

94. ARACHNECHTHRA FRENATA (*S. Müller*), *Verhandl.* p. 173, "New Guinea, Menado" (1843); *op. cit.* *Zool. Aves*, p. 61, pl. 8. f. 1; *Walden*, *Ibis*, 1870, p. 26. no. 6.

Hab. Celebes, Sula Islands, Mysol, Moluccas, Kaisa Island (*Wallace*); Batchian, Ternate, Aru Islands, New Guinea, Islands of Torres Straits (*G. R. Gray*); North-east coast of Australia (*J. Macgillivray*).

A. flavigastra (*Gould*), ex New Ireland, is closely related to this species. The male, as described by *Lesson and Garnot* (*Voy. Coq. Zool.* i. p. 344, note), is undistinguishable.

NECTAROPHILA, Reichenbach.

95. NECTAROPHILA GRAYI (*Wallace*), P. Z. S. 1865, p. 479, "Menado;" *Walden*, *Ibis*, 1870, p. 42. no. 30, pl. 1. f. 2.

Hab. Menado (*Wallace*).

ÆTHOPYGA, Cabanis.

96. ÆTHOPYGA FLAVOSTRIATA (*Wallace*), P. Z. S. 1865, p. 478, pl. 29. f. 2; *Walden*, *Ibis*, 1870, p. 35. no. 18; *Wallace*, *Ibis*, 1860, p. 141.

Hab. Menado (*Wallace*).

In the Proceedings of the Zoological Society (*l. c.*) Mr. *Wallace* states Menado to be the *habitat* of this species; but elsewhere (*Ibis*, *l. c.*) that gentleman states that he obtained this Sun-bird in a forest district beyond the Lake of Tondano, at an elevation of about 1500 feet.

A sixth species of *Nectarinia* appears to inhabit Celebes (*conf.* *Walden*, *Ibis*, 1870, p. 42. no. 30).

DICEINÆ.

DICEUM, Cuvier.

97. *DICEUM CELEBICUM*, S. Müller, Verhandl. p. 162, "Celebes;" Wallace, P. Z. S. 1862, p. 324.

Diceum leclancherii, Lafr. Rev. Zool. 1845, p. 94, "Menado;" op. cit. 1846, p. 42; Hartl. op. cit. 1846, pp. 4, 47, 111.

Hab. Celebes, Sula Islands (*Wallace*).

PRIONOCHILUS, Strickland.

98. *PRIONOCHILUS AUREOLIMBATUS*, Wallace, P. Z. S. 1865, p. 477, pl. 29. f. 1, "North Celebes;" Salvadori, Atti Accad. Scien. Torino, 1868, p. 420.

Parus — ?, Wallace, Ibis, 1860, p. 141.

Hab. Mountains of Minahasa (*Wallace*).

The female scarcely differs from the male.

MELIPHAGIDÆ.

ZOSTEROPS, Vigors.

99. *ZOSTEROPS INTERMEDIA*, Wallace, P. Z. S. 1863, p. 493, "Macassar and Lombock;" Hartl. J. für Orn. 1865, p. 16. (Pl. IX. fig. 2.)

Hab. Macassar, Lombock (*Wallace*).

The above specific title was attached to a Macassar example in the British Museum by Mr. G. R. Gray, and was adopted by Mr. Wallace, who first discovered and first described the species.

100. *ZOSTEROPS ATRIFRONS*, Wallace, P. Z. S. 1863, p. 493, "Menado." (Pl. IX. fig. 3.)

Zosterops nigrifrons, Temm. Mus. Lugd.; Hartl. J. für Orn. 1865, p. 22.

Hab. Menado (*Wallace*); Gorontalo (*Mus. Lugd.*).

PLOCEIDÆ.

PADDA, Reichenbach.

101. *PADDA ORYZIVORA* (Linn.), Amœn. Acad. iv. p. 243. no. 16 (1759), ex Edwards, pl. 41.

Hab. Macassar (*Wallace*); Java (*Horsf.*); Sumatra (*Raffles*); Malacca (*Cantor*); Lombock (*Wallace*); Banjarmassing (*Sclater*); South China (*Swinhoe*); Manilla (*Von Martens*).

Mr. Wallace informs me that this species is abundant near the town of Macassar.

MUNIA, Hodgson.

102. MUNIA NISORIA (Temm.), Pl. Col. 500. f. 2, "Java" (8 May, 1830); *conf.* Blyth, Ibis, 1870, p. 172; Walden, Ibis, 1869, p. 211, note.

Hab. Macassar (*Wallace*); Java (*mus. nostr.*).

A single Celebean example in Mr. Wallace's collection, the only individual I have been able to examine, agrees well with Javan specimens. The upper tail-coverts and edges of the rectrices, however, are olive-green, and not grey as is the case in all my Javan examples. Mr. Blyth (*l. c.*) observes that the Celebean race has no pale shafts to the feathers of the upper parts; but in this Macassar individual the pale shafts are very conspicuous. The two principal characters which distinguish the Javan *M. nisoria* (T.) from the Indian *M. punctularia* (L.), are the rufous colouring of the breast-markings and the grey colour of the upper tail-coverts and edges of rectrices. In the Indian bird these are golden yellow, and the breast-markings are almost black. Moulmein individuals, again, differ from those of India in having the breast-markings rufous, and from both Javan and Indian in having the upper tail-coverts and edges of the rectrices yellowish green; nor are the breast-markings in the Moulmein race as well defined. In the race which inhabits Flores the upper tail-coverts are pale olive-green, as in the Celebean bird.

M. punctularia and *M. nisoria*, in young plumage, before the breast-markings appear and the upper coverts assume the waxy lustre found in the adult, are extremely difficult to distinguish. The Indian bird, however, is considerably larger, and has the bill much stouter. From *M. rubro-nigra* and its allies, when in first plumage, they are likewise difficult to separate. The only sure characters are the sinuated commissure and massive form of the bill in *M. rubro-nigra*.

103. MUNIA MOLUCCA (Linn.), Syst. Nat. ed. 12, i. p. 302 (1766), ex Brisson, Orn. iii. p. 241. no. 10; Wallace, Ibis, 1860, p. 147.

Hab. Macassar (*Wallace*); Flores (*mus. nostr.*).

A Celebean example of an adult male collected by Mr. Wallace perfectly agrees with Brisson's description of Count Bentick's specimen obtained in the Moluccas, on which Linnæus bestowed the above specific title.

104. MUNIA BRUNNEICEPS, n. sp. (Pl. IX. fig. 1.) *Conf.* Blyth, Ibis, 1870, p. 171.

Hab. Macassar (*Wallace*).

Head, chin, throat, and breast brown; abdominal stripe, vent, and under tail-coverts black; remainder of plumage dark chestnut. From a Macassar example of a male collected by Mr. Wallace. In another example from the same locality, marked a female, the head and nape are of a lighter and less decided shade of brown. Wing 2 inches.

Were it not that Mr. Blyth had already remarked the imbrowned colouring of the head and neck in examples from Celebes, contained in the Leyden Museum, I should have felt less confidence in considering these Macassar individuals distinct from *M. rubronigra*, Hodgs.

CORVIDÆ.

CORVUS, Linnæus.

105. CORVUS ENCA (Horsf.), Trans. Linn. Soc. xiii. p. 164, "Java" (1822); Schlegel, Bijdrag. part viii. p. 13, pl. 1. fig. 23; Mus. Pays-Bas, *Coraces*, p. 29.

Corvus validus, var., Wallace, partim, P. Z. S. 1862, p. 343.

Hab. Macassar (*Bernstein*); Limbotto, Gorontalo, Kema, Toulabelle (*Von Rosenberg*); Java (*type*).

The species inhabiting Celebes has not been satisfactorily identified. By Professor Schlegel it is considered the same as that found in Java, while true *C. validus*, Temm., Bp. (Consp. i. p. 385), is from Sumatra, and does not occur in Java.

GAZZOLA, Bonaparte.

106. GAZZOLA TYPICA, Bp. Compt. Rend. xxxvii. p. 828, "Nouvelle Calédonie," *errore* (5th December 1853); Notes Orn. Coll. Delattre, p. 6 (1854); Sclater, Ibis, 1859, p. 113.

Corvus advena, Schlegel, Bijdragen tot de Dierk. pt. viii. p. 3, pl. 2, "Sumatra," *errore* (1859); Mus. Pays-Bas, *Coraces*, p. 6, "Macassar;" Wallace, Mal. Archip. i. p. 375.

Hab. Macassar (*Wallace*).

This species has hitherto been found only in the Macassar district. Mr. Wallace (*l. c.*) alludes to it as rare. It is an anomalous form, hardly exceeding a *Lycos* in size, but with a bill equal to that of *Corvus corone*, and of much the same character. The arrangement of the quills is peculiar. The fourth much exceeds the others; and the first is very short. Prince Bonaparte separated it generically, but placed it next to *Corvus (Physocorax) moneduloides* (Less.), another unique and aberrant Corvine form, with which it has nothing in common beyond its general family relations.

This species has partly been the subject of some of the most curious mistakes in ornithological literature; and the position of the generic title *Gazzola*, Bp., whether among the Campephagidæ or the Corvidæ, depends on a correct history and explanation of how the confusion arose. In the thirteenth edition of the 'Systema,' Gmelin gave the title of *Corvus caledonicus* to Latham's "New-Caledonian Crow," a species described by Latham (General Syn. i. p. 377) from a drawing belonging to Sir Joseph Banks. This is a true New-Caledonian *Graucalus*. In the second supplement to the 'Synopsis,' Latham inserted a distinct bird (Labillardière's "Pie de la Nouvelle Calédonie") under the title of "Caledonian Crow," and called it in the supplement to the 'Index

Ornithologicus' *Corvus caledonicus*. Thus there became a *Corvus caledonicus*, Gm., and a *Corvus caledonicus*, Lath., the first being a *Graucalus*, the last a *Streptocitta*, the first being a really New-Caledonian species, the last being only found in Celebes. In 1850 Bonaparte founded his genus *Gazzola*, making *C. caledonicus*, Gm., the type, and associating with it the correct synonyms of true *C. caledonicus*, Gm. Still it is evident that Bonaparte was confounding the then unique specimen in the Paris Museum of the Celebean black-and-white Crow (which was labelled "*Corvus dauricus* de la Nouvelle Calédonie") with *Corvus caledonicus*, Lath., the black-and-white *Streptocitta*; for the Prince would never have identified a true *Graucalus* with either a *Pica* or a *Corvus*, and he made *Gazzola* the connecting link between the Garrulidæ and the Corvidæ. Thus the elements of confusion were these:—one *Corvus caledonicus*, Gm.; two species under that title in Latham, one of them being described as black and white; a black-and-white *Corvus* in the Paris Museum labelled "*C. dauricus* de la Nouvelle Calédonie,"—only one of the three species being a New-Caledonian bird. Three years later Bonaparte partly cleared up the confusion. He (Notes Ornith. *l. c.*) changed the title from *Gazzola caledonica* (Gm.) to that of *Gazzola typica*, Bp., on the ground that the type of his genus *Gazzola* was neither of the "deux *C. caledonicus*, de Latham,"¹ nor that of Labillardière, nor that of Gmelin. The question now arises whether *Corvus caledonicus*, Gm., ought to be considered the type of the genus *Gazzola*. It has been so treated by Mr. G. R. Gray (Hand-list, no. 1246). But as the Prince has described the species he founded the genus on, I have thought it best to retain *Gazzola* for that species, which is the same as *Corvus advena*, Schlegel.

MM. Verreaux and O. des Murs (Rev. & Mag. Zool. 1860, p. 432) included *Gazzola typica*, Bp., in their list of New-Caledonian birds, trusting, in all probability, to the erroneous locality on the label of the Paris-Museum specimen.

STREPTOCITTA, Bonaparte.

107. STREPTOCITTA CALEDONICA (Lath.), Ind. Orn. Suppl. p. xxv. no. 3 (1801), ex Voy.

Entrecasteaux, ii. p. 226, pl. 35 (39?), "New Caledonia," *errore*.

Pie of New Caledonia, Labillardière, Voy. Entrecasteaux, Eng. Tr. (Stockdale), ii. p. 227, pl. 39;

G. R. Gray, Cat. Birds Trop. Isl. p. 25.

Pica albicollis, Vieill. N. D. Sc. Nat. xxvi. p. 128, ex Voy. Entrecast. pl. 39.

Streptocitta caledonica, Bp. Consp. i. p. 382.

— *albicollis*, Sclater, Ibis, 1859, p. 113; Wallace, Malay Archip. i. p. 430.

Hab. Macassar (Wallace, fide Sclater; *Mus. Brit.*).

Although Labillardière (*l. c.*) tells us, very circumstantially, the date and the occasion when and where he obtained his *Pie de la Nouvelle Calédonie*, Mr. Sclater's explanation

¹ This is a good illustration of the confusion that may be created by not quoting the names of the original authors, or by replacing them with the names of subsequent authors, who may have quoted or misquoted.

(*l. c.*) of the probable cause of the error is most likely correct. Yet it must be borne in mind that Labillardière never set foot on the island of Celebes proper; nor does Entrecasteaux's expedition appear to have had any direct communication with that island on either of the occasions of its presence in the Moluccas. On its way from Bouru to Sourabaya, in October 1793, the expedition, after failing in its attempt to pass the Straits of Tioro, occupied several days in passing those of Boeton, and remained a day at the town of Boeton itself. During this period the French naturalist made several excursions on shore, and, as he particularly mentions, in the island of Pangasane, and one, of two hours' duration, in the neighbourhood of the town of Boeton. It is most probable therefore that this form of *Streptocitta* was obtained either on the island of Pangasane or of Boeton; for the expedition did not touch the mainland of Celebes, nor at the island of Saleyer when passing the straits of that name.

I identify the species which inhabits the district of Macassar with Labillardière's bird, because it best agrees with his short description. By him the bill is stated to be "of a light black from the root to within one third of the point, the remainder is yellowish." This and the green hue of the black portion of the plumage easily distinguish the South from the North Celebean species. The bill is also more slender than that of the following species.

108. *STREPTOCITTA TORQUATA* (Temm.), *Nouv. Rec.* 75^{ième} livr. Pl. Col. 444, "Celebes" (Jan. 5, 1828); G. R. Gray, *Birds Trop. Isl.* p. 25.

Hab. Menado (*Mus. nostr.*).

I quite agree with Mr. G. R. Gray in regarding this form as specifically distinct from the true *S. caledonica*, from which it differs by its strong, jet-black bill, and by having the black portions of its plumage glossed with dark blue. Mr. G. R. Gray (*l. c.*) states that the actual individual from which Temminck's figure was drawn is in the British Museum.

In this species the first quill is barely one inch long; the fourth and fifth are nearly equal, the fifth being slightly the longest; the third is somewhat shorter than the fourth; the second still a little shorter than the third. The wing measures $5\frac{1}{2}$ inches. The second pair of rectrices exceeds the first by $\frac{6}{8}$ of an inch; the third the second by $1\frac{1}{8}$; the fourth the third by $1\frac{4}{8}$; the fifth the fourth by $1\frac{4}{8}$; and the sixth, or middle pair, the fifth by $2\frac{7}{8}$; the total length of the middle pair is $11\frac{4}{8}$; bill from nostril $\frac{6}{8}$ of an inch; tarsus $1\frac{3}{8}$.

Temminck's surmise that this species occurs in Borneo has not been, as yet, realized.

Professor Schlegel has generically separated his *Charitornis albertinæ* from *Streptocitta*; but it is difficult to seize the characters wherein it generically differs. The structure of the wings, tail, and feet is identical. The colouring of the plumage is congeneric. The nostrils are similar in form and position. The bill differs in being

more arched and stouter, but it does not differ in form from that of *S. torquata* so much as the bill of *S. torquata* does from that of *S. caledonica*. In *C. albertinæ*, however, the naked spaces, which are confined to the ophthalmic region in the Celebean birds, extend to under the throat. In it also the frontal plumes are not developed and curved back as in the two species of *Streptocittæ*. Indeed the normal condition of the frontal or nasal plumes is the only external character in which *Charitornis* differs from *Streptocitta*. It seems more in accordance with the facts to regard the three species as belonging to the same natural genus, with *S. caledonica* as the connecting link. In the colouring of the plumage *C. albertinæ* only differs from *S. caledonica* by having the head white. By the black-and-yellow colouring of the bill, the South-Celebean species occupies an intermediate position between the completely black bill of *S. torquata* and the completely yellow bill of *C. albertinæ*.

Mr. Wallace has led us to infer (Malay Archip. i. p. 430) that *Charitornis* is confined to Celebes; but this is doubtless an error. Professor Schlegel's types were obtained in the island of Soula Mangouli; and the species has not been recorded from any other locality.

I cannot concur with the Leyden Professor in placing *Streptocitta* among the Graculidæ; though a most anomalous form, its nearest affinities seem to be with the Corvidæ.

BASILEORNIS, Temminck.

109. *BASILEORNIS CELEBENSIS*, Temm. (Mus. Lugd.); G. R. Gray, P. Z. S. 1861, p. 184. no. 2, fig. 2; Wallace, Malay Archip. i. p. 430; Ibis, 1861, pl. 9. fig. 2.

Basileornis corythair (Wagler), Bp. Consp. p. 420 (?), nec Wagler; Sclater, Ibis, 1859, p. 113.

Hab. Menado, Macassar (Wallace).

Prince Bonaparte's description is so vague that it is impossible to decide whether he described from the Celebean or the Ceramese bird.

ACRIDOTHERES, Vieillot.

110. *ACRIDOTHERES CINEREUS*, Müller (Mus. Lugd.); Bp. Consp. i. p. 420, "Celebes" (1850). (Plate X. fig. 1.)

Hab. Celebes (*Mus. Lugd.*); Macassar (*mus. nostr.*).

This is a well-marked species, most nearly allied to *A. javanicus*, Cab. (= *Pastor griseus*, Horsf., nec Wagl.), but readily distinguishable by the upper and lower plumage being light grey, and not dark iron-grey. All its dimensions are less; and it has the base of the mandible with traces of black, but not as marked as in its other congener, *A. fuscus* (Wagler), ap. Jerd., of continental Asia.

STURNIA, Lesson.

111. STURNIA? PYRRHOGENYS (Schlegel), Faun. Jap. *Aves*, p. 86, "Japan, Borneo" (1842).
Lamprotornis pyrrhopogon, Schlegel, *op. cit.* pl. 46.

Hab. Japan, Borneo (*Schlegel*); Philippines (*Swinhoe*, P. Z. S. 1863, p. 302. no. 217); Celebes (*Salvin*).

Three examples, agreeing in every respect with Japanese individuals, are contained in Mr. O. Salvin's collection; and that gentleman tells me that they were all procured in Celebes. Although I have adopted Professor Schlegel's name, I have little doubt that eventually, after comparison has been made with Philippine examples, it will have to give way to *dominicanus*, Bodd., = *T. dominicanus*, Gm. These similar titles were founded on *Le Merle dominiquain des Philippines* of Montbeillard (Hist. Nat. Ois. iii. p. 396), who described it from a Philippine individual obtained by Sonnerat which was figured by Daubenton (Pl. Enl. 627. f. 2). Gmelin's title has hitherto most unaccountably been applied to the *Sturnus dauricus*, Pall. *Pastor ruficollis*, Wagler, Syst. Nat. Av. p. 92, ex Manilla, is also clearly a synonym of *T. dominicanus*, Bodd. & Gm., and not a distinct species as enumerated by Prince Bonaparte.

One of Mr. Salvin's specimens has the chin, tips and outer edges of the quills, the under and upper tail-coverts, and the rectrices deeply tinged with bright rusty red. Traces of this hue appear in other parts of the plumage. This peculiarity in members of this group has been remarked upon by Mr. Swinhoe (P. Z. S. 1863, p. 302), and is said by him to prevail during the breeding-season. Is the species, therefore, a permanent resident in Celebes?

In *S. pyrrhogenys*, Schlegel, and *S. dauricus*, Pall., the first quill is longest, and the second nearly as long, the third and following quills being much shorter. This indicates an affinity of these two species to true *Sturnus*; and the structure of the tail and the metallic hues of the plumage strengthen the evidences of the relationship. The form of the bill is peculiar, being short and stout, albeit *Sturnine*. On the other hand, *Oriolus sinensis*, Gm., the type of *Sturnia*, Lesson, is a true *Temenuchus*, Cab.; consequently all the species falling under the latter generic title must be referred to *Sturnia*, and *Temenuchus* will have to be suppressed. A distinct subgenus will probably have to be made for *S. pyrrhogenys* and *S. dauricus*, and another for the reception of the isolated Cingalese form *Pastor senex*, Temm., = *Sturnia albofrontata*, Layard.

ENODES, Temminck.

112. ENODES ERYTHROPHRYS (Temm.), Nouv. Rec. xlv^e livr.; Pl. Col. 267, "Celebes, environs de Menado, et dans l'île Taguatto (1st of May 1824);" Wallace, Ibis, 1860, p. 141.

Hab. N.-E. Celebes, confined to the interior mountain districts, never abundant (*Wallace*).

CALORNIS, G. R. Gray.

113. CALORNIS NEGLECTA, n. s.

Calornis obscura, var., Wallace, P. Z. S. 1862, p. 343.

Hab. Celebes (*mus. nostr.*); Sula Islands (*Wallace*).

Having carefully compared examples of nearly all the described species of this genus, I have no hesitation in considering the *Calornis* of Celebes and the Sula Islands distinct. In colouring it most nearly approaches *C. chalybea* (Horsf.), ex Java, with the allied races from Sumatra, Malacca, Borneo, and Cambodja; but its dimensions are much greater. From *C. obscura* (Forst.), ex Gilolo and Batchian, it can be readily discriminated by its bright green colouring. From all the members of the *C. metallica* group it may be known by the total absence of any iridescent colours. It perfectly agrees with examples from the Sula Islands.

The individuals on which this species is founded were sent from Menado in a box which contained nothing but Celebean birds. Notwithstanding, therefore, Mr. Wallace's statement (Mal. Archip. i. p. 431) that the genus does not occur in Celebes, we may, I venture to think, conclude that that island is not an exception to the general rule which prevails in the geographic distribution of *Calornis*.

The following attempt at an analysis of the species belonging to this difficult genus may perhaps assist in clearing up the confusion in which the synonymy of its members is involved. All the species are divisible into two distinct groups:—first, those in which the plumage is uniform green, varying from light to very dark green; secondly, those which have, added to the prevailing green colour of the plumage, metallic reflections of purple and violet. The uniform green species may be further subdivided into light green and dark green; while the metallic-green species are usually also distinguished by having the middle pair of rectrices much prolonged. In general terms it may be said that the first subdivision embraces all the Indo-Malayan, the second and third all the Australian forms.

A. *Uniform green plumage.*a. *Light green.*

1. *Muscicapa panayensis*, Scop., ex Sonn. pl. 73, = *Turdus cantor*, Gm., ex Sonn. pl. 73, = *Turdus columbinus*, Gm., ex Montbeillard, ex Sonn., "Philippines."
2. *Turdus chalybeus*, Horsf., = *Turdus strigatus*, Horsf. (*av. juv.*), = *Lamprotornis cantor*, Gm., ap. Temm. Pl. Col. 149, "Java."
3. *Turdus insidiator*, Raffles, "Sumatra."
4. *Calornis affinis*, A. Hay, "Tipperah, Arracan, Tenasserim, Nicobars."

It is very questionable whether these last three species are separable. To them

belong the Malaccan, Sarawak, and Cambodjan races, which are as yet without titles, but exhibit certain differences.

5. *Calornis neglecta*, nob., "Celebes, Sula Islands."

Turdus palmarum, Bodd., = *Turdus mauritianus*, Gm., both titles being founded on *Le Merle vert de l'île de France*, of Montbeillard; and Pl. Enl. 648. f. 2 belongs to one of these species; but to which, it is now impossible to say.

b. Dark green.

6. *Lamprotornis obscura*, Forst.; Bp. Consp. p. 417, "Gilolo." Given also from Batchian by Mr. G. R. Gray. A good species. Dark purplish green.
7. *Calornis crassirostris*, nob., "Lombock." Collected by Mr. Wallace. Very dark green. Bill high and stout as in *Aplonis*. The locality may not be correct.
8. *Calornis mysolensis*, G. R. Gray, "Mysol." Closely allied to, if not the same as, *C. obscura*.
9. *Calornis cantorooides*, G. R. Gray. Like *C. mysolensis*, only that the tail is shorter and nearly square. Considered by Mr. Wallace to be a good species (P. Z. S. 1862, p. 343).
10. *Lanius pacificus*, Gm., ex Lath., = *Calornis kittlitzii*, O. Finsch, = *Lamprotornis columbinus*, ap. Kittlitz ("Mariannes, Carolines, and Puynipet"), from the description, seems to belong to this subgroup.

B. *Green with purple and violet reflections.*

11. *Lamprotornis metallica*, Temm. Pl. Col. 226. Described from Timor and Celebes. The type was probably from Amboyna, perhaps from Australia, possibly from Timor.
12. *Calornis purpurascens*, G. R. Gray, = *C. metallica*, Temm., ap. Gould, "North and East Australia."
13. *Calornis amboinensis*, G. R. Gray, "Amboyna." Closely resembles the Australian species, but is smaller.
14. *Lamprotornis minor*, Müll.; Bp. Consp. 417, "Timor." Wallace gives it also from Flores and Lombock. A very distinct species.
15. *Calornis viridescens*, G. R. Gray, "Aru Islands." Near to *C. amboinensis*. Also given from Dorey by Mr. G. R. Gray under the inaccurate title of *C. virescens* (P. Z. S. 1859, p. 158).
16. *Calornis gularis*, G. R. Gray, "Mysol." Apparently nothing but *C. viridescens*.
17. *Calornis nitida*, G. R. Gray, "New Ireland," ex Less. & Garnot, Voy. Coq. Zool. i. p. 343. Seems to belong to the green and purple group.

Dimensions.

| | Wing. | Tail. | Bill. | Tarsus. | Locality. |
|--|---------|---------|-------|---------|------------|
| | inches. | inches. | inch. | inch. | |
| <i>C. purpurascens</i> , <i>G. R. Gray</i> | 4·250 | 4·750 | ·5625 | ·8750 | Cape York. |
| <i>C. amboinensis</i> , <i>G. R. Gray</i> | 3·875 | 3·500 | ·5000 | ·8125 | Amboyna. |
| <i>C. minor</i> (<i>Müll.</i>)..... | 3·875 | 2·500 | ·5000 | ·7500 | Timor. |
| <i>C. chalybea</i> (<i>Horsf.</i>)..... | 3·750 | 2·500 | ·5000 | ·7500 | Java. |
| <i>C. insidiator</i> (<i>Raffl.</i>)?..... | 4·000 | 2·875 | ·5000 | ·8125 | Malacca. |
| " " ?..... | 3·625 | 2·625 | ·5000 | ·8125 | Sarawak. |
| " " ?..... | 3·750 | 2·750 | ·5000 | ·8125 | Cambodja. |
| <i>C. neglecta</i> , nob. | 4·125 | 3·250 | ·5625 | ·8750 | Celebes. |
| <i>C. crassirostris</i> , nob. | 4·000 | 4·125 | ·5000 | ·8750 | Lombok. |
| <i>C. cantoroides</i> , <i>G. R. Gray</i> | 3·750 | 2·500 | ·5000 | ·8125 | Mysol. |

SCISSIROSTRUM, Lafresnaye.

114. SCISSIROSTRUM DUBIUM (Latham), Ind. Orn. Suppl. p. xviii. no. 5 (1801), ex Lath. Syn. Suppl. ii. p. 73. no. 11, descr. orig.

Scissirostrum pagei, Lafr. Rev. Zool. 1845, p. 93, "Manado;" Mag. Zool. 1845, pl. 59; Wallace, Ibis, 1860, p. 141; Malay Archip. i. p. 430.

Hab. Scarce at Macassar, plentiful near Menado (*Wallace*).

We owe the identification of this most anomalous form with the *Lanius dubius*, Lath., to Dr. Hartlaub (Arch. Nat. xiii. 2. p. 57). Notwithstanding Prince Bonaparte's incredulity (Consp. i. p. 423), a reference to Latham's original description, taken from a specimen "at Mr. Thompson's, Little St. Martin's Lane, London, but without any history of its manners or country annexed," leaves no doubt of its identity.

The sequence and relative proportions of the quills in this species are the same as in *Calornis*. The structure of the tail is similar to that of *Calornis metallica* (Temm.). The bill resembles most nearly, in its massiveness and general outline, that of *Eulabes javanus*, Cuv.; but the peculiar position of the nostrils, situated in narrow and deep ascending grooves, is quite unique. The sole existing representative of a subfamily (?) long since extinct, its systematic place seems to be between *Calornis* and *Eulabes*.

COLUMBÆ.

TRERONIDÆ.

OSMOTRERON, Bonaparte.

115. OSMOTRERON VERNANS (Linn.), Mantissa, p. 526 (1771), ex Briss. Orn. i. p. 143, "Philipp. Ins.;" Gm. Syst. Nat. i. p. 789, ex Linn.; Wallace, Ibis, 1863, p. 320.

Columba viridis, Scop. Del. Fl. Insub. ii. p. 94 (1786), ex Sonnerat, Voy. Nouv. Guin. p. 110, pl. 64, ♂, pl. 65, ♀, "îles de Luçon et D'Antigue."

Treron viridis (Scop.), Wallace, Ibis, 1865, p. 374.

— *vernans*, Steph., Schlegel, Nederl. Tijdschr. Dierk. i. p. 70.

Hab. Philippine Islands (*type*); Penang, Sumatra, Borneo, Macassar (*Wallace*); Java, Gorontalo, Sumatra, Bangka (*Schlegel*).

The Celebean form is here retained under the title of the Philippine bird, as I have not been able to compare examples from the two localities. But both from Mr. Wallace's and Professor Schlegel's remarks on the differences existing in examples from the different Indo-Malayan islands, it seems probable that the species inhabiting the localities given above will be all found to differ from one another specifically. On the Sumatran, Javan, Bankan, and Celebean birds, Professor Schlegel has bestowed the title of *griseicapilla*. And yet he distinguishes the Javan and Celebean forms from the Sumatran and Bankan species by remarking that the former has the head and throat dark greyish-green, while the latter has those parts "jolie gris bleuâtre."

116. OSMOTRERON¹ GRISEICAUDA (G. R. Gray), Mus. Brit. *Columbæ*, p. 10, "patr. incert." (1856); Wallace, ex Gray, P. Z. S. 1862, p. 344, "Sula Islands, Celebes;" Schlegel, Nederl. Tijdschr. Dierk. 1866, pp. 210, 346; Wallace, Ibis, 1863, p. 319.

Hab. Celebes, Sula Islands (*Wallace*).

Professor Schlegel (*l. c.*) is unable to discover any sufficient and constant distinctions between the Javan *T. pulverulenta*, Wallace, and this Celebean species. The Sanghir bird, on account of its stouter bill, the learned Professor considers to possess greater claims, but to be very closely allied. The Sula and Javan examples I have had an opportunity of comparing exhibit the differential characters Mr. Wallace has insisted on, and they seem to me sufficient. It would perhaps be convenient to separate the maroon-backed members of *Osmotreron* under a distinct subgeneric title.

LAMPOTRERON, Bonaparte.

117. LAMPOTRERON FORMOSA (G. R. Gray), P. Z. S. 1860, p. 360; Wallace, Ibis, 1865, p. 379, "Celebes."

Hab. Macassar, Menado (*Wallace*).

Closely allied to *P. superbus* (Temm.), and hardly admitted as distinct by Professor Schlegel.

¹ The type of *Treron*, Vieillot, is *C. curvirostra*, Gm., ex Lath., a species as yet not satisfactorily identified, and not *C. aromatica*, Gm., as stated by Mr. G. R. Gray (Gen. and Subgen. no. 1654). To whatever species Latham's Hooked-billed Pigeon belongs, it is evident from the plate (Syn. ii. pl. 59) that in it the corneous culmen extends to the forehead. Prince Bonaparte (Consp. ii. p. 10) reduced *Toria*, Hodgs., to a synonym of *Treron*, but associated *C. psittacea* and *C. aromatica* with *Toria nipalensis*, species not possessing the characters on which Mr. Hodgson founded his genus. *Treron* = *Toria* contains only two species, *T. nipalensis* and *T. nasica*; *C. curvirostris* belongs to either the one or the other, probably (as already suggested by Mr. Wallace) to *T. nasica*, Schlegel.

IOTRERON, Bonaparte.

118. IOTRERON MELANOCEPHALA (Forster), Zool. Indica, p. 16, pl. 7, "Java" (1781¹).

Ptilopus melanocephalus, Schlegel, Nederl. Tijdschr. Dierk. iii. p. 207.

Hab. Java (*type*); Flores, Sumbawa, Celebes, Sula Islands, Ceram, Sanghir (*Schlegel*); Lombock (*Wallace*).

Professor Schlegel (*l. c.*) has detailed the characters which distinguish the several races of this Pigeon inhabiting the islands of Java, Flores, Celebes, Sula, Ceram, and Sanghir. They undoubtedly should receive distinguishing titles; for until they and analogous forms are separately named, the physical geographer will only find half the truth when studying zoological catalogues. The Celebean bird has the yellow gular patch tinged with orange (*conf.* Schlegel, *l. c.*).

LEUCOTRERON, Bonaparte.

119. LEUCOTRERON GULARIS (Quoy et Gaimard), Voy. Astr. Zool. i. p. 247, pl. 29, "Menado" (1830).

Hab. Menado (*Wallace*).

C. diademata, Temm., *C. monacha*, Reinwardt, and *C. hypogastra*, Reinwardt, belonging to the *Ptilopodinæ*, were erroneously described by Temminck as inhabiting Celebes (*conf.* Wallace, *Ibis*, 1865).

CARPOPHAGA, Selby.

120. CARPOPHAGA PAULINA, Temm. Mus. Lugd. (*Columba ænea*, ♀, Temm., Knipp, Fig. i. pl. 4); Bp. Consp. ii. p. 35; Wallace, *Ibis*, 1865, p. 385; Schlegel, Nederl. Tijdschr. Dierk. iii. p. 200.

Hab. Macassar, Menado, Sula Islands (*Wallace*).

A Philippine example in the Leyden Museum is stated by Professor Schlegel (*l. c.*) to resemble the Celebean bird. But the differential characters it possesses render it likely that the Philippine bird is specifically distinct. The examples in the same collection, said to have been brought from the Mariannes (?), differ but slightly from the Celebean species, according to Professor Schlegel. Both Prince Bonaparte and Mr. Wallace rank this fine Fruit-Pigeon under *Ducula*, Hodgs. It appears to me to be a typical *Carpophaga*, Selby.

¹ I have not been able to refer to the first edition of Pennant's 'Indian Zoology;' but if this species is there named, it will have to take Pennant's title (1769).

DUCULA, Hodgson.

121. DUCULA ROSACEA (Temmin.), Pl. Col. 578, "Timor" (1835); Wallace, Ibis, 1865, p. 386; Schlegel, Nederl. Tijdschr. Dierk. iii. pp. 201, 345.

Hab. Timor (*type*); Macassar, Flores (*Wallace*); Tolofoko (northern peninsula of Halmaheira), Little Key Island (*Schlegel*).

The Celebean habitat of this Pigeon rests on the authority of Mr. Wallace (*l. c.*). The Gilolo bird discovered by the late Dr. Bernstein is stated by Professor Schlegel (*l. c.*) not to differ from the type species.

MYRISTICIVORA, Reichenbach.

122. MYRISTICIVORA LUCTUOSA (Reinw.), Temmin. Pl. Col. livr. xlii. pl. 247 (26th Feb. 1825); Wallace, Ibis, 1865, p. 386.

Hab. Menado, Macassar, Sula Islands (*Wallace*); Menado (*mus. nostr.*).

Professor Schlegel (Nederl. Tijdschr. Dierk. iii. p. 343) mentions the fact that, in this species only, the breast and abdomen are sometimes washed or even spotted with black. Mr. Cassin (United States Exped. p. 266) pointed out that while *C. bicolor* (Scop.) possesses fourteen rectrices, the North-Australian *C. luctuosa* (= *M. spilorrhoea*, G. R. Gray) has only twelve. An examination of examples in my collection fully bears out this observation; for I find that examples of

1. *M. bicolor* (Scop.), ex New Guinea, has fourteen rectrices.
2. " " ex Batchian, has fourteen rectrices.
3. *M. luctuosa* (Reinw.), ex Sula Islands, has fourteen rectrices.
4. " " ex Menado, has fourteen rectrices.
5. " " ex Menado, has twelve rectrices.
6. *M. spilorrhoea*, G. R. Gray, ex Port Albany, has twelve rectrices.
7. " " ex Somerset, has twelve rectrices.

The Menado example, with only twelve rectrices (no. 5), appears to have originally possessed two more, which have been lost.

ZONENAS, Reichenbach.

123. ZONENAS RADIATA (Quoy et Gaim.), Voy. Astrol. Zool. i. p. 244, pl. 26, "Menado" (1830).

Hab. Macassar, Menado (*Wallace*).

HEMIPHAGA, Bonaparte.

124. HEMIPHAGA FORSTENI (Temmin.), Knipp. Fig. ii. pl. 47; Bp. Consp. ii. p. 39; Wallace, Ibis, 1865, p. 387.

Hab. Menado; appears to be confined to the mountainous district of Minahassa (*Wallace*).

COLUMBIDÆ.

MACROPYGIA, Swainson.

125. *MACROPYGIA ALBICAPILLA*, Temm. Mus. Lugd.; Bp. Consp. ii. p. 57, "Celebes" (1857).

Hab. Macassar, Tondano, Sula Islands (*Wallace*).

126. *MACROPYGIA MACASSARIENSIS*, Wallace, Ibis, 1865, p. 389.

Hab. Macassar (*Wallace*).

Mr. Blyth (Ibis, 1870, p. 173) observes that *M. leptogrammica* (Temm.) is not from Java, but from Celebes. Its author (Pl. Col. 560) states that it inhabits Java and Sumatra. Mr. Wallace (*op. cit.* p. 390) restricts its range to west Java, where it is found up to an elevation of 7500 feet.

TURACENA, Bonaparte.

127. *TURACENA MENADENSIS* (Quoy et Gaim.), Voy. Astrol. Zool. i. p. 248, pl. 30, "Menado" (1830).

Hab. Macassar, Menado, Sula Island (*Wallace*).

Prince Bonaparte (Consp. ii. p. 59), apparently on Temminck's authority (Nouv. Rec. Pl. Col. 248), cites Celebes as the *habitat* of *Reinwardtæna reinwardti* (Temm.). Mr. Wallace (Ibis, 1865, p. 391) does not include Celebes within its range.

TURTUR, Selby.

128. *TURTUR TIGRINA* (Temm.), Knipp, Pig. pl. 43 (1811); Wallace, Ibis, 1865, p. 391.

Turtur chinensis, ap. Wallace, Ibis, 1860, p. 147.

Hab. Java, Malay peninsula, Lombock, Flores, Timor, Ternate, Celebes (*Wallace*); Menado (*mus. nostr.*).

GOURIDÆ.

PHLOGENAS, Reichenbach.

129. *PHLOGENAS TRISTIGMATA* (Temm.), Mus. Lugd.; Bp. Consp. ii. p. 87, "Tondano" (1857); Wallace, Ibis, 1865, p. 393, pl. 10; Malay Archip. i. p. 413.

Hab. Macassar, Menado (*Wallace*).

CHALCOPHAPS, Gould.

130. *CHALCOPHAPS STEPHANI*, Jacq. et Puch. Voy. Pôle Sud, Zool. p. 119, "Nouv. Guinée, côte occidentale" (1853); *Peristère d'Etienne*, Homb. et Jacq. Atlas, pl. 28. f. 2 (January 1846); Wallace, Ibis, 1865, p. 394; Schlegel, Nederl. Tijdschr. Dierk. 1866, pp. 265, 345.

Hab. North Celebes (*Wallace*).

Mr. Wallace (*l. c.*) has separated the New Guinea, Waigiou, and Mysol race from that inhabiting Celebes, and conferred on it the title of *Ch. hombroni*. But as the type of *Ch. stephani* was obtained in New Guinea, if the two races are distinct, the Celebean, and not the New-Guinea bird requires a new title.

131. CHALCOPHAPS INDICA (Linn.), Syst. Nat. 12, i. p. 284 (1766), ex Edwards, pl. 14; Schlegel, Nederl. Tijdschr. Dierk. 1866, p. 267.

Only two species of this subgenus are recognized by Professor Schlegel:—first, *Ch. stephani*, as restricted above; secondly, all the remaining races of Asia, its islands, Australia, New Caledonia, and the islands of the Gilolo and Ceram groups. Members of this second species are stated by the Professor (*l. c.*) to also inhabit Celebes and New Guinea, but to be exceedingly rare in those two localities. Mr. Wallace does not appear to have met with it in either country.

GEOPELIA, Swainson.

132. GEOPELIA STRIATA (Linn.), Syst. Nat. ed. 12, i. p. 282 (1766), “India orientali” (1766), ex Brisson.

Hab. Macassar (*Wallace*); Java (*Sparman*); Queda (*Sonnerat*); Lombock (*Wallace*); Philippines (*Von Martens*).

I include this species on the authority of Mr. Wallace.

CALÆNAS, G. R. Gray.

133. CALÆNAS NICOBARICA (Linn.), Syst. Nat. ed. 12, i. p. 283, “insula Nicobar” (1766), ex Albin, pl. 47; Wallace, Ibis, 1865, p. 400; Von Pelzeln, Reise der Novara, Vögel, p. 110.

Hab. Malacca and Singapore, Celebes, Batchian, New Guinea (*Wallace*); Treis Island, Nicobars (*Von Pelzeln*).

This species is given from Celebes by Mr. Wallace in his table of distribution (*l. c.*); but it is to be inferred, from the interesting account given by the same author of its range and habits (Malay Archip. ii. p. 65), that the Nicobar Pigeon is not found on the main island.

GALLINÆ.

PHASIANIDÆ.

GALLUS, Linnæus.

134. GALLUS BANKIVA, Temm. Fig. et Gallin. ii. p. 87, “Java” (1813).

Hab. Java (*type*); Macassar (*Wallace*).

Mr. Wallace has informed me that this species occurs in Celebes.

Gmelin's diagnosis of *G. ferrugineus* was undoubtedly taken from Latham's sixty-sixth plate, which represents the hen of the red Indian Jungle-fowl. But Gmelin first quoted Sonnerat's *Grande caille de la chine* (It. ii. p. 171), a bird that cannot, by its description, be referred to the genus *Gallus*, and which seems to have been described from an example of *T. perlatus*, Gm. Latham having erroneously identified Sonnerat's species with his own Hackled Partridge, was copied by Gmelin; hence two distinct birds are included under *Tetrao ferrugineus*, Gm.

It will be necessary to compare Celebean examples with those from other parts of Asia before we can decide to which species they belong.

TETRAONIDÆ.

EXCALFACTORIA, Bonaparte.

135. EXCALFACTORIA MINIMA, Gould, P. Z. S. 1859, p. 128, "Macassar," Birds of Asia, pt. xiii.

Hab. Macassar (*Wallace*).

A representative form of *E. chinensis* (Linn.), if admissible as distinct.

TURNICIDÆ.

TURNIX, Bonnaterre.

136. TURNIX RUFILATUS, Wallace, P. Z. S. 1865, p. 480, "Macassar."

Hab. Macassar (*Wallace*).

MEGAPODIIDÆ.

MEGAPODIUS, Quoy et Gaimard.

137. MEGAPODIUS GILBERTI, G. R. Gray, P. Z. S. 1861, p. 289, "Celebes;" Schlegel, Nederl. Tijdschr. 1866, p. 263.

Megapodius of small size, Wallace, Ibis, 1860, p. 142.

Hab. Celebes (*Wallace, Schlegel*); Island of Siao (Sanghir group?) (*Schlegel*).

M. rubripes, Temm. Pl. Col. 411, "Celebes," is neither from Celebes nor Amboyna (*conf. Schlegel, op. cit. p. 260*).

MEGACEPHALON, Temminck.

138. MEGACEPHALON MALEO, Temminck.

Megapodius rubripes, Temm., apud Quoy et Gaim. Voy. Astrol. Zool. i. p. 239, pl. 25, av. juv., nec Temm.

Megacephalon rufipes (Quoy et Gaim.), Gray & Mitch. Genera, iii. pl. 123.

— *maleo*, Wallace, Ibis, 1860, p. 142.

— *rubripes*, Wallace, Malay Archip. i. p. 413.

Megacephalon maleo, Temm., Bp. Compt. Rend. xlii. p. 876 (1856).

— *rubripes*, G. R. Gray, P. Z. S. 1861, p. 288; op. cit. 1864, p. 42, nec Temm.

Hab. North-east Celebes (*Wallace*).

Although we owe to Messrs. Gray and Mitchell (*l. c.*) an excellent figure, and to Mr. Wallace (*l. c.*) a most interesting account of this species, no description, with a distinctive title, appears ever to have been published of the adult bird. The specific title adopted above is the name by which this *Megapode* is known to the natives of North Celebes. Temminck's only published notice of the species is in these words:—"Le grand Mégapode, connu aux Célèbes sous le nom de *Maleo* ne nous est point encore parvenu" (Pl. Col. 411); and he then states that it must not be confounded with the other Celebean Megapode, *M. rubripes*, Temm. It was, however, so confounded for many years after, until Prince Bonaparte (*l. c.*) enumerated it as a distinct species in his 'Tableaux Paralléliques.' Temminck does not appear either to have published the characters of his genus *Megacephalon*.

A fine male from North-east Celebes (*mus. nostr.*) has the head, chin, throat, and entire upper half of the neck naked, with a few straggling, short, brown feathers interspersed. The quills, rectrices, upper and under tail-coverts are deep brown, nearly black, with a dark green gloss. Upper breast and entire upper surface dark brown. Under surface and flanks salmon-colour. Fifth and sixth quills equal, and longest; fourth and seventh a trifle shorter, and equal; third somewhat shorter than fourth; the second an inch shorter than the third, and the first an inch shorter than the second.

GRALLÆ.

CHARADRIIDÆ.

CHARADRIUS, Linnæus.

139. CHARADRIUS FULVUS, Gmelin, Syst. Nat. ed. 13, i. p. 687, ex Lath. Syn. iii. p. 211, "Otaheite;" Schelgel, Mus. Pays-Bas, *Cursorès*, p. 30.

Hab. Gorontalo, April, males passing into perfect plumage, female passing into perfect plumage, April 20 (*Rosenberg*); Gorontalo, passing out of perfect plumage, September 24 (*Forsten*).

The complete range of this species cannot be given until we have agreed upon the races which ought to be included under the above title. For an exhaustive essay on the subject, *conf.* Finsch & Hartl. Faun. Centralpolyn. p. 188.

EUDROMIAS, Boie.

140. EUDROMIAS VEREDUS (Gould), P. Z. S. 1848, p. 38, "Northern Australia;" Harting, Ibis, 1870, p. 209.

Hab. Macassar (*Wallace*); Northern and Eastern Asia, Malay archipelago, New Guinea, Australia.

ÆGIALITES, Boie.

141. ÆGIALITES DUBIUS (Scop.), Del. Faun. et Fl. Insub. ii. p. 93. no. 81 (1786), ex Sonn. Voy. Nouv. Guin. p. 84, pl. 46, "Luzon."

Charadrius philippinus, Lath. Ind. Orn. ii. p. 745. no. 11 (1790), ex Sonn. *l. c.*

— *alexandrius*, Hasselq. var. ♂, Gm. S. N. ed. 12, i. p. 684, ex Sonn. *l. c.*

— *philippinus*, Scop. (!), Schlegel, Mus. Pays-Bas, *Cursores*, p. 28.

? *Ægialites minutus* (Pall.), ap. Jerdon, Birds Ind. iii. p. 641.

Hab. Ayer-pannas, 6th of August (*Von Rosenberg*).

A Celebean example of a Ring-Plover, collected by Von Rosenberg, has been identified by Professor Schlegel (*l. c.*) with *Le petit Pluvier à collier de Luçon* of Sonnerat; and he has further united it with the Lesser Ring-Plover of Europe. A Philippine Ring-Plover has also been identified by Dr. von Martens (J. für O. 1866, p. 26) with the European bird, i. e. *C. curonicus*, Gm. (ex Beseke, Schr. Berl. Gesellsch. nat. Freunde, vii. p. 463. no. 48, who gave no title)—the *C. minor*, Meyer, of recent authors. In India, besides *C. curonicus* (= *C. minor*, or else *C. intermedius*, Ménétr., if really distinct), another small Ring-Plover occurs, the *Æ. minutus* (Pall.) ap. Jerdon, a species distinct from *C. curonicus*, Gm.; and the question arises whether this is not the species Sonnerat figured. As is the case in India, it is not impossible that both species inhabit the Philippines and also Celebes. Without inquiring into the validity of *C. minutus*, Pallas, and whether or not it indicates only *C. curonicus* in young plumage, as maintained by O. Finsch and Hartlaub (Orn. Ost-Afr. p. 661), these gentlemen seem to have been somewhat hasty in identifying Sonnerat's bird with *Æ. curonicus* (Gm.). Sonnerat states that the bill and feet are "noirâtres." Both Sonnerat and Buffon (Hist. Nat. viii. p. 93), who refers to Sonnerat's Philippine specimen, say that the Philippine species differs but little from the European Little Ring-Plover. But both those authors included it also among North- and South-American species, and Buffon hardly recognized the specific distinctness of *Æ. hiaticula*.

Æ. minutus (Pall.) ap. Jerd., is a smaller and more delicately formed species. In plumage it closely resembles *Æ. curonicus*, but has the head-markings better defined than those of any example of that species I have as yet seen. Its chief distinction is to be found in the smallness of the feet and shortness of the legs. A Katmandoo specimen has the legs dark reddish brown, instead of yellow. It behoves naturalists in India to investigate these differences. I am inclined to believe in there being two species, but have not been able to examine a sufficiency of individuals to form a decided opinion. Should the Philippine smallest Ring-Plover prove identical with the European *C. curonicus*, Gm., both will have to take the title of *dubius*, Scop.

Æ. minutus (Pall.) ap. Jerd. may be identical with *Charadrius pusillus*, Horsf. Trans. Linn. Soc. xiii. p. 187, ex Java.

Table of Dimensions.

| | Wing. | Tarsus. | Tail. | Bill. | |
|---|--------------------|---------|---------|-------|--|
| | inches. | inch. | inches. | inch. | |
| <i>Æ. curonicus</i> (<i>Gm.</i>) .. | 4.500 | .8750 | 2.875 | .5000 | Piedmont. ♀. May; not quite full plumage. |
| " " .. | 4.750 | .8750 | 2.875 | .5000 | Europe. Not quite full plumage. |
| " " .. | 4.625 | .8750 | 2.625 | .5625 | Bengal. Not quite full plumage. |
| " " .. | 4.500 | .8750 | 2.625 | .5000 | Malta, April 4. Not quite full plumage. |
| " " .. | 4.250 | .8750 | 2.875 | .5000 | Malta, April 4. Not quite full plumage. |
| " " .. | ¹ | .8750 | 2.750 | .5625 | Calcutta, February. Not full plumage. |
| " " .. | 4.875 | .8750 | 2.750 | .5000 | Turkey, May 7. Almost full plumage. |
| " " .. | 4.625 | .8750 | 2.750 | .5000 | Abyssinia, R. Amba, August 21. ♂. Young plumage. |
| " " .. | 4.875 | .8750 | 2.750 | .5000 | Coorg. Winter? or first plumage? |
| " " .. | 4.625 | .8750 | 2.750 | .5000 | Coorg. Winter? or first plumage? |
| <i>Æ. minutus</i> (<i>Pall.</i>), ap. | | | | | |
| <i>Jerd.</i> ? | 4.250 | .7500 | 2.375 | .4375 | Candeish. Full plumage. |
| " " .. | 4.125 | .7500 | 2.875 | .5000 | Candeish. Full plumage. |
| " " .. | 4.375 | .7500 | 2.875 | .4375 | North-western India. Full plumage. |
| " " .. | 4.375 | .7500 | 2.875 | .5000 | Maunbhoom, December 16. Full plumage. |
| " " .. | 4.125 | .6875 | 2.875 | .3750 | Katmandoo. Full plumage. |

142. *ÆGIALITES PERONII* (Temm.), Schlegel, Mus. Pays-Bas, *Cursores*, p. 33, "l'Archipel Indien" (March 1865); Swinhoe, P. Z. S. 1870, p. 139. (Pl. X. fig. 2.)

Hab. Borneo, Java, Semaou (*Schlegel*); Macassar (*Wallace*).

An example of this species in summer plumage was obtained by Mr. Wallace in Celebes. Mr. Swinhoe, who has also examined this individual, agrees with me in identifying it as above. It belongs to the subsection of which *Æ. cantianus* may be regarded as the type. As it is a rare species, I append the following description:—

Forehead, from the base of the bill, pure white; a broad white superciliary stripe, confluent with the white forehead, terminates above the black ear-coverts; narrow frontal band, lores, ear-coverts, and a broad band crossing the back and reaching to the sides black; a black pectoral stripe, continued from the black sides, is narrowed into a thin line on the breast, where it does not quite meet; this excepted, the entire under surface, cheeks, under wing-coverts, and a broad nuchal collar pure white. Upper plumage pale earthy brown, most of the feathers with albescent edgings, conspicuous on the wing-coverts, some of which are edged with a purer white; primaries reddish brown; secondaries paler brown, broadly margined on the inner webs, and tipped with white, more or less cinereous; all the shafts white; three outer pairs of rectrices pure white; the next pair pale brown, much mixed with white (the rest of the rectrices are absent in this example); bill jet-black, no trace of any other colour; legs, in dried skin, pale yellow brown. Wing $3\frac{3}{4}$, bill from forehead $\frac{6}{8}$, tarsus 1, tail $1\frac{6}{8}$.

The frontal white patch is broad, more so than in European examples of *Æ. hiaticula*. In proportion the black frontal band is narrow, and is not posteriorly edged with white.

¹ First primaries wanting.

STREPSILAS, Illiger.

143. STREPSILAS INTERPRES (Linn.), Syst. Nat. ed. 12, i. p. 248; Schlegel, Mus. Pays-Bas, *Cursores*, p. 43.

Hab. Celebes (*Mus. Lugd.*): almost universal.

ESACUS, Lesson.

144. ESACUS MAGNIROSTRIS (Geoffroy St.-Hilaire): Vieill. N. Dict. xxiii. p. 231 (1818), nec Latham.

Ædicnemus magnirostris, Geoffroy, Temm. Pl. Col. 387, "Celebes;" Wagler, Syst. Av. *Charadrius*, no. 3, "New Holland" (1827); Schlegel, Mus. Pays-Bas, *Cursores*, p. 22.

Charadrius giganteus, Lichtenst.; Wagler, Isis, 1829, p. 647, "New Holland."

Esacus magnirostris, Geoffroy, Gould, Hand-b. B. Austr. ii. p. 213.

— — (Latham), Wall. P. Z. S. 1862, p. 346, nec Latham.

Hab. Celebes (*Reinwardt*); Island of Raou, near Morty, Island of Moor, east coast of Gilolo, Waigiou, Bangka (*Mus. Lugd.*); northern and north-western parts of Australia (*Gould*); Sula Islands, New Guinea (*Wallace*).

The Australian "Great-billed Plover" of Latham (Syn. Supp. ii. p. 319, *C. magnirostris*, Lath. Ind. Orn. Supp. p. 66) has been shown by Mr. Strickland (Ann. Nat. Hist. xi. p. 337) to be nothing but *Ædicnemus grallarius* (Lath.). Consequently Illiger's genus *Burhinus* (Prodrom. p. 250, 1811), founded on *C. magnirostris*, Lath., is synonymous, not with *Esacus*, but with *Ædicnemus*, over which generic title it takes priority.

The name *magnirostris*, Geoffroy, seems to have been an unpublished museum title. I can find no earlier description of the species than that of Vieillot's (*l. c.*), who adopted the name from the Paris Museum.

Temminck figured (*l. c.*) a Celebean example collected by Reinwardt; but he united with it as belonging to one species individuals from India, Java, and *les îles Papous*. The Celebean bird in size, he observes, holds a middle place between the Indian and the Papuan, the last being the largest and having the plumage very dark-coloured. The Indian *E. recurvirostris* (Cuv.) is a recognized species; but may not the Celebean bird prove to be a species distinct from the Australian? Professor Schlegel unites the archipelagic with the Australian; but have they been compared?

HIMANTOPUS, Brisson.

145. HIMANTOPUS LEUCOCEPHALUS, Gould, P. Z. S. 1837, p. 26, "Australia, Java, Sumatra;" Birds Austr. vi. pl. 24; Schlegel, Mus. Pays-Bas, *Scelopaces*, p. 106; *conf.* Blyth, Ibis, 1865, p. 35.

Hab. Gorontalo, October 9 (*Forsten*); Ayer-pannas, August 14; Limbotto, August 29; Wawou, a few days old, August 27 (*Rosenberg*); Bengal (*H. intermedius*, Blyth,

J. A. S. B. ?; Cat. Mus. Calc. no. 1573); rare in India, J. A. S. B. 1845, p. 459 (*Blyth*); Java, Borneo, Amboyna, Ternate, Sumbawa, Timor, Lobo (New Guinea) (*Mus. Lugd.*); Australia (*Gould*).

RALLIDÆ.

PORPHYRIO, Brisson.

146. PORPHYRIO INDICUS, Horsf. Trans. Linn. Soc. xiii. p. 194, "Java" (1822, read 18th of April 1820); Schlegel, Mus. Pays-Bas, *Ralli*, p. 55; Finsch & Hartl. Faun. Centralpolyn. *Aves*, p. 170, pl. xii. f. 2.

Porphyrio smaragdinus, Temm. Pl. Col. 421, "Java" (February 1827).

Hab. Macassar, Menado (*mus. nostr.*); Tondano, 21st of April (*Forsten*); Gorontalo, 18th of April, 24th of May, 26th of June; Ayer-pannas, 11th of August (*Von Rosenberg*); Java (*type*); Ceram, Bouru (*Mus. Lugd.*); Banda (*G. R. Gray*); Sumatra (*Cassin*); Samoa Islands (*Peale*).

The absolute identity of the race of purple Coots inhabiting the islands above cited has yet to be established. To the Ceram race Temminck applied the title of *melanopterus*; that of Samoa has received the designation of *samoënsis*, Peale. It is true that the late Mr. Cassin could detect no difference between the Samoan and the Javan *Porphyrio*; and Messrs. Finsch & Hartlaub (*l. c.*) agree in uniting them. On the other hand, Professor Schlegel has observed slight distinctions between the individuals inhabiting Java, Celebes, and Ceram. I have not been able to compare a sufficient series in full plumage to form a decided opinion. But Celebean birds appear to have the throat, upper breast, and shoulder-coverts of a much richer and deeper blue than what I have found in Javan examples. I am unable to discover sufficient evidence to justify Latham's title of *poliocephalus* (Suppl. Ind. Orn. p. 58) being applied to the Philippine *Porphyrio*, rather than to the one of Continental India (*P. neglectus*, Schlegel). Latham's *Grey-headed Gallinule* (Syn. Suppl. ii. p. 375) was described by him from a drawing by General Davies, of an individual in Exeter Change. The description agrees well enough with the Indian bird, and better than with the Philippine. It is certainly not sufficiently minute to enable us to refer it without doubt to the latter species, *P. pulverulentus*, Temm. (Pl. Col. 405, erroneously given from Africa); while the probabilities are in favour of the type having come to London from India, and not from the Philippines.

HYDRALECTOR, Wagler.

147. HYDRALECTOR GALLINACEUS (Temm.): Pl. Col. 464, "Moluques" (5th of July 1828); Gould, Birds Austr. vi. pl. 75.

Parra cristata, Vieill., Schlegel, Mus. Pays-Bas, *Ralli*, p. 68.

Hab. Menado, Macassar (*mus. nostr.*); Ayer-pannas, adult male, 21st of August,

adult female, 18th of August, male partly moulting, 22nd of August, young female, 21st of August; Limbotto, adult male of small dimensions, 31st of August, female moulted, 29th of August; Gorontalo, adult female, 30th of April; Wawou, very young male, 27th of August (*Von Rosenberg*); Gorontalo, young female, 29th of June (*Forsten*); Port Essington, Eastern Australia (*Gould*); Queensland (*mus. nostr.*).

Temminck (*l. c.*) states that this is a bird of passage at Amboyna. Mr. Gould (Handbook, Austr. ii. p. 331, where an interesting account of its habits is given) mentions that it is a native of New Guinea. No authority is quoted; and I can find no confirmation of the statement. Professor Schlegel confines its range to Celebes and Australia. It breeds in Eastern Australia (*Gould, l. c.*); but unfortunately the month is not stated.

I cannot follow Professor Schlegel (*l. c.*) in referring this species to *P. cristata*, Vieill. (N. D. xvi. p. 430, ex Ceylon). Vieillot's title was given to *Le Grand Jacana verd à crête* of Temminck (Cat. Syst. Cabinet d'Ornith. p. 265. no. 403, 1807), whose description Vieillot reproduces almost word for word. Temminck's *Jacana*, as has already been shown by Dr. Hartlaub (Syst. Index, in Jard. Contrib. Ornith. 1849), is clearly *Parra indica*, Lath. (Ind. Orn. ii. p. 765, 1790). Wagler (Isis, 1832, p. 280) gives both *P. cristata* and *P. gallinacea* as the types of his genus *Hydralector*. But the generic character, "Ein aufrecht stehender Fleischkamm am Kopfe," evidently indicates *P. gallinacea* as the generic type.

My Macassar example, an adult, only differs from a Menado individual by being much smaller. Wing $4\frac{2}{8}$ against $5\frac{6}{8}$. All the other dimensions proportionally less; it is therefore probably a male. A Queensland example, a young bird, crown and nape rich rufous intermixed with black, only differs in having a much stouter bill.

GALLINULA, Brisson.

148. GALLINULA FRONTATA, Wallace, P. Z. S. 1863, p. 35, "Bouru."

Gallinula hæmatopus, Temm. Mus. Lugd.; Schlegel, Mus. Pays-Bas, *Ralli*, p. 44, "Celebes."

Hab. Menado (*mus. nostr.*); Ayer-pannas, 12th of August, adult male, 17th of August, adult female, 26th of August, female, 19th of August, young, one day old; Panybie, 9th of September, female of the year; Limbotto, 4th of September, female of the year, 31st of August, male and female of the year, 28th of August, female (*Von Rosenberg*); Amboyna (*Mus. Lugd.*); Bouru (*type*).

Professor Schlegel, in his admirable list of the birds of the Leyden Museum, the most perfect and practically useful work of its kind ever published, identifies the Celebean bird with that described by Mr. Wallace from Bouru. Temminck's MS. title of *hæmatopus* had never been hitherto used, except by Bonaparte (Comptes Rend. xliii. p. 600, 1856), and then only as a synonym of the nearly allied *G. tenebrosa*, Gould (P. Z. S. 1846, p. 20). I have therefore retained Mr. Wallace's title for the species.

It must, however, be remembered that no actual comparison appears as yet to have been made between Bouru and Celebean examples.

149. *GALLINULA ORIENTALIS*, Horsf. Trans. Linn. Soc. xiii. p. 195, "Java" (1822).

Gallinula ardosiacea, Vieill. Galerie, ii. p. 173, pl. 268, "Java" (1825).

Hab. Java (*Horsfield*); Macassar (*Wallace*).

An example of an adult male Moor-hen, closely resembling the common European species, was collected by Mr. Wallace at Macassar. It differs from *G. chloropus* in its smaller dimensions, and the size and form of the frontal plate. I have been unable to compare it with Javan individuals; but I shall provisionally adopt the title of the race which inhabits Java. Wing $5\frac{7}{8}$, tarsus $1\frac{7}{8}$, bill from anterior side of plate to tip $1\frac{1}{16}$, greatest breadth of frontal plate $\frac{7}{16}$.

ERYTHRA, Reichenbach.

150. *ERYTHRA PHENICURA* (Forsten): Zool. Ind. p. 19, pl. 9, "Ceylon" (1781).

Hab. Macassar (*Reinwardt*); Gorontalo, adult male, 20th of April, 17th of July, 1st of August—male with some black spots on sides of head, 26th of May; Negrielama, male in first plumage, 20th of September (*Von Rosenberg*); Gorontalo, male in imperfect plumage, October (*Forsten*); Banka, Java, Borneo (*Mus. Lugd.*); China, summer visitant (?), Formosa (*Swinhoe*); throughout India (*Jerdon*); Ceylon (*type*); Zamboanga (Mindanao) (*Von Martens*); Malayan peninsula (*Eyton*).

ORTYGOMETRA, Linnæus.

151. *ORTYGOMETRA CINEREA* (Vieillot): Nouv. Dict. d'Hist. Nat. xxviii. p. 29 (1819), ex Java; Pucheran, Rev. et Mag. Zool. 1851, p. 563; Schlegel, Mus. Pays-Bas, *Ralli*, p. 32.

Ortygometra quadristrigata (Horsf.), Finsch et Hartl. Fauna Centralpolyn. p. 164.

Hab. Gorontalo, April 21, May 23; Ayer-pannas, August 25, female in first plumage, August 25 (*Von Rosenberg*).

For the geographical distribution of this species and its complete synonymy, exclusive of the title, *conf.* Finsch and Hartl. *l. c.* Those gentlemen seem to have overlooked in this and in one or two other instances Dr. Pucheran's valuable notices of the types contained in the Paris Museum. According to the learned doctor, *Porphyrio cinereus*, Vieill., was collected in Java by Labillardière. This species is included in Mr. Hodgson's Catalogue of the Birds of Nipaul (J. A. S. Bengal, 1855, p. 381. no. 765) under the title of *Zapornia nigrolineata*. Mr. G. R. Gray, Cat. B. Mus. Nepal, 1846, p. 143, identified *Z. nigrolineata*, Hodgson, with *Rallus superciliaris*, Eyton, ex Malacca, and in the 3rd edition of that catalogue (1863) adopted Eyton's specific title. Mr. Blyth (Cat. Calc. Mus. p. 339) includes Nipaul within the range of *R. superciliaris*, Eyton.

Professor Schlegel (*l. c.*) has identified Eyton's species with *P. cinereus*, Vieill.; and Drs. Finsch & Hartlaub (*l. c.*) with *R. quadristrigatus*, Horsf. The species, however, is not included in Dr. Jerdon's work as an inhabitant of India.

HYPOTÆNIDIA, Reichenbach.

152. HYPOTÆNIDIA CELEBENSIS (Quoy et Gaimard), Voy. Astrol. Zool. i. p. 250, "Celebes," pl. 24. f. 2; Schlegel, Mus. Pays-Bas, *Ralli*, p. 22.

Hab. Menado (*Forsten*); Gorontalo, Limbotto (*Von Rosenberg*).

This is a representative form of the Philippine *Rallus torquatus*, Linn. (Schlegel, *l. c.*). Von Pelzeln (Novara, *Aves*, p. 134), with doubt, refers an example of a young Rail from Borneo to the Celebean species.

153. HYPOTÆNIDIA STRIATA (Linn.), Syst. Nat. ed. 12, i. p. 262 (1766), ex Brisson, "Philippines."

Rallus gularis, Horsf. Trans. Linn. Soc. xiii. p. 196, "Java" (1822).

Hab. Philippines (*type*); all India and Ceylon, Burmah (*Jerdon*); Sumatra (*Raffles*); Java (*Horsfield*); Cochinchina (*Diard*); Formosa (*Swinhoe*); China (*Mus. Lugd.*); Menado (*Wallace*); Banjarmassing (*Sclater*).

Mr. Wallace obtained near Menado a female example of a Rail which so well agrees with Brisson's description of the Philippine bird, that I have little hesitation in making the above identification. It must, however, be noted that, in the specimen referred to, the under tail-coverts are distinctly pale rufous and black, and not white and black.

154. HYPOTÆNIDIA PHILIPPENSIS (Linn.), Syst. Nat. ed. 12, i. p. 263 (1766), ex Brisson, Orn. v. p. 163, "Philippines;" Schlegel, Mus. Pays-Bas, *Ralli*, p. 25.

Rallus pectoralis (Cuvier), Lesson, ap. Finsch et Hartl. Faun. Centralpolyn. p. 157, nec Cuv.; conf. Pucheran, Rev. et Mag. Zool. 1851, p. 276.

Hab. Macassar (*mus. nostr.*); Tondano, in September (*Forsten*); Gorontalo, April 17, 24, May; a chick newly hatched, August 4 (*Von Rosenberg*); Australia (*Gould*); New Caledonia (*Verreaux et O. des Murs*); Philippines (*type*).

The Celebean bird has the nape rusty as in Australian individuals. In the event of the Philippine species proving distinct, the birds from the other localities above given will require a different title. Messrs. Finsch & Hartlaub (*l. c.*) have adopted Cuvier's title of *pectoralis*, copied by Lesson (Tr. p. 536), for this species, although Dr. Pucheran (*l. c.*) had shown that the type of *R. pectoralis*, Cuv., was *R. lewinii*, Swains. (*conf.* Hartl. J. für Orn. 1855, p. 420).

RALLINA, Reichenbach.

155. RALLINA MINAHASA, Wallace, P. Z. S. 1862, p. 346, "Sula Islands, Minahasa."

Hab. Minahasa (N. Celebes), Sula Islands (*Wallace*).

156. RALLINA ISABELLINA (Temm.), Schlegel, Mus. Pays-Bas, *Ralli*, p. 16 "Celebes" (1865).

Hab. Gorontalo, *type* (*Forsten*); Ayer-pannas, Modelido (*Von Rosenberg*).

157. RALLINA (?) ROSENBERGII, Schlegel, Nederl. Tijdschr. Dierk. 1866, p. 213, "Kema."

Hab. Kema (*Von Rosenberg*).

SCOLOPACIDÆ.

NUMENIUS, Linnæus.

158. NUMENIUS PLEOPUS (Linn.), Syst. Nat. ed. 12, i. p. 243 (1766); Schlegel, Mus. Pays-Bas, *Scolopaces*, p. 97.

Hab. Bonthain, South Celebes, March 7th (*S. Müller*); Tondano, North Celebes (*Forsten*); The Old World and Australia.

Until the breeding-grounds of the so-called distinct species of Whimbrels are discovered it is useless to attempt discriminating between them. Both the Celebean examples in the Leyden Museum possess the characters whereby Mr. Gould has distinguished his *N. uropygialis*.

159. NUMENIUS MINUTUS, Gould, P. Z. S. 1840, p. 176, "New South Wales;" Schlegel, Nederl. Tijdschr. Dierk. 1866, p. 348.

Numenius minor, S. Müller, Verhandl. p. 110, "Amboyna;" Schlegel, Faun. Japon. *Aves*, p. 111, pl. 67.

Hab. North Celebes, Aru Islands (*Schlegel*); Japan (*Von Siebold*); Amboyna (*S. Müller*); coasts of China (*Swinhoe*); New S. Wales, Port Essington (*Gould*).

ACTITIS, Illiger.

160. ACTITIS GLAREOLA (Gm.), Syst. Nat. ed. 13, i. p. 677 (1788); Schlegel, Mus. Pays-Bas, *Scolopaces*, p. 73.

Hab. Gorontalo, October 9th (*Forsten*); Europe, Africa, Asia and its islands.

161. ACTITIS HYPOLEUCOS (Linn.), Syst. Nat. ed. 12, i. p. 250 (1766); Schlegel, Mus. Pays-Bas, *Scolopaces*, p. 83.

Hab. Gorontalo, in October (*Forsten*); Europe, Africa, Australia, Asia and its islands.

TOTANUS, Bechstein.

162. TOTANUS GLOTTIS (Linn.), Syst. Nat. ed. 12, i. p. 245 (1766); Schlegel, Mus. Pays-Bas, *Scolopaces*, p. 63.

Hab. Celebes, in winter plumage (*Forsten*); Bonthain, South Celebes, in March (*S. Müller*): universal.

163. TOTANUS CALIDRIS (Linn.), Syst. Nat. ed. 12, i. p. 245 (1766); Schlegel, Mus. Pays-Bas, *Scolopaces*, p. 67.

Hab. Celebes, winter plumage, November (*Forsten*); Europe, Asia and its islands, Africa.

LIMOSA, Brisson.

164. LIMOSA UROPYGIALIS, Gould, P. Z. S. 1848, p. 38, "Australia;" Birds. Austr. vi. pl. 29; Schlegel, Mus. Pays-Bas, *Scolopaces*, p. 25.

Hab. Celebes, in November (*Forsten*); Gilolo (*Bernstein*); Java (*Van Hasselt*); Timor (*Müller*); Japan, New Zealand (*Mus. Lugd.*); Australia (*type*). (*Conf.* Finsch & Hartl. Fauna Centralpolyn. p. 177.)

TRINGA, Linnæus.

165. TRINGA MINUTA, Leisler, Nachtr. Bechst. Naturgesch. Deutschlands, Heft i. p. 74 (1811-15); Schlegel, Mus. Pays-Bas, *Scolopaces*, p. 46.

Hab. Celebes, in November, winter plumage (*Forsten*); Europe, Africa, Asia, Malay archipelago, New Guinea, Australia (*Mus. Lugd.*).

166. TRINGA DAMACENSIS (Horsf.), Trans. Linn. Soc. xiii. p. 192, "Java" (1822); Swinhoe, P. Z. S. 1863, p. 316; Schlegel, Mus. Pays-Bas, *Scolopaces*, p. 49.

Tringa subminuta, Von Middendorf, Sibir. Reise, Vögel, p. 222, pl. 19. f. 6 (tarsus).

Hab. Tondano, winter plumage; Tondano, male, partly in nuptial plumage, September; Gorontalo, male, winter plumage, October 9th; Celebes, moulting into perfect plumage (*Forsten*); Java (*type*); Borneo (*Schwaner*); China, Formosa (*Swinhoe*); Eastern Siberia (*Von Middendorf*); Amoor river (*Schrenck*).

LOBIPES, Cuvier.

167. LOBIPES HYPERBOREUS (Linn.), Syst. Nat. ed. 12, i. p. 249 (1766); Schlegel, Mus. Pays-Bas, *Scolopaces*, p. 59.

Phalaropus australis, Temm. Mus. Lugd.; Bp. Compt. Rend. xlii. p. 421 (1856), "Celebes," *vide* Schlegel, *l. c.*

Hab. Celebes, winter plumage (*Reinwardt*); Amboyna, winter plumage (*Hoedt*); Aru Islands, in winter plumage (*Wallace*); Madras (*Jerdon*); Peninsula of Luichow, April 3rd (*Swinhoe*); high latitudes of northern hemisphere, in summer.

Are the Moluccas the only, or at least the principal, winter residence of this species? Its occurrence has only been once observed in India.

GALLINAGO, Stephens.

168. GALLINAGO MEGALA, Swinhoe, Ibis, 1861, p. 343, "Amoy;" Schlegel, Mus. Pays-Bas, *Scolopaces*, p. 12.

Hab. Gorontalo (*Forsten*); Gilolo, Batchian (*Bernstein*); China, Formosa (*Swinhoe*).

ARDEIDÆ.

ARDEA, Linnæus.

169. ARDEA SUMATRANA, Raffles, Trans. Linn. Soc. xiii. p. 325, "Sumatra" (1822); Jerd. Birds Ind. ii. p. 740; Gould, Birds Austr. ii. p. 296.

Ardea typhon, Temm. Pl. Col. 475, "river Gambia" (*errore*), (Sept. 5, 1829); Schlegel, Mus. Pays-Bas, *Ardea*, p. 3.

— *rectirostris*, Gould, P. Z. S. 1842, p. 22, "New South Wales."

— *fusca*, Blyth, Ann. Nat. Hist. xiii. p. 176, "Arracan" (1844).

— *insignis*, Hodgs., Gray's Zool. Misc. p. 86.

Typhon robusta (S. Müll.), Bp. Consp. ii. p. 110, "Timor."

Ardea goliath, Temm., Bp. *l. c.*, "Celebes."

Ardeomega nobilis, "Blyth," Bp. *l. c.*, *nec* Blyth. (*Conf.* Blyth, Ibis, 1865, p. 36.)

Hab. Celebes (*Reinw.*); "Inde continentale," type of *A. typhon*, Temm. (*Schlegel*); Morty Island, Batchian, Toloforo (Gilolo) (*Bernstein*); Sumatra (*Raffles*); Coburg Peninsula (*Gould*); Clarence river (Australia) (*Schlegel*); Arracan (*Blyth*); N.-E. Bengal, Nepaul, Sikim, Terai, Assam (*Jerdon*); Sindh (*drawing*, *Sir A. Burnes*); Flores (*Wallace*).

ARDEOLA, Boie.

170. ARDEOLA SPECIOSA (Horsf.), Trans. Linn. Soc. xiii. p. 188, "Java" (1822); Zool. Res. pl. —.

Hab. Java (*type*); Celebes (*Wallace*).

I include the Javan form of *A. leucoptera*, Bodd., = *A. malaccensis*, Gm., on the authority of Mr. Wallace.

There appear to be four closely allied Asiatic species of *Ardeola*; but they yet require to be brought together and closely compared.

1. *A. leucoptera*, Bodd., ex Pl. Enl. 911, = *A. malaccensis*, Gm., ex Pl. Enl. 911, "Malacca," av. juv. *Buphus bacchus*, Bp., having been described from a Malaccan individual, becomes a synonym of the type species.

2. *A. grayi*, Sykes, "India," = *A. leucoptera*, Bodd., ap. Jerdon (B. of Ind.).

3. *A. speciosa*, Horsf., "Java." Most probably the same as the Malaccan form. Stated by Professor Schlegel to also occur in Sumbawa and Borneo.

4. *A. prasinoseles*, Swinhoe, "China."

Not recognizing the fact that Boddart and Gmelin founded their titles on the same

plate, Mr. Blyth (*Ibis*, 1865, p. 38) called the Indian bird *leucoptera*, Bodd., and that of the Malayan peninsula and Sumatra *malaccensis*, Gm.

HERODIAS, BOIE.

171. HERODIAS NIGRIPES (Temminck), *Man. d'Orn.* 2nd edit. part iv. p. 376, "L'Archipel des Indes" (1840); Schlegel, *Mus. Pays-Bas, Ardeæ*, p. 14, "Lac de Gorontalo, Celebes."

Not possessing a sufficient number of examples of *H. garzetta* (Linn.) and its allies to attempt an elucidation of its races, their habitats, and synonymy, I have followed Temminck, and given to the Celebean bird the title by which the Dutch zoologist distinguished the little Egret of India, of the Malay archipelago, and of New Guinea, from the European, North Asiatic, and Japanese bird. Professor Schlegel (*l. c.*) does not admit their specific distinction, and includes all under *A. garzetta*, Linn. To him we owe the important fact that Temminck founded his *A. nigripes* on examples from Java, Borneo, and Celebes now in the Leyden Museum. We are thus provided with a clue to the maze of confusion into which Prince Bonaparte (*Consp.* ii.) has thrown the synonymy of the White Egrets (*conf.* Schlegel, *op. cit.* p. 19).

172. HERODIAS EGRETTE (Gm.), *Syst. Nat.* ed. 13, i. p. 629 (1788), *ex Buff. Hist. Nat. Ois.* vii. p. 377, "America;" Schlegel, *Mus. Pays-Bas, Ardeæ*, p. 17.

Hab. Gorontalo (*Forsten*).

I adopt Professor Schlegel's determination with reserve, its correctness depending on the identity of the Asiatic with the American bird. The Celebean example is probably the *H. alba* (L.), *ap. Jerd.* (*Birds of India*), = *A. modesta*, Gray & Hardw., *A. alba vera* being restricted by Professor Schlegel to Southern Europe, Northern Africa, and Western Asia. The history of the Egrets has yet to be written.

ARDETTA, G. R. Gray.

173. ARDETTA SINENSIS (Gm.), *Syst. Nat.* ed. 13, i. p. 642 (1788), *ex Lath.*, "China."

Ardea melanoptera, Cuvier, *Mus. Paris. Puch.*; *Rev. Mag. Zool.* 1851, p. 575.

— *melanophis*, Cuv., *ap. Less. Tr.* p. 573, *errore*.

— *lepida*, Horsf. *Trans. Linn. Soc.* xiii. p. 190, "Java."

— *melanotis*, Cuv., *ap. G. R. Gray, Genera*, iii. *Append.* p. 25, *errore*.

Hab. Menado (*mus. nostr.*); all India (*Jerdon*); Java (*Horsf.*); Ceylon, Arracan (*Blyth*); China, from Canton to Tientsin, Formosa, in summer (*Swinhoe*); Borneo, Philippines (*Mus. Lugd.*); Ladrone or Marian Isles (?) (*G. R. Gray*).

I cannot concur with Mr. Blyth nor with Dr. Jerdon in regarding *Ardea nebulosa*, Horsf. (*l. c.*), as belonging to this species. Horsfield's diagnosis applies far better to *Ardetta cinnamomea* (Gm.). The expression "*cauda remigibusque badiis*" appears to me conclusive.

DEMIEGRETTE, Blyth.

174. DEMIEGRETTE SACRA (Gm.), Syst. Nat. ed. 13, i. p. 640, ex Latham.

Hab. Menado (*mus. nostr.*).

Two examples of an Ashy Egret were received from Menado in the dark ashy phase, but wanting the crest, dorsal trains, and pectoral plumes of the breeding-plumage. Both have a narrow median white line commencing at the chin and descending, with broken intervals, down the throat. No other part of the plumage is white. The wing measures $10\frac{1}{4}$ inches; the bill, from the forehead, 3 inches; the tarsus $2\frac{3}{4}$ inches; middle toe, without the nail, $1\frac{3}{4}$ inch. The dimensions of the bill, tarsus, and middle toe are much less than those given by Dr. Jerdon of the Indian bird, *D. asha* (Sykes).

Dr. O. Finsch (Centralpolyn. p. 201) has united all the titles given to the numerous named local races of this species under Gmelin's title of *sacra*, bestowed by him on the Sacred Heron of Latham, brought by Sir J. Banks from Otaheite. A want of a sufficient number of examples prevents me from questioning the correctness of this deduction, and I therefore provisionally adopt Gmelin's title. For an elaborate essay on the species, *conf.* Finsch & Hartl. *l. c.*

NYCTICORAX, Stephens.

175. NYCTICORAX GRISEUS (Linn.), Syst. Nat. ed. 12, i. p. 239 (1766); Schlegel, Mus. Pays-Bas, *Ardeæ*, p. 58.

Hab. Gorontalo (*Forsten*); Europe, Africa, Asia, America (*Ardea gardeni*, Gm.).

176. NYCTICORAX CALEDONICUS (Gm.), Syst. Nat. ed. 13, i. p. 626, "Nova Caledonia" (1788), ex Lath. Syn. iii. p. 55; Schlegel, Mus. Pays-Bas, *Ardeæ*, p. 59.

Ardea maculata, Lath. Ind. Orn. Supp. p. lxiv (1801), "New Holland," *vide* Strickl. Ann. Nat. Hist. xi. p. 338, *av. juv.*

Hab. Macassar (*S. Müller*); Tondano (*Forsten*); Timor, Gilolo, Morty Island, Amboyna (*Mus. Lugd.*); New Caledonia (*type*); Australia (*Gould*); Cape York (*mus. nostr.*).

Ardea caledonica, Forster, *apud* Meyen (N. Act. Ac. C. L. C. xvi. Suppl. prim. p. 103), seems to be *Nycticorax manilensis*, Vigors; and I have therefore omitted the Philippines from the range of Gmelin's species.

BUTORIDES, Blyth.

177. BUTORIDES JAVANICA (Horsf.), Trans. Linn. Soc. xiii. p. 190, "Java" (1822); Schlegel, Mus. Pays-Bas, *Ardeæ*, p. 44.

Hab. Gorontalo (*Forsten*); Menado (*mus. nostr.*).

The range of this Heron cannot be accurately stated until its conspecies have been studied and defined. *Conf.* Finsch & Hartl. Faun. Centralpolynes. p. 207, by whom, however, no specific differences are admitted to exist. My Menado example is in full

breeding-plumage, and conspicuously differs from Indian and Cingalese examples in having the crown and crest dark green, almost black, instead of a much lighter shade of green. Other differences are to be detected, which may not prove constant. For instance, in a Ceylon example, all the wing-coverts, and the four secondary quills nearest the body, are bordered with bright ochreous yellow, and not with white as in the Menado individual. If the Menado bird agrees with the Javan, Mr. Hodgson appears to have been justified in separating the continental form under the title of *chloriceps*.

CICONIIDÆ.

MELANOPELARGUS, Reichenbach.

178. MELANOPELARGUS EPISCOPUS (Bodd.), Tabl. Pl. Enl. (1783), ex Daubent. Pl. Enl. 906. *Ardea leucocephala*, Gm. Syst. Nat. ed. 13, i. p. 642, "Coromandel" (1788), ex Buffon, Hist. Nat. Ois. vii. p. 370; Schlegel, Mus. Pays-Bas, *Ciconiæ*, p. 11.

Hab. Saoussou, in June (*Rosenberg*); Ceylon (*mus. nostr.*); all India, Burma (*Jerdon*); Java, Borneo (*Mus. Lugd.*); Tropical Africa (*Schlegel*). *Conf.* O. Finsch & Hartl. Vög. Ost-Afr. pp. 722, 723.

TANTALIDÆ.

FALCINELLUS, Bechstein.

179. FALCINELLUS IGNEUS (S. G. Gmelin), Nov. Comm. Ac. Scient. Imp. Petropol. xv. p. 460, pl. 18¹ (1771).

Numenius viridis, S. G. Gmelin, *op. cit.* p. 462, pl. 19.

Tantalus castaneus, P. L. S. Müller, Syst. Nat. Suppl. p. 112 (1776), ex Marsigli.

Falcinellus peregrinus (S. Müller), Mus. Lugd., Bp. Consp. ii. p. 159, "Celebes, Java" (1857).

Ibis falcinellus, Vieill., Schlegel, Mus. Pays-Bas, *Ibis*, p. 2.

Tantalus falcinellus, Linn. S. N. ed. 12, i. p. 241 (1766).

Hab. Gorontalo, female, moulted, 30th September—male, in almost perfect plumage, 1st October—female in almost perfect plumage, September—male, moulted 30th September; Northern Celebes, male in perfect plumage; Celebes, examples in first plumage (*Forsten*); Macassar, female, moulted, March (*S. Müller*).

I do not venture on the general distribution of the Glossy Ibis, as it is still an open question whether the European, Asiatic, American, African, and Australian races are identical (*conf.* Bp. *l. c.*). S. Müller's specimen of *Inocotis papillosa* (Temm.), stated by Prince Bonaparte (*op. cit.* ii. p. 154) to have been collected in Celebes, came from Borneo (*conf.* Schlegel, *op. cit.* p. 10).

¹ J. F. Gmelin (S. N. p. 649) quotes the thirteenth plate, thus copying a misprint in S. G. Gmelin's text. The thirteenth plate represents *Caccabis rufa* (Linn.).

ANSERES.

ANATIDÆ.

QUERQUEDULA, Stephens.

180. QUERQUEDULA CIRCIA (Linn.), Syst. Nat. ed. 12, i. p. 204.

Anas querquedula, L., Schlegel, Mus. Pays-Bas, *Anseres*, p. 49.

Hab. Limbotto, 8th January, male in imperfect plumage—6th and 13th January, females (*Von Rosenberg*); Europe, Northern Africa, Asia to Island of Formosa.

Q. humeralis, Müller (Verhandl. p. 159), described from examples obtained on the north shores of Java, is not admitted to be distinct by Professor Schlegel.

MARECA, Stephens.

181. MARECA GIBBERIFRONS, S. Müller, Verhandl. p. 159, "Celebes;" Schlegel, Mus. Pays-Bas, *Anseres*, p. 58.

Anas gracilis, Buller, Ibis, 1869, p. 41, "New Zealand."

Hab. Gorontalo, young bird and an adult male; Menado, adult male; Tondano, male; Pegoiat, female, in November (*Forsten*); Ayer-pannas, 18th August, male, 13th August, female; Panybie, 13th September, female (*Von Rosenberg*); Macassar, female (*Müller*); Timor (*Müller*); near Port Essington (*Mus. Lugd*); Australia (*Verreaux*); near Melbourne, S. Australia (*Ferd. Müller*); New Caledonia (*Verreaux*); Flores (*Wallace*); New Zealand (*Buller*).

Professor Schlegel (*l. c.*) remarks that Celebean examples are smaller than those from other localities. It is probably this species that Mr. Gould alludes to (B. Austr. Svo, ii. p. 366) as one of the races of *M. punctata* (Cuvier) found in Australia.

DENDROCYGNA, Swainson.

182. DENDROCYGNA GUTTATA (Forsten), Mus. Lugd.; Schlegel, Mus. Pays-Bas, *Anseres*, p. 85, "Celebes."

Dendrocygna guttulata, Temm.; Wallace, P. Z. S. 1863, p. 36.

— — —, Müller; Sclater, P. Z. S. 1864, p. 300.

Hab. Limbotto, 1st September, adult male; Panybie, 12th September, adult female; Kema, 24th August, adult male and female (*Von Rosenberg*); Ternate, Gilolo (*Bernstein*); island of Kelang, Amboyna (*Hoedt*); Bouru, Ceram (*Wallace*); Goram, Aru, Little Key (*Von Rosenberg*).

183. DENDROCYGNA VAGANS, Eyton, MS.; Fraser, Zool. Typica, pl. 68, "Manilla" (1849); Schlegel, Mus. Pays-Bas, *Anseres*, p. 88; Sclater, P. Z. S. 1864, p. 300.

Hab. Tondano, December, adult female (*Forsten*); Limbotto, 9th January, adult

male; Gorontalo, 27th May and 20th July, male and female; Ayer-pannas, 11th, 15th, 17th August, males and females; Limbotto, 13th September, female; Pagouat 29th July, a nestling (*Von Rosenberg*); Macassar, E. Timor (*Wallace*); Philippines (*Cunning*); Java (*Diard*); New Caledonia (*Verreaux*). *Conf.* Hartl. & Finsch, Centralpolyn. p. 212.

According to Mr. Sclater (*l. c.*) there appear to be three races of this Tree-Duck—the Philippine, which is the type, the Australian (*D. gouldi*, Bp.), and the one inhabiting Celebes and Timor. It is true that at a later date (P. Z. S. 1866, p. 149) Mr. Sclater maintained that the three races are not separable. Professor Schlegel mentions that this species only occurs accidentally in Java.

LARIDÆ.

STERNINÆ.

HYDROCHELIDON, Boie.

184. HYDROCHELIDON NIGRA (Linn.), Syst. Nat. ed. 12, i. p. 227 (1766); Schlegel, Mus. Pays-Bas, *Sternæ*, p. 31.

Hab. Northern Celebes (*Forsten*, fide *Schlegel*); Northern Africa; Southern Europe; Northern and Eastern Asia.

I include this species on Professor Schlegel's authority. It has not been recorded from any other island of the Malay archipelago, although found throughout China (*Swinhoe*). Its occurrence in India rests on the evidence of specimens collected by Dr. L. Stewart (Jerd. B. of India, iv. App. p. 875); in what part of India, is not mentioned.

185. HYDROCHELIDON LEUCOPAREIA (Natterer), Temm. Man. d'Orn. 2nd ed. ii. p. 746 (1820), "Hungary;" Verner, Atlas, pl.

Sterna grisea, Horsf. Trans. Linn. Soc. xiii. p. 199, "Java" (1822).

— *hybrida*, Pallas, Zoog. Rosso-Asiatica, ii. p. 338 (1831), "Volga;" Schlegel, Mus. Pays-Bas, *Sternæ*, p. 32.

Viralva indica, Stephens, Shaw, Gen. Zool. *Aves*, xiii. p. 169, "India" (1825), ex Lath. Gen. Hist. x. p. 103. no. 5.

Sterna delamotta, Vieill. Ency. Méth. Orn. Add. i. p. 350, "Europe" (1823).

— *similis*, J. E. Gray, Illust. Ind. Zool. i. pl. 70. f. 2, ex India (1832).

Hydrochelidon fluviatilis, Gould, P. Z. S. 1842, p. 140, "interior of New South Wales."

— *delalandii*, Bp. Compt. Rend. xlii. p. 773, "Cap. B. Spei" (1856).

Hab. Lake of Gorontalo, 8th of October, female passing into winter plumage (*Forsten*) Pontianac, in Borneo (*Diard*); abundant in India (*Jerdon*); Ceylon (*mus. nostr.*); S.-W. Formosa (*Swinhoe*); interior of Australia (*Gould*); Cape York (*mus. nostr.*); Java (*Horsfield*); South and South eastern Europe; Northern and Western Africa.

ONYCHOPRION, Wagler.

186. ONYCHOPRION MELANAUCHEN (Temm.), Pl. Col. 427, "Celebes" (April 25, 1827); Schlegel, Mus. Pays-Bas, *Sternæ*, p. 28; Finsch & Hartl. Centralpolyn. p. 224; S. Müller, Verhandl. Land- en Volkenk. p. 125.

Sterna sumatrana, Raffles, Trans. Linn. Soc. xiii. p. 329, "Sumatra" (1822).

Hab. Celebes (*Reinwardt*); Ternate, Morty, Raou (*Bernstein*); west coast of New Guinea (*S. Müller*); common in the straits and bays of the Lobo district (*S. Müller*); Bay of Bengal (*Jerdon*); Nicobars (*Blyth*); Andamans (*Walden*); New Caledonia (*Verr.*); Loyalty Islands (*G. R. Gray*); Viti-Levu, Ovalu, Stewart Islands (*Finsch & Hartl.*); Cape York (*Macgillivray*); Sumatra (*Raffles*).

An Andaman and a New-Guinea example in my collection are identical.

There can be little doubt that this is the *S. sumatrana*, Raffles. A title, most inappropriate, but which has priority.

187. ONYCHOPRION ANÆSTHETUS (Scopoli), Del. Fl. Faun. Insub. ii. p. 92. no. 72 (1786), ex Sonnerat, Voy. Nouv. Guin. pl. 84.

Sterna panayensis, Gm. Syst. Nat. ed. 13, i. p. 607 (1788), ex Sonnerat, *l. c.*

— *panaya*, Gm.; Finsch & Hartl. Orn. Centralpolyn. p. 228; Vögel Ost-Afr. p. 833.

Hab. (Salayer) Celebes (*Wallace*).

An example of this species, in young plumage, was obtained by Mr. Wallace at Salayer.

For complete synonymy and distribution *conf.* O. Finsch & Hartl. (*l. c.*).

PELECANOPUS, Wagler.

188. PELECANOPUS MEDIUS (Horsf.), Trans. Linn. Soc. p. 199, "Java" (1822).

Sterna affinis (Cretzsch.), Rüpp. Reise, p. 23, pl. 14, "coasts of the Red Sea" (1826); Schlegel, Mus. Pays-Bas, *Sternæ*, p. 6.

— *bengalensis*, Cuv. Mus. Paris; Less. Tr. p. 621. no. 9, "côtes de l'Inde" (1831); Pucheran, Rev. et Mag. Zool. 1850, p. 512; *conf.* Jerd. Birds Ind. iii. p. 843; Blyth, Ibis, 1865, p. 39; *op. cit.* (1867) p. 177.

Thalasseus torresi, Gould, P. Z. S. 1842, p. 140, "Port Essington."

Hab. Macassar, March (*S. Müller*); North Celebes (*Forsten*).

If Mr. Blyth's identifications of the North-African and South-Asiatic species be correct, the range of this Tern extends from Sicily to Madagascar, the coasts of India, of Northern Australia, and the islands of the Malay archipelago, at least as far as Celebes. It must be remembered, however, that Dr. Pucheran (*l. c.*) has stated that the Abyssinian and Bengal species differs "par plus de noir dans les rémiges et par son bec moins courbé, et par cela même plus droit." (*Conf.* Finsch & Hartl. Vögel Ost-Afrika's, p. 830.)

189. PELECANOPUS CRISTATUS (Stephens), Shaw, Gen. Zool. contin. *Aves*, xiii. p. 146, "China, many of the south-eastern islands of Asia" (1825).

Sterna pelecanoides, King, Surv. Intertrop. Austr. ii. App. *Aves*, p. 422 (1827); Schlegel, Mus. Pays-Bas, *Sternæ*, p. 9.

— *velox*, Rüpp.; S. Müller, Verhandl. Land- en Volkenk. p. 125.

— *bergii*, Lichtenst.; Finsch & Hartl. Centralpolyn. p. 216, part.

Hab. Celebes, female, winter plumage (*Forsten*); Batchian, Gilolo, Morty, Oby (*Berstein*); Ceram (*Forsten*); Timor, west coast of New Guinea (*S. Müller*); Flores (*Semmelink*); coast of W. Australia, Port Essington, Torres Straits (*Gould*); Mysol (*Wallace*); Java (*S. Müller*); mouth of the Hoogly, Madras, Malabar coast (*Jerdon*); Southern China, Formosa (*Swinhoe*).

A race of this species, probably belonging to the Asiatic form, inhabits many of the islands still more to the eastward. Messrs. Finsch & Hartlaub (*l. c.*) have united the large Sea-Terns of Eastern Africa (*S. velox*, Rüpp.) and of South Australia and Van Dieman's Land (*Thalasseus poliocercus*, Gould) with the Asiatic and North-Australian species, under the title of *S. bergii*, Lichtenstein, bestowed on a Cape-of-Good-Hope individual. Professor Schlegel, in his masterly catalogue (*l. c.*), keeps these representative forms separate, but with much reluctance. With the exception of *T. poliocercus*, the facts known favour the opinion that the species are severally permanent residents in the localities they frequent. Dr. S. Müller, who identified the New-Guinea bird with the Red-Sea *S. velox*, Rüpp., states (*l. c.*) that it is known to the inhabitants of the straits and bays of the Lobo district by the name of *Ressa*. At a subsequent date he appears to have regarded it as a distinct species; for Professor Schlegel cites *Sterna ressa*, S. Müller, as a synonym.

PODOCIPIDÆ.

PODICEPS, Latham.

190. PODICEPS MINOR (Gm.), S. N. ed. 13, i. p. 591 (1788); Schlegel, Mus. Pays-Bas, *Urinatores*, p. 45.

Hab. Panybie (*Von Rosenberg*).

According to Professor Schlegel the Little Grebe of Java and Celebes is identical with that of Europe; and provisionally I refer the Celebean bird to the European species. But judging from the few South-Asiatic examples I have been able to compare with European individuals, I am not prepared to admit their identification as absolute. For instance, the Javan Little Grebe has an exceedingly stout bill which measures seven eighths of an inch in length, the wing being four inches and a quarter. The cheeks, chin, and throat are black; and a dark ferruginous line starts from behind each eye, and extends down each side of throat. Thus the Javan bird closely resembles the Australian *P. gularis*, Gould—a species, however, which Professor Schlegel does not admit.

PELECANIDÆ.

DYSPORUS, Illiger.

191. *DYSPORUS SULA* (Linn.), Syst. Nat. ed. 12, i. p. 218, "Pelago indico" (1766).

Sula fiber, G. R. Gray; Schlegel, Mus. Pays-Bas, *Pelecani*, p. 41.

Hab. Celebes (*Mus. Lugd.*). On the general distribution of this species, *conf.* Finsch & Hartl. Faun. Centralpolyn. p. 261.

PHALACROCORAX, Brisson.

192. *PHALACROCORAX MELANOLEUCUS* (Vieill.), Nouv. Dict. d'Hist. Nat. vol. viii. p. 88, New Holland (1817); Gould, Birds Austr. vii. pl. 70; Schlegel, Mus. Pays-Bas, *Pelecani*, p. 15.

Hab. Celebes, nuptial plumage (*mus. nostr.*); Gorontalo, imperfect plumage (*Forsten*); Gilolo, Timor (*Mus. Lugd.*); Tasmania, every part of Australia (*Gould*); Salwati (*mus. nostr.*).

PLOTUS, Linnæus.

193. *PLOTUS MELANOGASTER* (Forster), Zool. Ind. p. 22, pl. xii. "Java, Ceylon" (1781).

Hab. Menado (*mus. nostr.*); all India, Ceylon, Burma (*Jerdon*); Java (*Mus. Lugd.*); Australia (*Schlegel*).

A single example of a *Plotus* in adult male plumage is in my possession, collected near Menado. It does not appear to differ from Indian examples. *P. novæ-hollandiæ*, Gould, P. Z. S. 1847, p. 34, is not admitted as distinct from *P. melanogaster* by Professor Schlegel. Mr. Gould relies on its shorter scapularies and larger size.

List of species stated by various authors to occur in Celebes for which there is not sufficient authority:—

Uropiza torquata (Cuv.), Hand-list Birds Brit. Mus. no. 327.

Scops mantis, J. Müller, op. cit. no. 477.

Halcyon diops, Temm., op. cit. no. 1107.

Halcyon funebris, Forsten, op. cit. no. 1126.

*Philemon moluccensis*¹ (Gm.), op. cit. no. 2074.

Philemon inornatus, G. R. Gray, op. cit. no. 2077.

Philemon? collaris, Reichenbach, op. cit. no. 2083. The genus *Philemon* is unknown in Celebes.

Climacteris leucophæa (Lath.), op. cit. no. 2521. The genus *Climacteris* is unknown in Celebes.

Dicrurus bimaënsis, Temm. op. cit. no. 4212.

Dicrurus atroceruleus, G. R. Gray, op. cit. no. 4220.

¹ This species is a *Mimeta* (*conf.* Wallace, P. Z. S. 1863, p 26).

Drymophila alecto, Temm. op. cit. no. 4794. The genus *Drymophila* is unknown in Celebes.

Lalage aurea, Temm. op. cit. no. 5114.

Calornis metallica, Temm. op. cit. no. 6376.

Munia pallida, Wallace, op. cit. no. 6756.

Eos cochinsinensis (Lath.), op. cit. no. 8202. The genus *Eos* is unknown in Celebes.

Psittacus cyanicollis, S. Müller and Schl. op. cit. no. 8275.

Ptilinopus flavicollis, G. R. Gray, op. cit. no. 9125.

Ptilinopus xanthogaster (Wagler), op. cit. no. 9136.

Ptilinopus hyogaster (Reinw.), op. cit. no. 9144.

Macropygia leptogrammica (Temm.), op. cit. no. 9305.

Reinwardtæna reinwardti (Temm.), op. cit. no. 9310. The genus *Reinwardtæna* is unknown in Celebes.

Most of the erroneous habitats enumerated in the above list are transcribed from the older authors. In nearly every instance they have been corrected by more recent writers, especially by S. Müller, Schlegel, Wallace, and O. Finsch.

DESCRIPTION OF THE PLATES.

PLATE III.

Outline Map of Celebes and the adjoining islands, p. 23.

PLATE IV.

Trichoglossus meyeri, p. 32. From a specimen in Lord Walden's collection.

PLATE V.

Buceros exaratus, 1 ♂, 2 ♀, p. 47. From specimens in Lord Walden's collection.

PLATE VI.

Fig. 1. *Artamus monachus*, p. 67. From a specimen in Lord Walden's collection.

Fig. 2. *Geocichla erythronota*, p. 61. From the typical specimen in Mr. A. R. Wallace's collection.

PLATE VII.

Fig. 1. *Myialestes helianthea*, p. 66.)
 Fig. 2. *Hypothymis puella*, p. 66.
 Fig. 3. *Cyornis rufigula*, p. 66. } From specimens in Mr. A. R. Wallace's collection.

PLATE VIII.

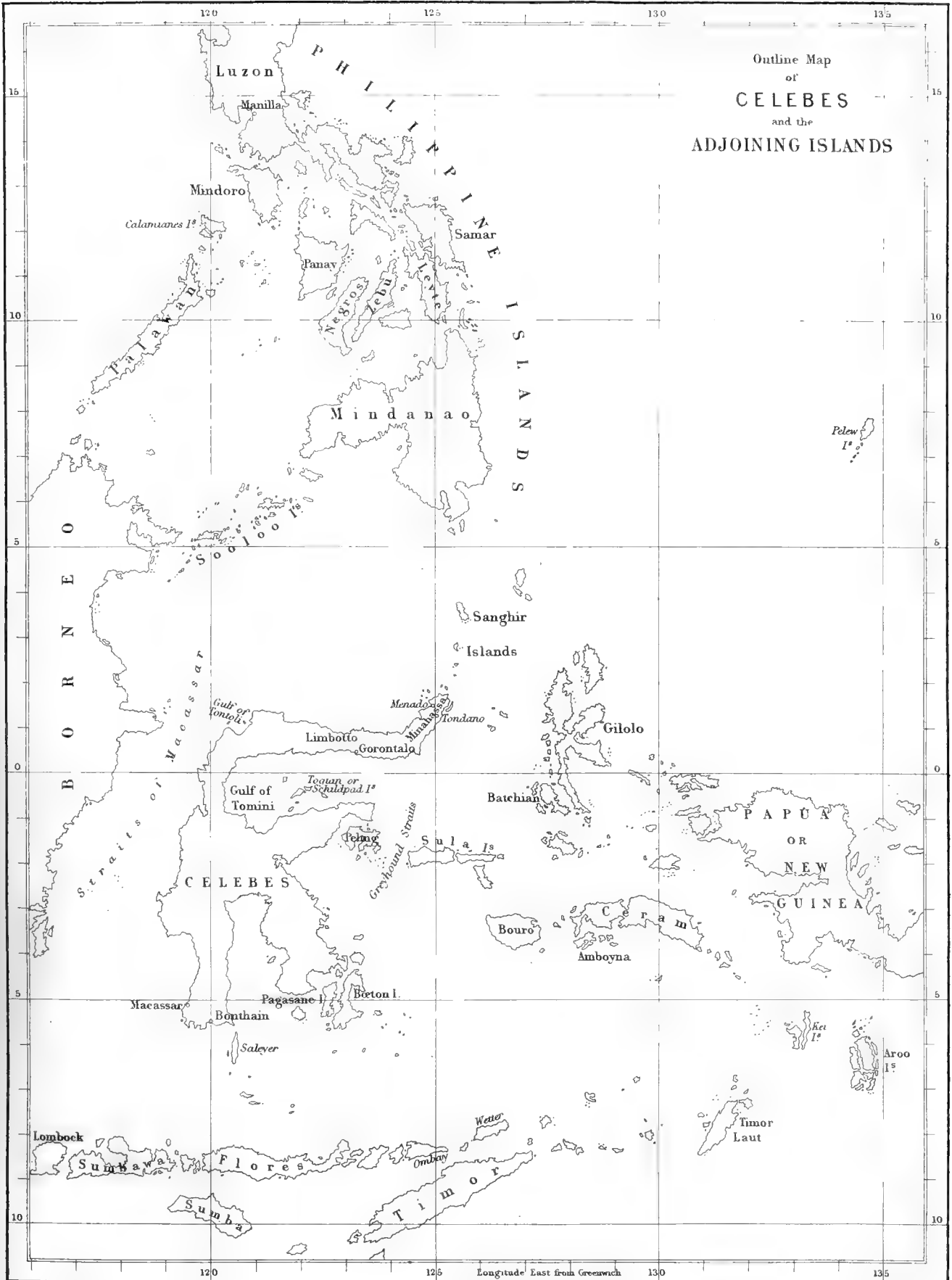
- Fig. 1. *Volvocivora morio*, p. 69. }
Fig. 2. *Lalage leucopygialis*, p. 69. } From specimens in Lord Walden's collection.

PLATE IX.

- Fig. 1. *Munia brunneiceps*, p. 73. }
Fig. 2. *Zosterops intermedia*, p. 72. } From specimens in Mr. A. R. Wallace's collection.
Fig. 3. *Zosterops atrifrons*, p. 72. }

PLATE X.

- Fig. 1. *Acridotheres cinereus*, p. 77. From a specimen in Lord Walden's collection.
Fig. 2. *Ægialites peronii*, p. 90. From a specimen in Mr. A. R. Wallace's collection.







J. Smut del.

M. & N. Hanhart imp.

TRICHOGLOSSUS MEYERI





$\frac{1}{2}$





1. SPITAM W. M. NACHUS
2. GEUCICHLA ERYTHROCIA





J Smut. lith.

M & N Hanhart imp.

1. MYIALESTES HELIANTHEA
2. HYPOTHYMIS PUELLA
3. CYORNIS RUFIGULA





J. Smit del.

M. & H. Harbat imp.

1 VULVOGIVORA MORIO
2 LALACE LEUCOPYGIALIS





Small lith

1845. 1846.

1 MUNIA BRUNNEICAPS
2 ZOSTEROPS INTERMEDIA
3 ZOSTEROPS ATRIFRONS



1

2



LAURIDOTERES VIRENS
2. E. SIALITES ALBIVENTRIS



III. *Appendix to a List of Birds known to inhabit the Island of Celebes.* By ARTHUR, Viscount WALDEN, F.R.S., *President of the Society.*

Read May 7th, 1872.

[PLATES XI. to XIII.]

I. *Additional Observations on the Birds included in the previous List.*

WHILE the List of Celebean Birds contained in the preceding pages was passing through the press the island of Celebes was being visited and its zoology investigated by a most indefatigable collector and naturalist, Dr. Bernhard Meyer. With the greatest liberality Dr. Meyer has permitted me to examine all the birds collected by him in Celebes; and I avail myself of this opportunity to thank him for his courtesy. The additional materials thus placed at my disposal have enabled me to add to the list several species which had not previously been known to inhabit Celebes, as well as a few more which were altogether new to science. The considerable number of examples, representing the rarer species, collected by Dr. Meyer, has also rendered it possible and desirable to add some supplementary observations. The greater part of the collection was made in North Celebes, and consequently on old ground; yet Dr. Meyer has added twelve species new to the island, and at least four of which were previously undescribed. In the Togian islands a small collection was likewise made, showing that these islands, as we might have naturally supposed, possess a generally Celebean ornithology; yet, among the small number of species thus obtained, two¹ were new to science, and have not as yet been discovered on the mainland of Celebes.

TERASPIZA RHODOGASTRA, *antea*, p. 33. (Plate XI.)

Three stages of immature plumage, hitherto undescribed, are represented by three individuals obtained in North Celebes.

One, a male (Pl. XI.), has the head dark brown, mixed with rufous. The back, wings, and tail are bright rufous. The nuchal and dorsal feathers are centred with dark brown. The wing-coverts have each a black subterminal drop. The secondary quills are crossed by five distinct black bands. The basal halves of the primaries are banded with brown and pale rufous alternating; the terminal halves are light brown, obscurely banded with dark brown, rufous replacing the light brown on the outer webs. On the under surface of the quills the dark brown bands are better defined and more conspicuous. The five middle pairs of rectrices have four broad black bands, besides

¹ *Loriculus quadricolor*, Walden, Ann. & Mag. N. Hist. ser. 4, vol. ix. p. 398; and *Criniger aureus*, Walden, l. c. p. 400.

an obscure brown band at the root of the feathers. The outer pair have seven bands. The plumage of the under surface of the body is fulvous, each feather with a bold brown longitudinal central stripe. The under tail- and shoulder-coverts are unspotted fulvous. The middle toe is very long; and the tail is conspicuously forked.

The second example is of a young female, much resembling the male above described, but having bold brown drops on the under shoulder-coverts and axillaries, and the general colouring of the upper surface not quite so bright a chestnut. In it also the tail is not forked, and the outer pair of rectrices are shorter than the middle.

The third example is of a young female passing from the chestnut plumage of no. 2 into that of the adult. The nuchal feathers are ashy; and a few similar plumes are interspersed on the throat and upper part of the breast. The breast-feathers and a few on the flanks are pure vinous red. A few of the upper tail-coverts are dark ashy; and one of the long wing-coverts has come in ash-coloured, and with two pure white spots on the inner web. The chestnut colouring of the remainder of the plumage is very dingy and faded. The tail is not forked.

Dimensions.

| Wing. | Rectrices. | | Tarsus. | Toes. | | | | |
|---------|------------|---------|---------|--------|---------|--------|---------|---------------------------------|
| | Middle. | Outer. | | Outer. | Middle. | Inner. | Hallux. | |
| inches. | inches. | inches. | inches. | inch. | inch. | inch. | inch. | |
| 7.50 | 6.75 | 6.63 | 2.25 | 1.13 | 1.62 | .75 | .75 | ♀. Changing into adult plumage. |
| 7.50 | 6.50 | 6.12 | 2.13 | 1.12 | 1.50 | .75 | .75 | ♀. Immature. |
| 6 | 5.12 | 5.50 | 1.87 | .81 | 1.13 | .50 | .50 | ♂. Immature. |

The toes are measured without the nails. The nails of the inner toe and hallux are very large, strong, and equal. Those of the middle and outer toes are slender and short.

TACHYSPIZA SOLOËNSIS (Horsf.), *antèa*, p. 34.

This species also inhabits China, extending at least as far north as Peking (Swinhoe, (P. Z. S. 1871, p. 342).

LIMNAËTUS LANCEOLATUS, Bp., *antèa*, p. 34.

Four examples from North Celebes have reached me—two (male and female) fully adult, and two (male and female) in the immature plumage already described (*l. s. c.*). The adult pair do not differ; and the example of the immature female only differs from that of the male by having the two pairs of middle rectrices more frequently banded and in a different manner. In the adult birds of both sexes the middle rectrices have a broad, terminal, dark brown band; then, above, a broader band of pale greyish brown, and then three narrow dark brown bands separated by broad pale bands. This is also

the character of the banding on the middle rectrices of the immature male. But in the immature female there is no terminal dark brown band, and the middle rectrices are almost evenly divided by seven pale and seven dark-brown bands. Yet in all other respects the immature pair are identical in plumage.

PERNIS CELEBENSIS.

Pernis ptilorhyncha (Temm.), *anteà*, p. 36.

An examination of several examples of the Celebean Honey-Buzzard has convinced me that it is distinct from the Indian and Javan species. In this view I am only concurring with both Messrs. Gurney and Wallace, and therefore propose the above title for it. The remarkable resemblance of this species to *Limnaëtus lanceolatus*, in adult plumage, has been commented on by Mr. Wallace and Professor Schlegel.

Upper surface brown. Chin, throat, and cheeks white, each feather broadly centred with dark brown. Breast pale rufous, some of the feathers with brown central stripes. Abdominal and ventral region, flanks, under wing- and tail-coverts, and the thigh-coverts white, with two, three, or four broad transverse bands. Tail crossed by three broad dark-brown bands, one being terminal; between the terminal band and the next a broad, light greyish-brown band of irregular shading and marking; between the second dark-brown band and the third a paler brown band.

YUNGIPICUS TEMMINCKII (Malherbe), *anteà*, p. 41.

Dr. Meyer has sent a male as well as several females of this rare species. The male, hitherto unknown, is peculiar in having the sides of the neck blood-red instead of a narrow stripe behind the eyes. In other respects it exactly resembles the female. Notwithstanding Bonaparte's remark (*Consp.* i. p. 137, no. 20), this species in no way resembles *Y. kisuki*. It is an isolated form, readily distinguished by its olive-brown plumage, spotted on the wings with yellowish-white dots, by its fulvous upper tail-coverts and rump, and by all its rectrices being barred rufous and brown.

MEROPOGON FORSTENI (Temm.), *anteà*, p. 42.

This species has the first primary half the length of the second, which is a little shorter than the third. The third and fourth are longest, and equal. The fifth is somewhat shorter than the third and fourth, but longer than the second. In the structure of the wing, therefore, it differs from both *Merops* and *Melittophagus*¹, but agrees with *Nyctiornis*. The grooved culmen of *Nyctiornis* is not present; but a shallow channel extends from the base of the maxilla, on both sides of the culmen, for two

¹ Prince Bonaparte says (*Consp.* i. p. 164), "*alæ Melittophagi*;" but in *Melittophagus*, *M. minutus* being the type, the third quill is the longest. The African species which most resembles *M. forsteni* in the graduation of the quills and the form of the rectrices, the middle pair excepted, is *M. bullockoides*, Smith.

thirds of its length. This character is not possessed by either *Nyctiornis*, *Merops*, or *Melittophagus*. The rectrices are truncated, as in *Nyctiornis*; but the middle pair are elongated, as in *Merops*, and closely resemble in form and proportion those of *M. philippensis*. The feet are those of the family. The elongated pectoral plumes resemble in character the same feathers in *Nyctiornis*. Altogether *M. forsteni* may be regarded as a link uniting *Nyctiornis* to *Merops*, but most nearly allied to *Nyctiornis*.

CEYCOPSIS FALLAX (Schlegel), *antèa*, p. 45.

Several examples were obtained in North Celebes by Dr. Meyer.

Tanysiptera riedelii was not obtained in Celebes (*conf.* P. Z. S. 1872, p. 1); and as yet there is no evidence that the genus occurs in the island.

LYNCORNIS MACROPTERUS, Bp., *antèa*, p. 47.

This species, *L. macrotis*, Vigors, and *L. temmincki*, Gould, are representative forms, closely resembling each other in plumage, but differing in size, the Celebean species being a little smaller than the Philippine. *L. cerviniceps*, Gould, the giant of the genus, differs considerably in colouring and markings.

EUDYNAMIS MELANORHYNCHA, Müll., *antèa*, p. 53.

This species also passes through a rufous phase of plumage. The entire upper surface, in one individual, is deep bay, each feather being traversed by broad and perfectly regular black bands. The chin, throat, and cheeks darker bay, with longitudinal black central streaks. A broad white stripe from the rictus to the neck. Lower plumage fulvous, with narrow, crooked, transverse markings. Edge of shoulder white.

CENTROCOCYX AFFINIS (Horsf.), *antèa*, p. 56.

CENTROCOCYX JAVANENSIS (Dumont), *antèa*, p. 60.

I have had an opportunity of examining a large Celebean series of both these species, and find that they do not differ from Javan individuals.

BRODERIPUS CELEBENSIS.

Broderipus coronatus (Swains.), *antèa*, p. 60.

Of fourteen examples of the Celebean *Broderipus* collected by Dr. Meyer, seven have the black coronal ring complete, and seven incomplete. One of the latter exhibits faint traces of yellow at the tips of the lesser wing-coverts. The remaining thirteen specimens are without any indication of a wing-spot. None have the middle pair of rectrices completely black, although in one example they are nearly so; and yet it shows no wing-spot. The series illustrates the progress of the coronal ring before uniting. In one individual the black loreal mark of *Oriolus galbula* extends behind the eye somewhat

further than what is found in *O. kundoo*; in others it has extended still further, until it is found encircling the head. Unfortunately Dr. Meyer has not noted the localities of the several individuals, and we are left in doubt whether there are two species or one; but, from the graduations the coronal ring exhibits, it seems likely that there is but one species. This gradual development of the coronal ring has not been observed in any other species of *Broderipus*, and, taken together with the almost total absence of the wing-spot, separates the Celebean Oriole from all known species.

GEOCICHLA ERYTHRONOTA, Slater, *anteà*, p. 61.

Several examples were collected in North Celebes.

TRICHOSTOMA CELEBENSE, Strickl., *anteà*, p. 62.

Obtained in North Celebes.

ARTAMUS MONACHUS, Temm., *anteà*, p. 67.

Celebean examples are identical with those obtained in the Sula Islands.

GRAUCALUS TEMMINCKII, S. Müller, *anteà*, p. 68. (Plate XII.)

A few examples of this rare species were obtained in North Celebes by Dr. Meyer.

CORVUS ENCA (Horsf.), *anteà*, p. 74.

Two examples sent by Dr. Meyer from Celebes give me the opportunity of comparison with the Javan species. I am unable to detect any difference, except in the dimensions, the Javan bird being somewhat the largest. *C. validus*, Temm., as represented at Malacca is a very distinct species.

Dimensions.

| | Wing. | Bill from forehead. | Tail. |
|------------------------------------|------------------|------------------------|-----------------|
| <i>C. enca</i> , ex Java | inches. 11·75 | inches. 2·50 | inches. 6·50 |
| „ „ | 11·50 | 2·50 | 6·37 |
| „ ex Celebes | 10·50 | 2·12 | 5·50 |
| „ „ | 11·12 | 2·18 | 5·75 |

CALORNIS NEGLECTA, Walden, *anteà*, p. 79.

Numerous examples of this species were obtained by Dr. Meyer in Celebes, thus fully establishing its Celebean *habitat*.

OSMOTRERON VERNANS (Linn.), *anteà*, p. 81.

On examination of a large series of the Celebean form from North Celebes I find

that the grey cap is paler than in Malaccan examples. The greenish tinge on the throat is common to individuals from both localities. I can find no difference between the amount of lilac on the neck (*conf.* Wallace, *Ibis*, 1863, p. 320). Mr. Maingay obtained the male and female of *O. bicincta* at Malacca.

CHALCOPHAPS STEPHANI, Jacq. & Puch. *antèa*, p. 85.

A single example of this rare and well-marked species has been sent from North Celebes by Dr. Meyer. It is in full plumage, and in every respect agrees with the plate and description (*l. s. c.*). If then the New-Guinea species differs, the origin of the type must have been Celebes, and not New Guinea (west coast) as stated by M. Pucheran (*l. c.*).

CHALCOPHAPS INDICA (Linn.), *antèa*, p. 86.

Examples from North Celebes in no way differ from Ceylon, Indian, Burman, Malaccan, and Javan individuals. Judging from the number of specimens obtained by Dr. Meyer, this species cannot be so rare in Celebes as stated by Professor Schlegel (*l. s. c.*).

NYCTICORAX CALEDONICUS (Gm.), *antèa*, p. 100.

It may be inferred that this species breeds in Celebes, an example in spotted immature plumage having been obtained in the northern part of the island by Dr. Meyer.

II. *List of Species to be added to the Celebean Avifauna.*

Genus CAPRIMULGUS, Linn.

1. CAPRIMULGUS AFFINIS, Horsf. Trans. Linn. Soc. xiii. p. 142, "Java" (1820).

Caprimulgus europæus, L. ap. Raffles, op. cit. p. 315, in part. "Sumatra."

Hab. Java (*type*); Sumatra (*Raffles*); East Timor, Lombock (*Wallace*); Celebes (*Meyer*).

Dr. Meyer has sent from Celebes a single example of a *Caprimulgus* which appears to belong to the species cited above. I have been unable to compare it with a Javan individual; but it perfectly agrees with Lombock and East-Timor specimens. Four pairs of rectrices are missing; and it is otherwise in indifferent order; I therefore add a short description of the species, taken from a Lombock individual—Horsfield's account, the only one published, being very meagre.

Above, the general aspect of the plumage is iron-grey, somewhat mixed with brown, caused by the feathers being finely dotted or sprinkled with black and grey, here and there with fulvous. In some of the crown-feathers black prevails; but there are no regular stripes on the head. On the sides of the throat are two white spots. The lower breast-feathers are fulvous, with several well-defined brown transverse bars. The

ventral region and the under tail-coverts are fulvous, without any markings. The major wing-coverts are distinctly banded with alternate rufous and brown. A large white spot on each of the first four primaries. The chin, throat, and upper breast are clothed with feathers finely marked with fulvous-grey points on a brown ground. Many of the upper breast-feathers with bold rufo-fulvous tips. The middle rectrices have the general colouring and marking of the upper plumage, and are traversed by eight or nine more or less distinct irregular black bands. The two outer pairs are pure white throughout their entire length. The wing in six examples averages 6.25 inches, and the tail 4.25.

This species, as has been well observed by Mr. Blyth (Cat. Calc. Mus. p. 84, note), is as diminutive as *C. monticola*, Frankl.

2. CAPRIMULGUS, sp. ?

A large dark-coloured *Caprimulgus* is among the novelties obtained in Celebes by Dr. Meyer. The example is unfortunately in such indifferent order that the inherent difficulties which attend the discrimination of many species of the family are very much increased. Above, this Celebean Goat-Sucker closely resembles Javan examples of *C. macrourus*, Horsf. Underneath, it is darker in colour, and the transverse barring of the abdominal plumage is less regular and well defined. The principal points in which it differs from a considerable series of *C. macrourus* are:—the great length of the rictal bristles, which measure a full inch; the greater length of the bill; the smallness of the terminal white spots on the two outer pairs of rectrices; and the peculiar markings on the under surface of all the rectrices except the middle pair. In true *C. macrourus* the white terminal spot on the outer pair of rectrices measures about two inches; in this individual it measures only seven eighths of an inch. In the Javan bird the under surface of the rectrices is more or less uniform brown, without markings; this Celebean bird has some eleven or twelve distinct narrow rufous bars crossing the rectrices. Its first primary has no white spot, while on each of the three next it is much smaller than in *C. macrourus*, which has a large white spot on all four primaries. The length of wing is equal to the average length observable in the Javan bird, seven and a quarter inches; nor do the dimensions of the tail (six inches) differ.

As there are two Bornean species, *C. arundinaceus*, Jacq. & Puch., and *C. binotatus*, Bp., which have yet to be satisfactorily identified, I refrain from conferring a distinct title on this Celebean Nightjar.

CUCULUS, Linn.

3. CUCULUS CANORUS, Linn. S. N. i. p. 168 (1766).

A single specimen obtained by Dr. Meyer in North Celebes is not to be distinguished from a British-killed example of the adult Common Cuckoo. The wing alone is shorter, 7.50 against 8.31; the tail is equal. Two other specimens, with the upper

plumage changing to the adult stage, the transverse, pectoral, and abdominal bands rather broader, and with immaculate buff under tail-coverts, seem to belong to the same species; and a fourth, in bright chestnut and brown plumage, must be referred to it. Without the example in full plumage it would have been difficult to say whether the other three did not belong to *C. canoroides*, Müller. If *C. canoroides* is equal to *C. saturatus*, Hodgs., = *C. himalayanus*, ap. Jerd., it is a very distinct form; but I have never met with an Archipelagic Cuckoo in the dark adult plumage of Himalayan *C. saturatus*. Timor and Amboyna examples of so-called *C. canoroides* only differ from those of *C. canorus* by having a shorter wing. But individuals of *C. canorus* from different parts of the Old World (that is, individuals identical in plumage) vary extremely in the length of wing, as the following table shows:—

| | | |
|-------------------|------|--|
| England | 8.31 | } These measurements are taken from examples in fully adult plumage, and almost identical in colouring and marking. |
| Abyssinia..... | 9.00 | |
| Menado | 7.50 | |
| Deyra Doon | 8.00 | |
| ” ” | 8.75 | |
| India | 9.50 | |
| Philippines | 9.25 | |
| Simla | 8.50 | |

HIEROCOCCYX, S. Müller.

4. *HIEROCOCCYX CRASSIROSTRIS*, Walden, Ann. & Mag. Nat. Hist. ser. 4, vol. ix. p. 305, “North Celebes” (1st April 1872). (Plate XIII.)

This species, in mature plumage, most nearly resembles *C. micropterus*, Gould.

5. ?*CACOMANTIS SEPULCRALIS* (Müller), Verhandl. p. 177, not., sp. 2, “Java, Sumatra.”

For the present I refer three examples of a *Cacomantis* obtained by Dr. Meyer in North Celebes to the Javan species, rather than create a new title; for without a large series of individuals inhabiting all parts of the archipelago it is impossible to discriminate the species belonging to this perplexing group.

One of the three Celebean examples is in fully mature plumage, and has the chin, cheeks, and throat pale grey, the head iron-grey, the upper plumage deep bronze-green, the breast, abdominal region, flanks, under tail-, and shoulder-coverts deep rufous; the middle pair of rectrices are black, the outer one black-brown tipped with white, and with one or two small white shallow triangular marks on the edge of the inner webs; the quills are traversed by the usual white band. Wing 4.25 inches, tail 5.75.

These Celebean individuals differ from all examples of the Javan *C. sepulcralis* known to me in the much deeper bronze-green of the upper plumage, the much deeper rufous of the under, and in their shorter wings and tail.

6. *CISTICOLA GRAYI*, Walden, Ann. & Mag. Nat. Hist. ser. 4, vol. ix. p. 400, "North Celebes" (1st May 1872).

CORYDALLA, Vigors.

7. *CORYDALLA GUSTAVI* (Swinh.), P. Z. S. 1863, p. 90, "China;" op. cit. 1871, p. 366.
Pipastes batchianensis, G. R. Gray, H.-list, i. p. 251. no. 3642, "Batchian" (1869).
Anthus arboreus, var., G. R. Gray, P. Z. S. 1860, p. 350, "Batchian."
Hab. Amoy, China (*Swinhoe*); Batchian (*Wallace*); North Celebes (*Meyer*).
 A single individual from North Celebes agrees well with the Batchian example contained in the British Museum, and there identified by Mr. Swinhoe.

8. *CYORNIS BANYUMAS* (Horsf.), Trans. Linn. Soc. xiii. p. 146, "Java" (1820); Zool. Res. in Java, pl. —.
Muscicapa cantatrix, Temm. Pl. Col. 226, ♂, ♀ (1823).
 ? *Muscicapa rufigastra*, Raffles, Trans. Linn. Soc. xiii. p. 312, "Sumatra."

Hab. Java (*type*); Sumatra? (*Raffles*); Banjarmassing (*mus. nostr.*); North Celebes (*Meyer*).
 Undistinguishable from Javan examples.

HYLOTERPE, Cabanis.

9. *HYLOTERPE SULFURIVENTRA*, Walden, Ann. & Mag. Nat. Hist. ser. 4, vol. ix. p. 399, "North Celebes" (1st May 1872).
Hab. North Celebes (*Meyer*).

MYZOMELA, Vigors & Horsfield.

10. *MYZOMELA CHLOROPTERA*, Walden, Ann. & Mag. Nat. Hist. ser. 4, vol. ix. p. 399, "Celebes" (1st May 1872).

The discovery of this species adds another Papuan genus to the Celebean fauna.

GLAREOLIDÆ.

GLAREOLA, Brisson.

11. *GLAREOLA GRALLARIA*, Temm. Man. d'Ornith. vol. ii. p. 503, "Austral-Asie" (October 1820); Gould, B. of Austr. vol. vi. pl. 22.
Hab. Moreton Bay (*Gould*); west Coast of New Guinea (*Müller*); Obi-major (*Bernstein*); Flores (*Semmelink*); Borneo (*Schwaner*); Java (*Kuhl* and *V. Hasselt*); Celebes (*Meyer*).

Several examples in mature and immature plumage were obtained in Celebes by Dr. Meyer.

STERNULA, Boie.

12. STERNULA MINUTA (Linn.), S. N. vol. i. p. 228 (1766).

Several examples from North Celebes have been sent by Dr. Meyer. They are all in full plumage. Tail pure white.

These twelve additional species thus raise the number of authentically recorded Celebean birds to two hundred and five.

DESCRIPTION OF THE PLATES.

PLATE XI.

Teraspiza rhodogastra, p. 109. From a specimen in Lord Walden's collection.

PLATE XII.

Graucalus temminckii, p. 113. From a specimen in Lord Walden's collection.

PLATE XIII.

Hierococcyx crassirostris, p. 116. From specimens in Lord Walden's collection.

Plumage of F. rhodogaster



84

I. Smit. lith.

V. H. Harhart imp.

TERASPIZA RHODOGASTER ♂ jr



Graucalus temminckii



$\frac{3}{4}$

J. Smith lith.

M&N Harbort imp.

GRAUCALUS TEMMINCKI



Handwritten text, possibly a date or reference number.



Handwritten signature or initials.

$\frac{1}{2}$

J. Smith lith.

M. & N. ...

HIEROCOCOCYX CRASSIROSTRIS (Linné) ...



IV. On *DINORNIS* (Part XVII.): containing a Description of the *Sternum and Pelvis*, with an attempted Restoration, of *Aptornis defossor*, Ow. By Professor OWEN, F.R.S., F.L.S., &c.

Read June 6th, 1871.

[PLATES XIV. to XVI.]

THE nearly complete sternum and pelvis of *Aptornis defossor* about to be described, in addition to the evidences of that bird submitted to the Zoological Society in a former Memoir¹, encourage me to attempt a restoration of the skeleton of the extinct species (Pl. XVI.), with which I propose to conclude the present Memoir.

The sternum, figured of the natural size in Pl. XIV. figs. 2, 3, 4, presents a close family, if not generic, resemblance to that described and figured in my fourth Memoir on *Dinornis*², with regard to which, recognizing in it unequivocal characters of a Ralline type, closely resembling that of the wingless Wekas (*Ocydromus*), but of much larger size, I had doubts whether to refer the bone to the *Notornis* (subsequently recognized as a still existent species), or to the still larger *Aptornis otidiformis*, which is most probably extinct.

In *Tribonyx ventralis* the length of the sternum is 2 inches, that of the femur is 2 inches 3 lines. In *Ocydromus australis* the length of the sternum is 2 inches, that of the femur is 2 inches 8 lines. In *Notornis*³ the length of the femur is 4 inches 10 lines; in *Aptornis otidiformis*⁴ the length of the femur is 6 inches 3 lines. The length of the sternum described p. 18, and figured in pl. 4. figs. 5-8, in Zool. Trans. vol. iv., is 4 inches 6 lines, measured from the foremost part of the coracoid groove to the tapering hind end, which is not entire. I do not suppose, however, that the missing portion would exceed 6 lines in length; and it might probably be less. An addition of 4 lines would make the sternum in question equal in length to the femur of *Notornis*, and 1½ inch shorter than the femur of *Aptornis otidiformis*. I select the femoral bone of the hind leg for this test comparison, because it varies less in proportion to the trunk or general size of the bird than the more distal elements of the limb. A comparison of the metatarsus of *Notornis* with that of *Aptornis* instructively illustrates this principle⁵.

The contiguity of the bones of *Aptornis defossor* here described, when discovered,

¹ On *Dinornis*, part xv., Trans. Zool. Soc. vol. vii. p. 353.

² Trans. Zool. Soc. vol. iv. p. 17, pl. 4. figs. 5-8.

³ *Ib.* vol. iv. p. 12, pl. 2. fig. 3

⁴ *Ib.* vol. iv. p. 10, pl. 3. fig. 3.

⁵ 'On the Archetype and Homologies of the Vertebrate Skeleton,' 8vo, 1848, p. 200, note, p. 202.

enables me to refer with confidence the sternum to that species, most probably to the same individual as the pelvis; and the comparison of the sternum with the femur described and figured p. 371, pl. 43. figs. 5, 6, 7, Zool. Trans. vol. vii., gives the following proportions of length:—sternum 6 inches 6 lines, femur 7 inches 6 lines. The length of the sternum is here taken from the fore border of the coracoid groove to the tapering hind end, which is all but entire.

The inferiority of size of the sternum figured in vol. iv. pl. 4. figs. 5–8 to the sternum of *Aptornis defossor* is greater than that of the femur of *Aptornis otidiformis* as compared with that of *Apt. defossor*. But the relative size of the smaller sternum to the femur of *Aptornis otidiformis* is more like the relative size of the sternum of *Aptornis defossor* to the femur of that species than is the relative size of the smaller sternum to the femur of *Notornis*. Seeing therefore, in the two existing Rallines here compared, that as the wings decrease and the legs increase in size the sternum becomes shorter in proportion to the femur, I am inclined to believe that the smaller sternum (Trans. Zool. Soc. vol. iv. pl. 4. figs. 5–8) has belonged to *Aptornis otidiformis* rather than to *Notornis*. This view derives further support from the fact that, with the decreasing relative size to the femur, there is a progressive simplification of the sternum in the recent Rallines (*Tribonyx*, *Ocydromus*), by which the still more simple type of the bone in *Aptornis defossor* is approached. The slender lateral processes, for example, in *Tribonyx ventralis* come off immediately behind the costal border, diverge and extend backward beyond the body of the bone, with slightly expanded terminations. In *Ocydromus australis* the slender lateral processes come off at some distance from the costal borders, near the hind part of the body of the sternum, are consequently much shorter, and have no terminal expansion. The keel, which is well developed in *Tribonyx ventralis*, is much reduced in *Ocydromus australis*¹; it is almost obsolete in *Aptornis defossor*.

As the wings of *Notornis* are relatively less than those of the Weka, and the legs relatively larger, it is not likely that the sternum would bear the same proportions of length to the femur as the sternum figured in *tom. cit.* pl. 4. figs. 5–8 bears to the femur figured in *tom. cit.* pl. 2. fig. 3. Whether, however, the sternum of the smaller species of *Aptornis* would be shorter in proportion to the femur than it is in *Aptornis defossor* may be questioned.

Demonstration on this point still waits the acquisition, so long desiderated, of the entire skeleton of *Notornis*.

This, at least, is certain, that the larger sternum, belonging to *Aptornis defossor*, repeats all the generic characters of that of which the reference oscillates between *Aptornis otidiformis* and *Notornis mantelli*.

As in it, the present larger sternum is of an elongate triangular form, the base anterior and concave, the curve of the emargination being interrupted by the pair of

¹ Descriptive Catalogue of the Osteological Series, Mus. Coll. of Surgeons, 4to, 1853, p. 238. no. 1280 (*Brachypteryx*).

prominences (Pl. XIV. fig. 2, *a, a*), from which the faint beginnings of the keel converge as they retrograde to the thick low ridge (ib. *s, s*) representing that part of the sternum in birds of flight. The body of the sternum describes a slight curve lengthwise to the tapering end, with the convexity downward or outward (ib. fig. 4); the general transverse lay of the outer surface of the sternum is slightly convex; but between the keel-ridge and the lateral margin the surface is feebly excavated. The ridge (ib. *s, s*) expands and subsides about an inch and a quarter from the hind end.

In the smaller sternum (of *Aptornis otidiformis*!) the initial ridges converging from the anterior tuberosities to the sternal ridge are better defined by the excavation of the surface outside them than in *Aptornis defossor*, and the ridge expands into a transversely convex prominent tract, which is continued to the broken end (as shown in fig. 5. pl. 4, Zool. Trans. vol. iv.); it consequently extends further back than in *Aptornis defossor*, apparently not leaving a terminal flattened tract of the outer surface of the bone, such as is shown in fig. 2. Pl. XIV., near the end of the sternum. The costal border in *Aptornis defossor* forms two fifths of the lateral border of the sternum, and presents articular surfaces (ib. fig. 4, *c, c*) for five sternal ribs. The foremost surface is a narrow ridge, crossing obliquely the costal surface close to the articular groove for the coracoid. This surface appears to be obliterated by ankylosis of the coracoid to the sternum on the right side (ib. fig. 2, *d*); and the left side shows a fracture at the part corresponding to the smooth deep coracoid groove in the sternum of *Apt. otidiformis* (?). The coracoid union with the sternum is restricted to as small an extent, relatively, of the anterior border or base of the bone as in *Apt. otidiformis* (?).

The second, third, and fourth articular surfaces for the sternal ribs are ridges with extensive intervening smooth and imperforate cavities (Pl. XIV. fig. 4, *c, c*). The last or hindermost articulation is a small subcircular cavity with a raised border. The costal border contracts from the third ridge backward. The non-articular side-border of the sternum contracts as it recedes to a rather sharp edge, the two sides converging to a nearly pointed end. There is no trace of the lateral fissures and slender processes characterizing the sternum of *Ocydromus* or *Tribonyx*¹. A very shallow tract (ib. fig. 2, *r*) for the insertion of muscle is bounded by a feeble ridge (ib. fig. 2, *t, r*) 8 lines behind the anterior border of the sternum, which tract is less smooth and even than the rest of the outer surface of the bone.

At the fore part of the inner or upper surface the sternum is strengthened by a transverse prominence or bar (ib. fig. 3, *b*), which expands as it subsides at each end upon the inner part of the costal tract. This bar is further from the anterior border, and consequently more internal in position, than is the corresponding ridge in the sternum of *Apt. otidiformis* (?), where it seems to form the upper or convex border of a thickened anterior margin of the sternum². A shallow excavation of the inner surface of the sternum is bounded by a curved border (ib. fig. 3, *t*), concave forward, nearly midway

¹ Trans. Zool. Soc. vol. iv. p. 18.

² Ib. vol. iv. pl. 4. fig. 8.

between the fore and hind sides of the sternum. The corresponding part of the inner surface of the sternum of *Aptornis otidiformis*, or of *Notornis* (?) is not so defined, but is undulated by a rising, convex lengthwise, parallel with the mid third of the costal borders.

The figures of the sternum of *Aptornis defossor* in Pl. XIV., being of the natural size, preclude the necessity of further admeasurements.

There is no pneumatic perforation in any part of the sternum, which agrees, in this respect, with that provisionally referred to the smaller species of the genus.

The generic distinction between *Aptornis* and the extinct gigantic Ralline bird called *Cnemiornis* is strongly expressed by the sternum. In *Cnemiornis* the ridged representative of the keel¹ subsides much nearer the fore part of the bone; the costal border is relatively longer, and includes articular surfaces for seven sternal ribs; the body of the bone appears to retain its breadth for a greater extent as it recedes than in *Aptornis defossor*. The portions of sternum picked up with the other bones of *Cnemiornis* enable the above comparisons to be instituted, but they are not sufficient to give a satisfactory idea of the shape of the entire sternum in that genus.

The pelvis of *Aptornis defossor*, figured of the natural size in Pl. XIV. fig. 1 and Pl. XV., exhibits a slight deformity or departure from the normal symmetrical figure at its fore part, which is somewhat bent to the right—the twist, which chiefly affects the neural spine and ilia, being most conspicuous when the bone is viewed from the front and from below, as in fig. 2. Pl. XV. It is doubtless an individual variety, and indicates the bird from which it was derived to have been aged.

The articular surface of the centrum of the first sacral vertebra (Pl. XV. fig. 2, *s* 1) is transversely extended, measuring in that diameter 1 inch $4\frac{1}{2}$ lines, the vertical diameter at the middle being 5 lines; but this extends to 7 lines on each side beyond the neural canal, which is circular, and only $3\frac{1}{2}$ lines in diameter at its anterior outlet. The prezygapophyses (Pl. XIV. fig. 1, *z*) are large, with their outer borders bent strongly forward; the right is the largest, partaking of the asymmetry above noticed. The articular surface, concave transversely, is vertically plane, or rather convex. The fore part of the neural spine shows a rough surface for ligamentous attachment along the lower half of its extent; this surface expands to a breadth of 4 lines, then contracts to a point, beyond which the spine presents a sharp anterior margin to near the summit, where it again expands and coalesces with the contiguous parts of the iliac bones. A deep and narrow ilio-neural fissure extends backward on each side the spinal plate.

The neuropophysis, developing the zygapophyses, is coextensive with the centrum, and expands beyond that element into a broad depressed diapophysis, confluent above with the ilium (Pl. XV. fig. 2, *i*): this process forms at its hinder angle a roundish flat surface (Pl. XIV. fig. 1, *d*) for the tubercle of the first free sacral rib. The articular surface for the head of that rib is large and flat on the left side (Pl. XIV. fig. 1, *pl*), but is small on the right side partaking of the asymmetry above noticed. The under

¹ Trans. Zool. Soc. vol. 7. pl. 63. fig. 9, *s*.

surface of the centrum is carinate; the keel beginning 2 lines behind the lower border of the articular surface. The keel runs to the third sacral centrum (Pl. XV. fig. 2, *c*), where it begins to expand, as in *Aptornis otidiformis* (Zool. Trans. vol. vii. pl. 42. fig. 2).

The surface for the head of the second sacral rib is small, subcircular, concave, and produced. The succeeding pleurapophyses (*pl*) are represented by short thick parapophyses abutting against the lower border of the ilia, to the fifth (seventh, including the moveable ribs) pair, which abuts against the part to which the head of the pubis is ankylosed (Pl. XV. fig. 2, *64*). There are consequently six pairs of interapophysial vacuities (ib. *id. id.*) at the antacetabular part of the pelvis. The mid tract beneath the centurms gains a breadth of $\frac{1}{2}$ inch at the seventh vertebra, beyond which it contracts to a point at the fourteenth.

The sacral centurms maintain their breadth to the seventh vertebra, contract at the eighth, but between the acetabula maintain a breadth of $9\frac{1}{2}$ lines to the eleventh vertebra, beyond which they contract to the fifteenth, and again expand at the seventeenth (17) to a breadth of 5 lines, which they retain, below, to the twentieth vertebra. The last three of them (*n, n*, fig. 1, Pl. XV.) are caudals, which, like the dorsal and lumbar vertebræ at the other end of the pelvis, have become "sacral" by ankylosis.

In the three interacetabular sacrals (Pl. XV. fig. 2, *c'*) the parapophyses are, as usual, suppressed; there is, however, a filamentary representative of one of those processes from the left side of the eighth sacral centrum. The parapophyses reappear at the eleventh sacral (ib. *p*, 11), where they are long and slender, and combine at their distal ends with those of the twelfth, thirteenth, and fourteenth sacrals to form a plate or screen of bone (ib. *u*), dividing the interacetabular depression (*t*) from the postacetabular or postrenal one (*u*). The parapophyses of the fourteenth (ib. fig. 2, 14), fifteenth, and sixteenth sacrals increase in breadth, and bend or arch outward and upward to form the lower and lateral walls of a passage or cavity on each side of the crest formed by the continuous or confluent neural spines of the corresponding vertebræ. These "ectoneural" canals are partially divided above by diapophysial or upper transverse plates, arching from the neuro-spinal crest to the inner surface of the plate or ectoneural side-wall.

The civil engineer might study, perhaps with advantage, the disposition of the several buttresses, beams, and arched plates of bone which support the iliac roof of the pelvis, and strengthen the acetabular walls receiving the pressure of the thigh-bones, in this large and powerful Wood-hen.

The unusual depth and width of the excavation at the postacetabular part of the pelvis, the hind part of which excavation is partitioned off from the general pelvic cavity by a deck, as it were, of bone (Pl. XV. fig. 2, *v*), extending from the ischium and confluent part of the ilium inward or mesiad to join the hinder sacral vertebra (ib. *c*, 17), led me to examine the pelvic viscera in a recent Ralline (*Rallus aquaticus*) with a view to determine the nature of the contents of the homologous ilio-ischial postacetabular excavation in that bird.

On a first view of the pelvic viscera, as exposed by removal of the intestines, the kidneys appear to be chiefly developed anteriorly, the broad lobes there extending beyond the ilia with a convex border covering, or lying in contact with, part of the iliac origins of the abdominal muscles. The length of these anterior renal lobes equals that of the antacetabular part of the pelvis in *Aptornis defossor*; the second lobes, commencing mesiad of the anterior ones, acquire their greatest breadth where those terminate, but are here much narrower than the anterior lobes. Thence the middle lobes contract transversely to a point, underlapping the narrow posterior lobes, which seem to end where the ischia join the sacrum, and to blend with each other; but it is merely close contact, they are distinct¹.

On each side of the hind part of the kidney is the belly of the "obturator internus" or postrenal muscle, which underlies the inferior opening of the ilio-ischial excavation.

This muscle being removed, the renal substance is found to pass "neurad," expanding to a breadth equal or superior to that of the anterior lobes, with much greater depth or thickness in the neuro-hæmal or dorso-ventral direction; and this the true posterior renal lobe is shown, by a vertical longitudinal section of the side of the pelvis, to fill the whole of the great posterior ilio-ischial cavity, extending from the partition bounding posteriorly the interacetabular cavity backward to above and beyond the ischio-iliac deck-like plates (Pl. XV. fig. 2, *v'*).

The vertebræ numbered 19, 20 in Pl. XV. fig. 2 are homologous with the first two free caudals in *Rallus aquaticus* and *Ocydromus australis*. The parapophyses of the seventeenth and eighteenth sacrals expand, coalesce (a small foramen intervening), and unite with the "deck" (*v'*), of which they form the inner beginning. The parapophyses of the first caudal in *Rallus* abut against the ilia, leaving a small intervening foramen between them and the antecedent parapophyses. The homologous foramina are seen on each side of the vertebra 19 in fig. 2. Pl. XV.

From these foramina each ilium extends backward 2 inches. The free terminal ends bend slightly toward each other, leaving an interval of 9 lines; they are obtusely rounded. Externally each is strengthened by a vertical ridge (Pl. XIV. fig. 1, *l*).

The entire length of the ilium, following the upper curve, of *Aptornis defossor* is $12\frac{1}{2}$ inches, equalling that of the same part of the pelvis in *Casuaris bennettii*. This length is pretty equally divided by the mesial beginnings of the "gluteal ridges" (Pl. XV. fig. 1, *g*).

The fore half of the ilium repeats very closely the characters of that part in *Aptornis otidiformis*². The upper curve is greater in *Aptornis defossor*; the gluteal ridge is stronger, runs more outward, and ends by an obtuse process (Pl. XIV. fig. 1, *h*). The

¹ In my 'Anatomy of Vertebrates,' the statement (vol. ii. p. 227) that "the kidneys are more or less blended together at their lower extremities in the Coots (*Fulica*)" will probably bear the above explanation. I am indebted to our excellent Secretary, Mr. Solater, for the subject of the above dissection.

² Trans. Zool. Soc. vol. vii. p. 366, pl. 42. fig. 1, pl. 43. fig. 1.

rest of the pelvic disk (Pl. XV. fig. 1, *r, r*) is bounded externally by the strongly produced ridge overhanging the vertical postacetabular plate (Pl. XIV. fig. 1, *62, l*) of the ilium, which coalesces with the similarly vertical expanding plate of the ischium (ib. *63*). The foramen (ib. *m*) between the ilium and beginning of the ischium is a full ellipse or oval. The ischium develops downward a ridge, behind the obturator notch (*q*); but this does not meet the ridge reciprocally directed upward from the pubis (ib. *64*): there are impressions of the attachment of a strong fibrous sheet which closed the obturator groove behind; and this sheet becomes a thin plate of bone in old individuals of some existing Rallines (*Tribonyx ventralis, Ocydromus australis*).

The proportions and form of so much of the pubis (*64*) as is preserved adhere to the ralline type of that bone; but the tubercle, prominent below the fore part of the bone in most existing Rallines, is not developed in *Aptornis*.

I have restored, in dotted outline, the parts of the ischium and pubis broken away from the otherwise complete and truly singular and interesting form of pelvis in *Aptornis defossor*. It may aid in future comparisons of this most complex of bones to subjoin a list of the parts of the pelvis, conveniently indicated by names, with the symbols used to indicate them in Pl. XIV. fig. 1, and Pl. XV.

The specimens of *Aptornis defossor* above described are from a cavernous fissure at Timaru, Canterbury Settlement, South Island of New Zealand. I am indebted to Dr. D. S. Price, of the Crystal Palace, Sydenham, for the much valued opportunity of describing, comparing, and figuring them.

Parts of the Pelvis of Aptornis defossor, Ow.

- a.* Acetabulum (the letter marks, in Pl. XIV. fig. 1, the inner aperture).
- b.* Postacetabular facet.
- c.* Centrum (marking, in Pl. XV. fig. 2, the ridged underparts of the first and second sacral vertebræ).
- c'*. Centrum (marking the unridged underparts of succeeding centurms).
- d.* Diapophysis (marking, in Pl. XIV. fig. 1, the diapophysial articular surface).
- e.* Subacetabular fossa. *f, f.* Antacetabular part of ilium (Pl. XV. fig. 1).
- g.* Gluteal ridge. *h.* Gluteal process (Pl. XIV. fig. 1).
- i.* Ilium (marking, in Pl. XV. fig. 2, the part anchylosed with and overhanging the foremost diapophysis).
- id.* Interdiapophysial vacuities (marking the six anterior ones).
- l.* Postiliac tuberosity. *m.* Ischiadic foramen.
- n.* Neurapophysis; *n'* in Pl. XV. fig. 1, is the fore part, *n** the hind part, of the neurapophysial crest. *o.* Ilio-neural orifices.
- p.* Parapophyses, } both combine to separate, below, the interdiapophysial vacuities:
- pl.* Pleurapophyses, } in Pl. XIV. fig. 1, *pl* marks the articular surface for the head of the first sacral rib.

- q.* Obturator notch. *r.* Pelvic disk.
s. Sacral vertebræ (*s* 1, in Pl. XV. fig. 2, marking the anterior articular surface of the first centrum).
t. Interacetabular cavity. *u.* Postrenal cavity.
v. Ilio-ischial plate or deck-like production.
z. Prezygapophysis (marking, in Pl. XIV. fig. 1, that of the first sacral vertebra).
 1-20 indicate the sacral vertebræ from before backward.
 62. Ilium. 63. Ischium. 64. Pubis.

In the restoration of the skeleton (in which I have taken the vertebral formula of *Ocydromus*) the *Aptornis defossor*, with the neck bent and head supported as in the ordinary standing position of the bird, would be about 3 feet in a straight line from the top of the head to the soles of the feet; the length, in a straight line, from the end of the beak to that of the tail would be about 2 feet 10 inches. The chief departure from the ordinary form of the Coots is seen in the shorter and more robust proportions of the tibiæ and metatarsal segments of the legs, in which feature *Notornis*, amongst recent Rallines, offers the nearest approach to *Aptornis*.

DESCRIPTION OF THE PLATES.

PLATE XIV.

- Fig. 1. Side view of pelvis of *Aptornis defossor*, nat. size.
 Fig. 2. Front or under view of sternum of ditto, nat. size.
 Fig. 3. Back or upper view of sternum of ditto, nat. size.
 Fig. 4. Side view of sternum of ditto, nat. size.

PLATE XV.

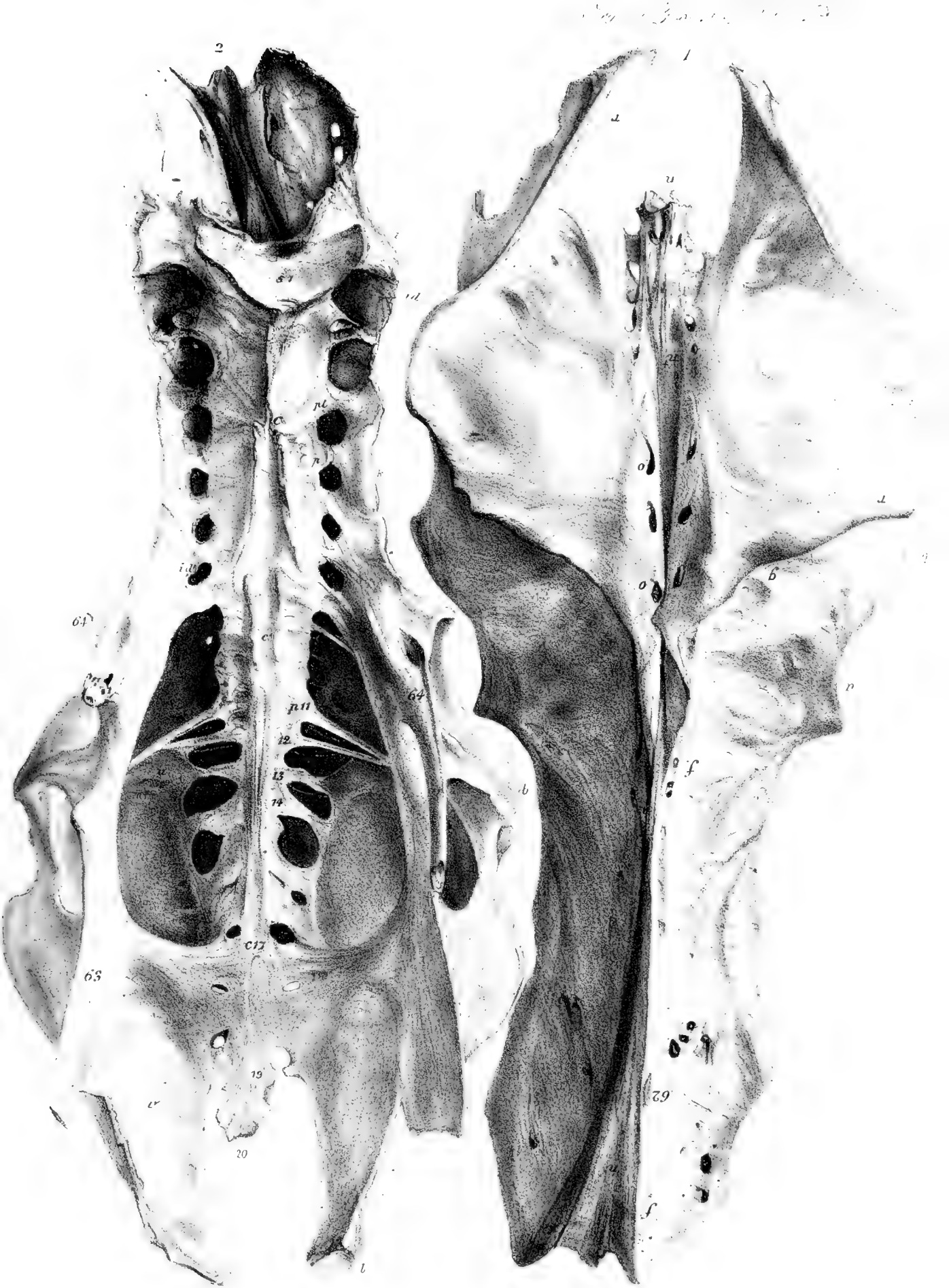
- Fig. 1. Upper view of pelvis of *Aptornis defossor*, nat. size.
 Fig. 2. Under view of pelvis of ditto, nat. size.

PLATE XVI.

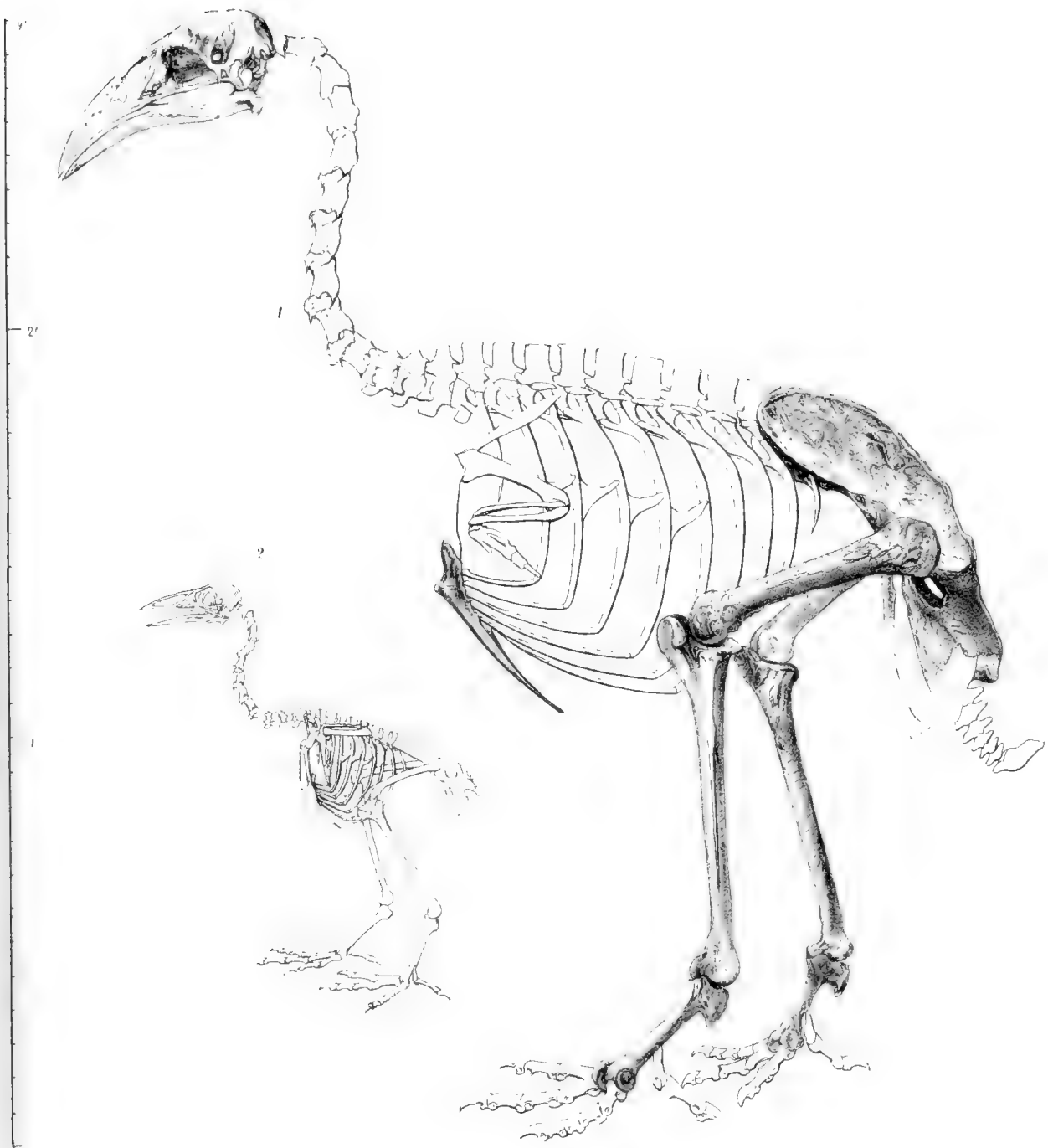
- Fig. 1. Restoration of skeleton of *Aptornis defossor*. $\frac{1}{4}$ th nat. size.
 Fig. 2. Skeleton of *Ocydromus australis*. $\frac{1}{4}$ th nat. size.











1 APTORNIS DEFOSSOR. 2 OCYDROMUS AUSTRALIS



V. *On the Form and Structure of the Manatee (Manatus americanus).*

By Dr. JAMES MURIE, F.L.S., F.G.S., &c.

Read November 15th, 1870.

[PLATES XVII. to XXVI.]

I. EXTERIOR ASPECTS AND DIMENSIONS.

1. *GENERAL CONTOUR*.—Among original investigators of the uncouth aquatic mammal the Manatee, the painstaking Daubenton, in one of Buffon's well-known volumes, has given a representation of a fœtus in profile, and of the head foreshortened¹. These evince only a certain accuracy, being too small to bring out the minor tegumentary characters. This remark applies in common to Sir Everard Home's better executed figure², copied by Frederick Cuvier³, to J. A. Albers's fœtus⁴, and to that of Alexander von Humboldt⁵. Dr. Hermann Stannius⁶ in his larger illustrations of the head of the animal, likewise fails to depict skin-texture, although the peculiarities of the muzzle are effectively rendered. Professor W. Vrolik⁷ expresses himself thus concerning his own folio plates:—"I suppose that my representation is quite exact, and will give such a just idea of the animal that it is useless to enter into more particulars."

It is therefore in no hypercritical or self-satisfied spirit that I draw attention to pictorial defects in the able treatises of these revered preceptors of comparative anatomy, but rather in vindication of my reproducing work already done. Of the two specimens which have come under my scalpel, female and male, I was content to note that the former did not coincide in certain points with Vrolik's delineation. Bethinking myself, however, on receipt of the latter, that a good photograph would be a desirable acquisition, I took such views as seemed best to afford evidence of the external affinities of this singular creature, and of the adaptability of its unwieldy carcass to propulsion through a watery element. In museums, it is customary to see

¹ Histoire Naturelle, tome xiii. plate 57.² Lectures on Comp. Anat. vol. iv. pl. 55.³ Pl. 1 of the Hist. Nat. des Cétacés. Paris, 1836.⁴ Icones ad illustrandam Anat. Comp. fasc. ii. tab. iv. Lipsiæ, 1818.⁵ In Dr. Wiegmann's 'Archiv für Naturgeschichte,' 1838, p. 1, pls. 1 & 2.⁶ Beiträge zur Kenntniss der amerikanischen Manatis von Hermann Stannius. Rostock, 1846. Tab. 1. figs. 1 & 2.⁷ "Bijdrage tot de Natuur- en Ontleedkundige Kennis van den *Manatus americanus*," p. 58 (pls. 1 & 2), in the Memoirs of the Zool. Soc. Amsterdam, Natura Artis Magistra, 1852. For a copy of this folio monograph I am indebted to the liberality of J. Norrdhoem Heyt, Superintendent of the Zoological Gardens, Amsterdam.

such bloated over-stuffed specimens, that from them, as well as figures extant, an unfair idea of the configuration is obtained, and one is embarrassed to comprehend the mode of progression of such an awkward form in water as on land.

Emendations on the text of the forementioned authors relative to the shape of the animal are less necessary; so that I limit myself to a notice of the points which photography has elucidated in the present case. Pl. XVII. fig. 1, profile view, shows that in the young Manatee the head and body, to as far as the root of the tail, have together a very elongated biconical contour—not so protuberant at the posterior belly part as in Home's figure, and quite different from the barrel-like aspect of Vrolik's animal. Seen on the dorsal (Pl. XVIII. fig. 3) and on the ventral (Pl. XVII. fig. 2) aspects, the biconical form is less rigid, from the deep skin-sulci being more emarginate; whilst towards the pelvic region there is a sudden rugged contraction, as if behind the ribs a broad band had been tightly lashed round the short axis of the body. Posteriorly to this the outer border-lines obliquely diverge in a very gradual and regular manner, so as to form a comparatively long and very broad, thin, shovel-shaped, caudal organ.

The hindermost border, whilst rounded¹, has a remarkable truncated character, and centrally is incised; or rather there is a short, shallow longitudinal sulcus on its upper surface, which forms a corresponding convexity below. The tail of Home's specimen gives a three-quarter or tilted view; but this, if compared with the present fig. 1, is too much narrowed at the end. The Beaver-shaped tail attributed to *Manatus* by some writers is true only to a certain extent, inasmuch as in the latter it broadens greatly compared with the former, and, as Albers's figure distinctly represents, there is a slight mesial V-shaped indentation or emargination.

Regarding the head, Stannius's figure is by far the most trustworthy; but, as already particularized, the absence of texture detracts from the otherwise characteristic physiognomy of the creature. W. Vrolik's best representation, to my mind, seems to be that depicting the under surface of the lower jaw and muzzle (pl. 2. fig. 5); his front foreshortened view of the head (pl. 2. fig. 4) has far too large, staring eyes; and these are not widely enough apart. The facial expression, as dependent on the eye, is markedly noticeable on comparing Vrolik's plates and those now given. The accuracy of the present lithographs are vouched for as carefully taken photographs, faithfully and minutely copied by my artists, Messrs. Berjeau and Smit, figure 3 alone having been slightly reduced from the negative impression so as to fit the length of the plate.

2. *Admeasurements*.—Humboldt, Stannius, and Vrolik have each recorded some of the proportional dimensions of the body. On this account it might be deemed superfluous to institute a fresh series of measurements, were it not that it lends precision to the description and figures of the specimens under immediate consideration. Inches and decimals have been taken as the standard throughout.

¹ This peculiarity has evidently caused the adoption of the name "Round-tailed *Trichechus*" for the Manatee, vid. Shaw's 'Zoology,' vol. i. p. 244.

| | Female. | Male. |
|---|---------|---------|
| | inches. | inches. |
| Body generally. | | |
| Extreme length, from the snout to the tip of the tail . . . | 65·0 | 48·0 |
| Girth of neck just behind vertex of cranium | — | 24·5 |
| Girth immediately in front of the pectoral extremities . . . | 32·5 | 25·5 |
| Girth immediately behind the pectoral extremities | 39·5 | 28·5 |
| Girth about 4½ inches in front of the umbilicus | 47·0 | 29·5 |
| Girth at the umbilicus | 51·0 | 31·5 |
| Girth at the opening of the penis in the male | — | 32·5 |
| Girth at about 3 inches in advance of rectum in male, or equivalent to the position of the vulva in female | 41·0 | 28·0 |
| Girth at the anus | 35·5 | 20·0 |
| The Head. | | |
| Extreme length, or distance between the muzzle and occiput | 11·3 | 9·0 |
| Girth at the snout, including the lower lip | 14·0 | 12·5 |
| Girth vertically before the eyes, including the lower lip . . | 18·6 | 15·0 |
| Girth behind the projecting part of lower lip, vertical to the eyes | 20·0 | 17·0 |
| Girth, middle of head, just anterior to projection of mandible | 23·0 | 20·5 |
| Oral region, or length of side of the mouth | 2·2 | 1·9 |
| Length of under lip, following tegumentary curve | 4·5 | 3·0 |
| Breadth of chin, following tegumentary curve | 4·0 | 2·5 |
| Breadth of chin at the angles of the mouth | 5·0 | — |
| Muzzle and Nostrils. | | |
| Measurement of arch over muzzle covering nostril | 8·5 | 7·0 |
| Nasal orifices, distance behind free end of muzzle | — | 0·4 |
| Nasal orifices, diameters across and vertically, when dilated, about | 0·5 | 0·5 |
| Nasal orifices, distance apart at inner angles, about | 0·5 | 0·3 |
| Nasal orifices, distance apart at outer angles | 1·7 | 1·35 |
| The Eye. | | |
| Diameter | 0·5 | 0·3 |
| Distance from front of muzzle (outside) | 5·0 | 3·3 |
| Distance from front of muzzle (mesially) | 6·0 | 4·0 |
| Distance from the inner angle of nostril | 4·5 | 3·0 |
| Distance between them at their centres | 7·0 | 4·3 |
| Distant from the angle of the mouth | — | 1·9 |
| The Ear. | | |
| Auditory orifice distant from posterior angle of eye | 4·0 | 2·8 |
| Auditory orifices apart from each other in diameter | 7·0 | — |

| | Female. | Male. |
|---|---------|---------|
| | inches. | inches. |
| Pectoral Extremity. | | |
| Distant from the muzzle | — | 10·0 |
| Distant from the end of tail | — | 38·0 |
| Width from one tip to the other when outstretched | — | 25·0 |
| Roots apart from each other, following curve of back | 19·0 | — |
| Extreme length of free portion | 10·0 | 8·0 |
| Extreme breadth of free portion | 4·4 | 3·5 |
| At the narrowest portion its transverse diameter is | — | 2·5 |
| Girth at the root | 10·3 | 8·0 |
| Girth at about the middle | 10·5 | 8·0 |
| Girth at about the outer or distal third | 8·8 | 8·0 |
| Thickness at the elbow | — | 1·7 |
| Thickness at the middle of the metacarpals | — | 0·6 |
| Tail, or caudal extremity. | | |
| Extreme length, or from the last loin-wrinkle backwards, measured on the ventral surface | 19·0 | 16·0 |
| Extreme length measured on the dorsal surface | 18·5 | 15·0 |
| Distance betwixt first wrinkle and angle of terminal border | — | 12·0 |
| Breadth following curvature of terminal border | — | 18·0 |
| Extreme breadth following superior curvature of skin | 16·5 | 13·0 |
| Girth, about four inches from the tip | 27·8 | 26·0 |
| Girth, about ten inches from the tip | — | 20·5 |
| Girth at the root or hindermost loin-wrinkle | — | 17·0 |
| Notch or median terminal incision, in diameter | — | 0·5 |
| Generative organs &c. | | |
| Rectum distant from end of tail | 24·0 | 18·5 |
| Distance from middle of anus to middle of vagina | 3·2 | — |
| Distance from middle of anus to opening of penis | — | 9·8 |
| Length of generative outlet, including labia | 1·4 | 1·3 |
| Length of generative outlet, solely the opening | 0·9 | 0·9 |
| Diameters of anus, about | 0·5 | 0·5 |
| Breadth of each labial elevation bounding penal aperture | — | 1·3 |
| Circumference of both | — | 4·0 |
| The umbilicus is distant from the muzzle | — | 18·0 |
| The umbilicus is distant from the end of tail | — | 30·0 |
| The umbilicus is distant from the middle of penal opening | — | 2·4 |

The umbilicus in the male has a cicatrix one inch long by half an inch broad.

When studying in the Stuttgart Museum I derived much information from Professor Krauss, the able Director. Among other things he mentioned that their large stuffed

specimen of Manatee was the mother of our Society's young male, as attested by Herr Kappler, of Surinam, who transmitted it. The length of the female mounted skin I ascertained to be 122 inches, therefore twice and a half the length of the young animal possibly six or eight months old. Another stuffed male specimen at Stuttgart measures 94 inches. Both the above are doubtless stretched to their fullest extent; still one is justified in assuming the adult *Manatus* to be from 9 to 10 feet long. Comparing this with Steller's account of *Rhytina*, it appears that the extinct northern form exceeded the existing American one in the proportion of two and a half to one, or something equivalent to the difference betwixt the young and old of the latter.

3. *Weight*.—According to Mr. Greey the entire carcass of the Zoological Society's female when weighed immediately after death on board ship was 228 lb. That of the young male as ascertained by myself was 61 lb.

4. *Colour*.—This has been defined by different writers as grey, bluish grey, and steel-grey. It is indeed difficult to specify the precise tone of colouring, which is a kind of neutral tint, varying according to the condition of the skin. When the epidermis is dry, the colour approaches to a dull iron-grey; but when moist, it appears more of a dull black or sooty hue. It is best compared with that of the Elephant, to which in other respects it offers strong resemblances, as shall afterwards be mentioned.

The anterior truncated portion of the muzzle, projecting part of the palate, and lower lips are paler than the body, namely of a dull yellow.

II. THE INTEGUMENT, ITS APPENDAGES AND SUBJACENT TEXTURES.

1. *The Skin*.—The coarse, hairy hide of the Manatee is one of those external features which at once arrest attention, and claim for it kindred with Pachyderms rather than with its aquatic congeners the smooth-skinned Cetæ.

The construction of the extraordinary-looking truncated muzzle having been commented on by Baron von Humboldt, and freshly described by Professors Stannius and Vrolik, I need therefore but cursorily allude to its dermal minutæ. The anterior face, and particularly its under surface, has a very warty-looking, but regular, pitted structure. In some parts the arrangement of the furrows and ridges is of a cross-linear kind; and in the neighbourhood of the bristly projections (afterwards to be noted) the puckered skin assumes a stellate sculpturing. The much smaller-sized lower lip has three or four regular transversely arched ridges and deepish intervening furrows, and in front of these some half a dozen shallow linear grooves. The under surface of the bulging chin is altogether smoother than the muzzle; but yet its dermis has a tessellated superficies. The short throat has deep transverse wrinkles.

The various tegumentary folds, though passed over by authors, are worthy of special consideration. On the upper surface of the head, and well nigh obscured neck, several deep transverse wrinkles extend in arches from side to side.

The furrow immediately behind the muzzle is much the deepest, and especially so

towards the angle of the mouth, where it is quite a cleft. Vrolik's figures well define it, Stannius's less so. Between it and the eye there is a second notable, but narrower, groove. At the vertex another deep furrow runs round quite to the angles of the lower jaw. Betwixt these there are shorter and shallower grooves, some of them obliquely joining those described.

There are no very determinate upper and lower eyelids; but radiating round the palpebral fissure are a series of crooked wrinkles. These, I have been told by those who have seen the living animal, are twisted together in the act of closing the eye.

Vrolik's artist has so circumscribed these ocular radii by an external dark, broad, circular line, as to deceive any ordinary observer by the supposition that the animal has a large patent eyeball. This deception is further heightened by a heavy backwardly overlapping orbital fold, which certainly was not present in either of the specimens examined by me. The text, however, corrects this misapprehension, as the author pointedly alludes to the diminutive eye of the Manatee.

Besides those very long grooves and tegumentary areas just mentioned, a striking feature of the head, and notably so on its upper half, are the rough scale-like patches. These circumscribed elevated spots are irregularly shaped, though chiefly roundish, flat on their upper surface, some smooth, others roughened or minutely pitted, as is the rest of the skin. They vary in size from \circ to \bigcirc , on the vertex give a nailed appearance, and on the side of the face subdivide the rugged skin into elongated and diamond-shaped corrugations.

The pectoral extremity, as has been noted by others, is sunk into a great shoulder-fold.

As far as the elbow there are deepish transversely oblique skin-folds; but the remainder of the limb presents only minute wrinkling. The axillary creases are short and decussating. Both on the outer and inner aspects of the flattened limb the surface is studded with the small warty flattened bodies spoken of as existing on the head. In the limb, however, they are much more uniform in outline and size. The body, from the obscurely defined neck backwards to the loin-constriction, possesses multitudinous encircling narrow linear plaits, which run parallel to each other, and frequently obliquely interdigitate. This gives to the skin a kind of velvety structure, increased in semblance by the sombre tint of the derm. Behind the shoulders several massive folds are mapped out rather than project; and these are carried from the back round the chest. Upon the sides and shoulders tuberculated scale-patches, resembling those on the head, are here and there distributed. Numerous short, but irregular, longitudinal wrinkles are met with upon the throat and abdomen.

The marked broad but sudden constriction immediately behind the ribs, forming a loin-girdle, consists below of two large hoop-like folds, the one before the other, the anus being set midway between them, and the vulva just anteriorly in the female. As these folds reach the back, their boundary furrows augment and increase the number of the folds, while their height is diminished accordingly.

That portion of the subcaudal surface which, as it were, defines the fleshy limits of the tail possesses numerous short sinuous transverse wrinkles; but the remainder of the expanded organ is devoid of these. The upper surface is comparatively smooth. The scaly epidermal patching met with on the fore part of the body is very sparsely distributed on the tail—and where present is chiefly at the margins, as small punctate dermal tracery. All round the very posterior edge of the caudal expansion, but on the dorsal surface, there is a smooth cord-like rim one eighth of an inch broad.

The thickness of the skin varies with its situation. Near the generative outlet I found it to be 0·4 inch, the epidermis itself $\frac{1}{16}$ of an inch¹.

2. *Hair and Bristles.*—The sparsely distributed hairs upon the head, trunk, tail, and extremities of *Manatus* and *Halicore* have been mentioned by all observers; I shall but append a supplement to their remarks. Two kinds of dermal appendages have been noted—longish pliant hairs, and short stiff bristles. The former, scattered over the back and belly, have an average length of $1\frac{1}{2}$ inch; but many are shorter, though a fair proportion reach and even exceed 2 inches. Each hair is very fine, soft, smooth, and pale-coloured. Upon the limbs the hairs are considerably shorter than above stated, but are closer set together, especially on the palmar aspect. On the upper surface of the head they are likewise curtailed in length compared with those on the body and tail. At each angle of the mouth, partially within the lips, developed on the upper, but still more so on the lower jaw, is a pretty thick bunch of long, somewhat coarse, hairs. Of these Stannius says that they cause the cheeks to appear thickly beset with hair; but this neither his nor Vrolik's sketches clearly exemplify.

These hairs within the mouth are not without interest, as, it may be, they, and not the horny palate, are the homologues of the whalebone or baleen plates of some Cetacea.

Quite under the chin, as Vrolik shows, the hairs are stiffer than those described, uniform in calibre, and about a quarter of an inch in length. These, both in outward aspect and texture, are intermediate between the hairs of the body generally and the true bristles. The latter are stout, blunt-pointed, and spring from the pits of the rough muzzle and ridged lower lip. They vary in total length from 0·3 to 0·4 inch, though not more than half that is free. Towards the nares, where smallest, they project only slightly, but lower down increase in size and rigidity, so that when the hand is passed over the surface it feels like a rasp. At the dependent angle on each side of the muzzle is a circumscribed oval prominence, half an inch in diameter, where the ridges, furrows, and bristles are specially pronounced. This spot would seem to possess most tactile delicacy; for twigs of the infraorbital and facial nerves are abundant thereto. On the semilunar, pale-coloured, tough, lower lip, there are three transverse rows of bristles and trapezoidal ridges. Besides bristles there were many of the long silky hairs scattered on the face of the muzzle, they being in greatest plenty, however, circumferentially.

¹ For its microscopical composition, consult Professor Paulsen's observations, and woodcut in Brandt's *Symb. Siren.* iii. p. 252, and Leydig's *Lehrb. d. Histol.* p. 87.

The above disposition strongly reminds one of the moustachial apparatus of the Walrus; but their shortness and rigidity render them unequal to perform the office of a sieve, as is the case in the Pinniped: they therefore incline to the hirsute covering of the muzzle of the Hippopotamus.

3. *Fatty Envelope &c.*—The two animals differed considerably as regards their bodily condition. The female was fat as a pig, whilst the younger male, though on the whole plump, possessed rather an abundance of areolar and fibrous textures than fatty tissue. In the former, immediately beneath the skin, and enveloping the whole of the body and root of the tail, there existed a layer of remarkably dense fat. This adipose material, under the knife, cut not unlike bacon or solid mutton suet, being rather more greasy, however, than the latter. The pectoral limbs and the anterior portion of the muzzle differed from the body in being almost destitute of fatty clothing, its place being supplied by fibroid tissues. On the back the fat had a thickness of $1\frac{1}{2}$ inch, and at one spot, behind the shoulder-blade, where the panniculus muscle becomes aponeurotic, it had a depth of 2 inches. On the abdomen generally it did not exceed 1 inch thick, thinning to $\frac{1}{2}$ an inch or so towards the vulva and anus. Still further backwards it lessened by degrees, until lost in the interlacing tendinous aponeurosis forming the flat caudal expansion. In front, over the head and lower jaws, the fat likewise diminished gradually, so as to leave the great nasal and mandibular muscles almost superficially free from it. As referred to in my description of the muscles, and mentioned by Stannius in his dissection, there was a layer of softer fat intervening between the panniculus carnosus and the muscles lying beneath. In some places, chiefly the anterior half of the body, this exceeded half an inch in depth; but posteriorly it was considerably less in quantity. A lump of fat covers the deep layer of fascial muscles beneath the infra-orbital process.

Structurally, as Vrolik justly observes, the cutaneous fat is unlike that of Cetacea in possessing little or no free liquid oil; and in consequence it more resembles that of ordinary mammals. I noticed particularly in the abdominal layer a vast number of minute red puncta. These appeared to be the cut extremities of vascular twigs, the continuation, it might be, of the subjacent rete mirabile.

I had the curiosity to weigh the fat taken from the outside of the body of the female, and found there were 24 lb. 10 oz. This approximates closely to one ninth of the total weight of the animal.

Desirous of judging of the flavour of the flesh of the Manatee, I had several portions of the specimen forwarded by Mr. Latimer cooked. One or two gentlemen partook of it along with myself; and the unanimous opinion expressed was, that it ate excellently. When broiled, the fibre appeared white and delicate, and the flavour was that of a crisp, tender veal cutlet. This is *en rapport* with the accounts of the natives, travellers, &c., who eat it freely; and, indeed, it is said the Catholic clergy in South America do not object to its being used on fast days, on the supposition of its being allied to the

fish tribe. Steller's advice that the *Rhytina* was good food too was eagerly adopted by the northern mariners, to the annihilation of that remarkable Sirenian race. The same fate awaits the Dugong, since not only is its flesh appreciated in Australia, but the oil, obtained by boiling the fat on the body, according to Dr. Hobbs of Queensland, rivals, if not surpasses, in therapeutical excellence the better-known cod-liver oil.

III. THE SKELETON AND ITS LIGAMENOUS CONNEXIONS.

My annotation concerning the skeleton of the Manatee shall be circumscribed, forasmuch as its osteology has heretofore been subjected to careful research at the hands of shrewd, scrupulous, and laborious investigators. The literature on the osteology of the Sirenia, though the order contains but four genera, *Halitherium*, *Rhytina*, *Halicore*, and *Manatus*, with few species, stands forth prominently on account of the galaxy of talent that has swept the field. Steller's¹ early observations still hold a worthy place. On the Lamatins, living and fossil, the genius of Cuvier, in his 'Ossemens Fossiles' (vol. v.), and De Blainville, in his 'Ostéographie,' are monuments of masterly generalization. Stannius and Vrolik and Krauss², in their special monographs on the American species, largely treat of the skeleton; whilst the names of Schlegel³, Owen⁴, Gervais⁵ and Serres, Kaup⁶, Brandt⁷, Gray⁸, Nordmann⁹, Huxley¹⁰, and others not a few, individually attest to the assiduous toil bestowed on the above group of Mammals and the excellency of the workers thereon.

1. *The Spinal Axis.*

Notwithstanding what I have said, it is somewhat remarkable that no two authors virtually agree as to the total number of vertebræ in *Manatus*. This, it would seem, may arise from several reasons.

1st. Computation in some instances possibly has been taken from set-up skeletons, incomplete in the terminal caudal elements; 2nd, the number may differ in the very young and adult animals; 3rd, the amount present may bear a relation to the sex;

¹ De Bestiis Marinis. 1749-51.

² "Beiträge zur Osteologie des surinamischen Manatus," in Müll. Archiv f. Anat. & Phys. 1858; also Archiv, 1862, p. 415, tab. xiii.; on *Halitherium*, by the same author, N. Jahrb. f. Mineral. 1858 and 1862.

³ Abhandl. &c. Leyden, 1841.

⁴ Dugong, P. Z. S. 1838, p. 28.

⁵ "Sirénides, Mam. Foss. du Midi d. l. France," Ann. d. Sci. Nat. 1841, 1846, 1847, 1849, 1850, &c., and Zool. et Paléon. Gén. 1867-69, &c.

⁶ *Halitherium*, 'Beiträge,' Darmstadt, 1855-62; N. Jahrb. f. Mineral. 1838, 1856, 1858, &c., with many illustrations.

⁷ "Symbolæ Sirenologicae," Mém. de l'Acad. Imp. d. Sci. de St. Pétersb. 1849, 1861, 1868, 1869, and other papers in the Bull. d. l'Acad.: altogether a series of magnificent monographs.

⁸ P. Z. S.; Ann. & Mag. N. H., various; and B. M. Catalogues.

⁹ Beiträge, *Rhytina*, Helsingfors, 1861, and Act. Soc. Sci. Fennicæ, tom. vi.

¹⁰ Hunterian Lectures, reported in 'Lancet,' Feb. 1868. Furthermore, see extended references to literature, Brandt, *l. c.* fasc. iii. pp. 237, 300.

4th, numerical variability may occur in individuals of the same species apart from sex; 5th, if there are several distinct species, as some hold, the aggregate in each may be different.

In reply to the first of these reasons, it is doubtless true that the tiny ossicles terminating the caudal region, and each of which represents a vertebral element, occasionally are lost; the total numbers therefore in such cases would be under the maximum. But this only accounts for one kind of deficiency, whereas differences in numbers are attributed to the cervical and dorsal vertebræ, where the same excuse does not hold good. Concerning the second reason, here also non-ossification of the terminal caudals would give rise to the very young animal having a minimum of vertebræ in the spine. But in this, as in the last, uniformity of regional numbers seemingly does not obtain. Third, the data extant showing relation of sex to spinal formula, does not prove that male and female possess a constant ratio the one to the other. The fourth proposition, I am of opinion, is the true explanation of the manifold discrepancies, excepting what concerns the cervicals. Professor Krauss, I may affirm, has had more Manatee skeletons pass through his hands than any other *savant* in Europe; and these have been received all from one locality, and undoubtedly of one species. His observations, most accurately made, are in every way trustworthy; and they go to show that the numbers of dorsal as well as lumbo-caudal vertebræ are subject to irregularity. Results coming under my own notice substantiate his data. Fifth, specific distinction yields no very determinate data of spine-formulæ, especially as concerns the supposition of distinctive American forms. It may be concluded, therefore, that the vertebral series of *Manatus* is inconstant within certain limits, and in this respect presents resemblances to those of the Cetacea.

Besides differences of opinion respecting the total number of vertebral elements, authorities also disagree as to the numbers and character of vertebræ taken regionally. The singular *Manatus* has thus afforded a moot case, every ray of light shed upon which brings out fresh features or readings of the facts. As regards the cervical region, two points have excited discussion:—one, whether six or seven was the normal number of bones; the other, which vertebra was the missing one, provided the mammalian law of seven was deviated from. The vantage-ground has latterly been ceded to those who have maintained the presence of but six osseous representatives.

Of special observers as to the first point at issue, Sir Everard Home, Alex. v. Humboldt, De Blainville, Leuckart¹, and Robert² have enunciated that there are seven cervical elements; whilst Daubenton, the brothers Cuvier, Meckel³, Schlegel, Stannius, A. Wagner⁴, Vrolik, Owen, Krauss, Brandt, Flower, and Gray, on more weighty grounds, have recognized only six clearly developed neck-vertebræ. In both animals dissected by myself, only six appreciable neck-vertebræ obtained. I thought I had detected the rudiment of a seventh in the young male; but a more scrutinizing search failed to justify

¹ Zool. Bemerk. (Stuttgart, 1841), p. 62.

² Comptes Rendus, 1836, p. 363.

³ Vergl. Anat.

⁴ Schreb. Säugethiere, Fortsetz. 1846, pt. 7. p. 106.

my first impression. I may further say that of very many skeletons, in various stages of growth, examined by me in Continental and English Museums, none exhibited more than six cervicals.

As to the second point, recognition of the absent one, De Blainville took up the question very categorically, inasmuch as he maintained that in one of the Leyden specimens he counted seven; and he assumes rather than proves that "la sixième, finit par disparaître dans son corps; l'arc restant libre dans les chairs, est enlevé avec elles." This statement has been contradicted by Vrolik, who cites Temminck, Schlegel, and Peters as witnesses in evidence of its absence in the Leyden skeleton in question. In my examination of the same specimen I certainly only found six. Professor Brandt also throws doubts on De Blainville's assertion; and he himself, in a study of the Sirenian neck-vertebræ, holds, from analogy in the disposition of the cervicals of *Halicore* and *Rhytina*, and the way in which the head of the first rib articulates, that the seventh is that which is wanting. The first dorsal, however, or numerically the seventh from the cranium, he is inclined to regard in the light of an anomaly—functionally a dorsal, yet in some way a cervical. Somewhat incongruously I think, while admitting on sound grounds but six for the neck, he would do away with this apparent exception by the less stable assumption of a cervical simulating an undoubted true dorsal. Professor Flower, in a short communication¹, very sensibly argues against Brandt's opinion. Basing his reasoning on the cervical irregularity extant in the Sloth, as elucidated by Bell and Turner, and on the individual characters of the seven cervical vertebræ of the Dugong compared with those of the Manatee, he concludes that morphologically the sixth is the missing one in the latter animal.

For my own part I venture to dissent from the above distinguished authorities; and suggest that it is the usual third cervical of Mammals which is the undeveloped or absent one in *Manatus*. This conviction I am led to adopt for several reasons. In Cetacea with ankylosed cervicals more generally the third is the least distinct, the fourth, fifth, and sixth by degrees evincing greater separation. In adult Sirenia occasionally the axis and so-called third and fourth are found partially united. In them also the three vertebræ succeeding the axis, although subequal in thickness, do show slight successive increment, so that, *ceteris paribus*, the missing true third one would be most reduced, and its thinned body and lamina more readily coalesced to non-detection with the enlarged axis. Again, in my dissections (*vide* fig. 29) I found that there is a tiny accessory tendon of the scalenus muscle, which comes from a small triangular fleshy slip alongside of the larger axial division, and is fixed immediately behind it to the same vertebra. The third nerve passes between them. This diminutive additional tendon, therefore, completes the normal number seven of the cervical attachments of the scalenus, notwithstanding there being only six well-developed neck-vertebræ; moreover its relation to the third nerve is, I hold, important. Inferentially this

¹ Nat. Hist. Rev. 1864, p. 259.

and the other reasons adduced point somewhat weightily to the presumption that the third is the deficient cervical vertebra in the Manatee.

Regarding dorsal vertebræ, Krauss's tables show 16 and 17 to be most frequent, though Stannius records 15. I select four examples from my own observations in support of inconstancy in dorsal vertebræ and ribs. In the Stuttgart Museum there is a skeleton of a young animal (received from Herr Kappler, 1864) of which the spinal numbers are 6 cervical, 16 dorsal (with ribs), and 25 lumbo-caudal, =47. In the Zoological Society's juvenile male there obtained 6 cervical, 17 dorsal (with ribs)¹, and 25 lumbo-caudal, =48. In an adolescent skeleton in Heidelberg Anat. Mus. I counted 6 cervical, 17 dorsal (17 ribs on left and 16 on right side), lumbo-caudal 25, but possibly two ossicles deficient, =48 or 50? In the Zoological Society's female the numbers (with ribs) were, 6 cervical, 18 dorsal, and 27 lumbo-caudal, =51 in all. Excepting the Heidelberg specimen, the terminal tail-elements were intact, being connected by ligaments.

The so-called lumbar vertebræ are two or three, according to circumstances. Thus, one thing with the other, it results that the spinal column of the genus presents conflicting anomalies.

2. *The Spinal Ligaments.*

There is a certain amount of rigidity in the spinal column of the larger-sized *Manatus*, resultant from the very limited amount of intervertebral substance. In the older female specimen the thickness of the intervertebral cartilage barely exceeded one tenth of an inch, the bones in consequence approximating very closely. This deficiency of the elastic cushion of soft cartilaginous substance is not confined to any one region of the spine, but is met with from the cervical almost to the tip of the caudal vertebræ. In the young animal there is much greater flexibility of the spine; as, indeed, one would anticipate, seeing this is the universal rule in the Mammalia.

Counterbalancing the deficiency of intervertebral cartilage, there is an ample development of ligamentum subflavum in all the spine-bearing vertebræ. In the neck, as might be expected from the antero-posterior compression of the six bones, it is thin, and accommodated to the wide arches. Between the dorsal spinous processes, especially from the fifth backwards, it is remarkably thick and strong. In some interspaces it measured above an inch broad, and almost as much deep. From the true dorsal vertebræ backwards it decreases in the ratio of the size of the spines. This ligamentum subflavum is composed chiefly of yellow elastic tissue.

The equivalent of the anterior common ligament of the vertebral column, here horizontally placed, is only of moderate breadth and strength. From the seventh dorsal segment to the lumbar vertebræ the ligament in question is mainly noticeable as existing between the keeled part of the ventral processes.

¹ I have to regret an error in Plate XXVI. fig. 37, where eighteen ribs are drawn. I bear due share of blame for not detecting in time that my artist had mistaken a fibrous band coming from the cartilaginous tip of the first lumbar as a rib; the eighteen costæ in the female doubtless also misled us both at the moment.

The posterior common ligament within the spinal canal was not examined.

I observed in nine or ten of the anterior dorsal vertebræ an extra ligament. This passes as a more or less strongish band from the posterior surface or border of the lower portion of the vertebral lamina to the anterior border of the transverse process, and over the articulating process. From the fourth to the seventh vertebra it is well marked, but is less distinct in the succeeding ones.

The capsular ligament is divided by a strong interarticular spur from the intervertebral. The two synovial cavities are very distinctly separate.

Of the true ligamentous bands lashing the costæ to the spinal elements, each stellate ligament is only imperfectly divided into two bundles.

The anterior costo-transverse ligaments of human anatomists are wanting.

But in all the ribs there are developed short, but immensely strong, middle costo-transverse ligaments. These are situated deeply, and pass in an oblique direction between the ribs and the transverse processes. They are covered by a portion of the external intercostal muscles, and partly surrounded by the intervertebral plexus of vessels.

Every one of the eighteen posterior costo-transverse ligaments is remarkably broad and strong. Along with the stellate ligament the middle costo-transverse ligament prevents the rib rotating too far forwards.

3. *Limbs, Pelvis, and Ligaments.*

Vrolik's portraiture (pl. 3) and remarks (*l. c.* p. 69) on the progressive development of the pectoral limb are sufficient for practical purposes. In his larger specimen the ossific centres of the phalanges, three to each and two to the thumb, are not quite so rigidly defined as in that coming under my own observation. The ligaments connecting the limb-segments are very simple, the flattened condition of the bones obviating much differentiation; and each joint is uncommonly lax. The tendon of the subscapularis pierces and greatly strengthens the shoulder-joint.

The pelvic bones of two males at different ages have been delineated in the 'Bijdragen' (pl. 5); and, excepting in greater circularity of the central mass, my young male agreed. In the older female ossification had proceeded further. The figure of the bone is furcate or semilunar, therefore differing from the adult male, where it has an irregular diamond-shape. The extremities of the horns are cartilaginous, the rectus abdominis muscle being inserted between (*vide* fig. 50); and the posterior concave border has likewise a cartilaginous rim, to which the ischio-coccygeus is affixed. On the inner border the transversus perinæi &c. are attached. This edge, therefore, represents the ischium, the tuberosity being that turned rearwards; the anterior cartilages tipping the cornua are respectively pubis and ilium. The surfaces of the bone are smooth, and indeed slightly concave; but all limb-structure is absent. The relative dimensions of the pelvis were:—male, $\frac{1}{2}$ inch in diameter; female, about $1\frac{1}{2}$ inch in long and 1 inch

in cross diameter. Besides suspensory ligament derived from the transverse process of what may be considered a sacral vertebra, there is another, equally strong, passing inwards from the pubo-ischial region to the vulva, behind which it meets its fellow of the opposite side. This interpelvic bridge appears to be the homologue of a sub-pubic ligament.

4. *Cranium and Dentition.*

So often has the skull of the Manatee been described and figured, that I restrict myself to a short notice of its interior, and to a few remarks on the fœtal cranium.

The sections chosen to illustrate the cranial cavity are the internal basis as opened horizontally or with calvarium removed, and a longitudinal vertical section to the left of the middle line. The former (fig. 36, Pl. XXV.), of the female specimen, has the dura mater attached on the left side, but the bones have been cleaned on the right; the latter (fig. 37, Pl. XXVI.), of the younger male, is part and parcel of the sectional view of the body with membranes and organs *in situ*.

The interior basis cranii may be likened in figure to a broad stirrup, being very square across the supraoccipital region, and arching regularly round from the temporal to the frontal region. It is flattish below, as is the vault; but the sides of the entire cavity are steep and but slightly arched mesially. The length and breadth of the cranial cavity are nearly equal; but the height is rather less than either. In the female skull (that depicted in fig. 36) the two horizontal diameters were about $3\frac{1}{4}$ inches, the vertical close upon $2\frac{3}{4}$ inches.

The skull's walls are very remarkable as regards inequality of thickness. The vertex, to say the least, is as solid a piece of bone as can well be conceived, whilst the sides, especially at the temporal region, are quite the reverse of this—namely, a thin plate of bone. To specify, and with reference to our figure, the nearly vertical section of the frontal bone in this female was above three quarters of an inch deep, the temporal and part of the parietal plates little more than a line, the occipital wall less than half an inch at its middle, but thicker at the sides. The structure of the bone also varies. The frontal is, to an extreme, dense and compact, as, indeed, is the osseous consistence generally; only a film of diploë is apparent on the lateral walls, and the occipital segment has a distinct (though finely cancellated) interior, with a thin outer vitreous table.

The internal basis cranii examined, as in our figure, with the dura mater retained on one moiety, presents a notable difference on the two sides. In that with the membrane remaining (the left side, but right of fig. 36, as seen in the Plate) there are two subequal-sized oval fossæ, divided by a nearly transverse arched membranous ridge.

These correspond respectively to the posterior and middle fossæ of, say, the human skull. The anterior fossa of Man, in the Manatee is nearly perpendicular, or forms the front cranial wall, and hence is only partially visible on looking directly downwards into the cranial cavity. Those fossæ present in *Manatus* contain the anterior and posterior

cerebral lobes. An ethmoidal elevation or ridge of bone is well marked; outside it (partly seen in fig. 36) is the broad depression which lodges the olfactory bulb (1); the optic foramen (2) at its posterior border is barely distinguishable. A narrow elliptical slit (5) pierces the outer wing of the arched transverse fibrous septa, and transmits the fifth nerve. In the posterior fossa, behind the septa and partly to the inner side of the slit spoken of, there is a broad hollow (*t*), wherein the temporal lobe of the brain lies. About the centre of the cranial floor and within the area of the somewhat triangular inner horn of the transverse fibrous septa from before backwards, are as follows:—a tiny elevation representative of the lesser wing of the sphenoid; outside it a perforation in the membrane corresponding to the sphenoidal fissure (3), transmitting the third and fourth nerves &c.; behind that a shallow pituitary fossa (*p*); and lastly, posteriorly, an oblique groove and membranous perforation for the carotid artery (*ca*).

About the middle of the posterior fossa, in the valley of the nodular petrous elevation, is the large internal auditory foramen (7). Rearwards of this, at the occipital, is a wide groove running outwards and backwards, the membranous covering of which hides the jugular portion (*j*) of the foramen lacerum posterius. Outwards from this, in an angular corner of our section, are the great vascular plexus (*Px*) and vein which fill the deep lateral sinus. The spinal vascular plexus (*Px**), which communicates with this, occupies a considerable portion of the foramen magnum.

On removal of the dura mater (as the opposite half of the figure shows), the bones of the cranial basis display material distinction from the fossa as covered by the membrane. They agree in most respects with the allied form *Halicore*, to some extent with the young of *Elephas*, and certainly resemble these more than they do Cetaceans.

The frontal, fenestrated plate, and stout crista galli of the ethmoid form the anterior perpendicular cranial wall, partly assisted below by the fair-sized orbito-sphenoid (*o.s*). The cribriform ethmoidal lamella is oval, fully half an inch in vertical depth, and freely perforated. A groove leading to the small optic foramen (2*) runs obliquely outwards; and immediately external to this is a large irregular ovoid perforation, separating the orbital from the alisphenoid. This interspace, one inch long by half an inch broad in our female specimen, is partly freely open and partly blocked up by a semiglobular projection of the dental portion of the maxillary bone (*Mx*), which in this case contained the germs of molars.

The alisphenoid plate (*As*), ankylosed with the basisphenoid (*Bs*), constitute the mid floor; the former constitutes a part of the lateral cranial wall, being wedged in between the squamosal parietal and tip of the orbito-sphenoid. The suture betwixt the basioccipital and basisphenoid is distinct, that between the latter and orbito-sphenoid less so. A pair of aborted nipple-like leaflets of bone appear to represent the anterior clinoid processes; and behind these are a few foramina.

Backwards from the basisphenoid is the flat bar of the basioccipital (*Bo*), which, forking outwards with the inner spur of the exoccipital (*EO*), circuit the lower margin

of the great foramen magnum. But the two more interesting phases of the interior osseous cranial construction are an immense fissure (a continuous foramen lacerum medium and posterius) and as remarkable a development of the periotic (*Per*). The great fissure spoken of forms a considerable segment of a circle, broad and irregularly contoured in front, and narrowing as it sweeps inwards and then round the periotic. It is bounded laterally, forwards, and internally, respectively, by two divisions of the periotic presently to be mentioned, a tip of the wedge squamo-parietal, the posterior border of the alisphenoid, and by the basioccipital. Its narrow posterior horn, or what corresponds to the jugular portion, dips between the posterior border of the periotic and exoccipital, and communicates with the great inferior basal petrotympanic cavity. The massive and dense periotic within the skull is bicuspid, and occupies nearly half the interior. The anterior smaller division partially constitutes the lateral cranial wall, and abuts upon the squamo-parietal wedge behind the alisphenoid. The posterior larger division (= pars petrosa) juts across the cranial basis, as a thick nodular mass, behind the above-mentioned foramen lacerum medium. Its upper moiety is swollen, a prominent node marking the semicircular canals (*sc*²), on the posterior surface of which is a vertical fissure (aquæductus vestibuli?). The lower moiety is separated from the upper by a transverse sulcus, superior petrosal groove, near the anterior end of which is the meatus auditorius internus (7), and above and forwards by two foramina (=hiatus Fallopius and lamina cribrosa?).

The great cranial fissure is ordinarily closed above by the dura mater, as has been shown; and beneath this is a large sac, connected with the Eustachian tube, and communicating with the tympano-periotic fossa. The lower wall-membrane of this sac reaches from the alisphenoid to the exoccipital and stylo-hyal cartilage, and crosswise from the basiocciput to the tympanic.

The youngest *Manatus* skeleton which I have had access to is that in the Amsterdam Zoological Gardens, and said by Vrolik, in his memoir, to be that of a fœtus.

Each half of the inferior maxillary bone apparently has had three centres of ossification, at least is suturally divided into three areas (1, 2, 3, fig. 16)—namely, symphysial, angular, and ascending ramal divisions. The sutural lines of demarcation spring triradially from the proximal end of the body of the bone, and are pretty regular in their course, that across the ramus being the longest. The frontal bone (*Fr*) is bilateral, as Vrolik has shown¹; and a large fontanelle mesially divides the parietals backwards to the supraoccipital. The coronal suture runs in nearly a straight line across the vertex. A parieto-squamal suture is well defined. The supraoccipital (*So*) is a single transversely oval-figured bony area, quite separated from the exoccipital by interfibrous material, and laterally bounded by broadish fontanelles (*fo*²), which continue backwards and divide the temporal from both. The tympanic (*Ty*) and squamo-malar

¹ Bijdragen, pl. iv. fig. 13—an upper view of skull, but which I have supplemented by two other sketches of the same specimen (Pl. XXII.).

elements of the latter are very distinct. The exoccipital (*Eo*) is in two subquadrate halves widely apart, the foramen magnum (*fm*) being surrounded by membrane and fibroid tissue. The basiocciput (*Bo*) is free, its basisphenoid articulation, as in older animals, being unossified. Each alisphenoid (*As*) is disconnected from the basisphenoid (*Bs*); and behind them the membrane of the considerable-sized Eustachian sac is left intact (fig. 17, *Eus*). The palatines (*Pl*), maxillæ (*Mx*), præmaxillæ (*Pmx*), and jugal bones (*Ju*) have their lines of approximate union very marked; how many ossific centres each had I did not note. In the adult, at the outer posterior angle of the orbit, a bony process is sent up from the jugum; this is a sesamoid or separate ossific element (*s*) in the fœtal skeleton.

In the above fœtus, on each side, a pair of spaces indicated the future molars in their saccular condition, and a tiny orifice a premaxillary incisor. In our Society's specimens with difference of age the same conditions obtained, viz. five grinding-teeth in use and a sixth almost erupted, whilst in the cavity behind there was evidence of at least three more in an undeveloped state. Minute denticles representative of a pair of upper and lower incisors I distinctly detected.

IV. THE MUSCULAR SYSTEM.

To my knowledge Stannius is the only author who has treated of the myology of the Manatee¹; and his descriptive remarks are chiefly confined to a very general account of the abdominal and caudal muscles. These he has compared with those of Cetaceans, taking the Common Porpoise as his type. He briefly points to certain resemblances between the tail-muscles of the two, shows that the cutaneous panniculus, the muscles of the abdomen, and the so-called psoas muscles differ in the one form and in the other. But the restricted manner in which he traces the homologies, and the fact that he has left unnoted the muscularly clad anterior extremity, the extraordinarily developed facial muscles, and the large deep muscles of the otherwise shortened neck, render it desirable that further demonstration of the fleshy structure of this singular mammal should be placed on record.

The Manatee's pseudo-Whale-characters (herbivorous Cete of the Cuviers and others) and Gravigrade tendencies (of Blainville) cause me to compare its myology respectively with Whales and the Elephant. Laurillard's² superb delineations serve well my purpose for the latter; Stannius's, Carte and Macalister's³, and my own dissections of Cetacea abundantly supply me with material for the former.

1. *Muscles of the Axial Skeleton.*

(A) *Those connecting the Spinal Column.—Dorsal Aspect.*—I shall take the deep fleshy and tendinous bundles upon the dorsal surface of the spine as the starting-point whereon to build up the muscular structure incorporating the soft frame of the

¹ *Loc. cit.* p. 34.

² *Recueil de Myologie*, plates 272 to 295.

³ *Phil. Trans.* 1868, p. 218.

Manatee. Here we find that definition into separate or individual muscles is not easy, from the very fused condition of the parts. There may be traced, however, through the length of the dorsal and what constitutes the lumbar region oblique sets of fibres which answer to those of the *multifidus spinæ* and *semispinales*.

The *levatores costarum*, corresponding to the number of ribs less one, are more easily defined than the preceding; but they also have their fibres much intermingled with the long spinal muscles presently to be spoken of.

As regards the *interspinales*, these either are aborted or so masked by the volume of interspinal yellow elastic ligamentum subflavum that their function is supplanted by the latter.

From that close adherence of the mass of the erector spinæ to the tissues beneath, *intertransversales* muscular slips are chiefly apparent in the lumbar and caudal regions, reference to which shall be made further on.

What corresponds to the combined or continuous *spinalis dorsi* and *levator caudæ internus* is a long, narrow, but, in the back, vertically deep muscle, which runs from the neck backwards as far as the end of the tail. Anteriorly, where laterally compressed but fleshy, it fills vertically the hollow between the cervical spines and transverse processes. Posteriorly it becomes tendinous and aponeurotic, and is fastened to the caudal vertebræ superiorly.

There is a very massive and in great part fleshy *longissimus dorsi*, which extends outside the last from the first rib backwards to the very end of the caudal vertebræ, thus including what constitutes the *levator caudæ externus* of most other Mammals. Like the preceding the tail-tendons are interwoven into an aponeurosis, partially fixed to the transverse and to the spinous processes.

The well-marked *sacro-lumbalis* is a rather narrow but thick muscular elongation, lying upon and firmly attached to the whole of the ribs outside their angles. Its outer tendons are short and fixed to the costæ along with the fleshy part of the external border of the muscle; the internal tendons are even more imbedded among the muscular substance. At the first rib the sacro-lumbalis is very narrow, but is broader towards the middle of the body—in the larger specimen being 2 inches in transverse diameter. At the last rib there is a fusiform muscle, almost like a continuation of the sacro-lumbalis, but which I shall describe along with the subcaudal series. A few fleshy fibres are continued forwards on to the axis, from the sacro-lumbalis, and a still larger amount from the longissimus dorsi; but, as might be expected from the remarkable shortness of the Manatee's neck, neither of these compressed bundles is of much import functionally. They are individually homologues of the *cervicalis ascendens* and *transversalis colli*.

There is, moreover, a better representative of the *trachelo-mastoid*, which is a much longer and distinct muscular band, proceeding forwards from the edge of the *transversalis colli*, and is inserted into the skull. The cranial attachment is upon the

exoccipital bone, betwixt the cephalo-humeral and the complexus muscles; the united superior obliquus and the rectus lateralis are situated below and within.

The *splenius* and *complexus* appear almost a continuation of the long internal spinal muscle; there is, however, a distinct separation, excepting a few of the fibres. Of the two the *splenius* (*Sp*, fig. 8) is much the smaller. It diverges, so to speak, from the fleshy fibres of the complexus outwardly, opposite the second rib, and proceeds broadly to the skull, where it is inserted by a short, flat, but very strong tendon into the exoccipital ridge above and behind the cephalo-humeral. The larger, thick and long complexus arises from the outer side of the *spinalis dorsi*, above the head of the sixth rib. It covers the remaining interspace between the ribs and the compressed anterior portion of the *spinalis dorsi* forwards to the cervical vertebræ, where it spreads out and lies superficial to the short recti and oblique muscles. It is inserted into the whole of the back of the cranium, as far outwards as the paramastoid.

The short deep muscles of the back of the neck are well represented, in spite of the diminution of the posterior cervical vertebræ; for the atlas and axis are still of fair dimensions. They show no deviation in attachments from those of ordinary mammals. The *rectus capitis posticus major* and *minor* have coalesced fleshy fibres, the former being much the larger of the two. The *obliquus inferior* is well developed, and somewhat fusiform. The *obliquus superior* and *rectus lateralis* are closely united, and together form a short fleshy band.

These posterior short muscles of the neck Stannius¹ partly treats along with the semispinales in the Porpoise; but in the Pilot Whale, Macalister² and myself have both found a very large rectus posticus, apparently major and minor. I have also defined obliqui in the same animal. In the Elephant³ there are a distinct voluminous rectus capitis major, an obliquus superior, and obliquus inferior obtain.

Ventral Aspect.—Before drawing attention to the descriptions and opinions of Rapp and Stannius concerning the presence and homologies of the infralumbar and subcaudal muscles of the Dolphin and Manatee, I deem it preferable to render an account of my own dissection of the parts in question. In *Manatus* five, or at least four, distinct muscular masses can be traced without difficulty, as superimposed in two broad flattish layers, with an additional lateral or outlying fusiform one.

The first and notable muscle is that which in the profile and under-view appears as a great and the only mass filling the interval between the last rib and the caudal extremity, and the space between the chevron bones and the tips of the lumbo-caudal transverse processes. This aspect is in some respects deceptive, as the muscle, when manipulated by the scalpel, is found to be only one of two thick and long layers occupying the area in question. The superficial stratum or musculo-tendinous lamella arises from the outer half and inferior surface of the last rib, being here partially overlain by the external oblique and panniculus; thence, with inwardly oblique fibres,

¹ *Loc. cit.* p. 30.

² P. Z. S. 1867, p. 481.

³ Myologie, pl. 282, lettered M², N, and N¹.

it is inserted mesially from the third chevron bone, backwards to the termination of the spinal column, and outwardly is fixed to the tips of the transverse processes. Anteriorly the muscle is strong, thick, and very fleshy; but halfway along the tail, and nearly throughout the middle line, it becomes tendinous, by degrees thinner, and towards the end is little else than a dense glistening aponeurotic fascia with coarse tough fibres. These fibres, when unravelled with care, separate into broadish tendons, one to each vertebra, which posteriorly commingle with the great flat tail-aponeurosis.

The second or deeper muscular lamella, also taper-shaped, is as a whole much thicker and fleshy, but not quite so broad as the last. Besides a very small slip anteriorly derived from the last rib, it has firm attachments along the under surfaces of the two lumbar and all the caudal vertebræ, filling the interspace betwixt the vertebral bodies, the sides of the chevron bones, and the distal extremities of the transverse osseous elements. This sheet, like the former superficial one, is fleshy anteriorly and tendinous inwardly and behind. Its terminal fasciæ or tendons are more cord-like, and with less difficulty resolvable into separate elements. The direction of the fibres of no. 2 are somewhat more backwardly oblique than no. 1.

Neither of these two muscles, be it noted, passes underneath the diaphragm, but stops short quite abreast of its posterior surface.

The next muscle (or pair of muscles) is very diminutive compared with the foregoing. It lies on the inner and anterior aspect of the deep caudal layer, and partly passes forwards beneath the diaphragm. The innermost and slightly longer of the two arises by tendinous and fleshy fibres from the sides of the bodies of the last two dorsal vertebræ and of the vertebral end of the final rib; narrowing posteriorly it is inserted on the first chevron bone. The outermost is attached in front to the last rib and behind to the outside of the same chevron bone as its neighbour. Nerves apparently representative of the lumbar plexus issue between these two muscles.

Lastly, if considered amongst the subcaudal muscles, and not what it to some extent simulates, a continuation of the sacro-lumbalis, we have the lateral or superficial outlying fusiform muscle intermediate between the dorsal and ventral surfaces of the tail. This numerically fifth infracaudal muscle, narrow, roundish, and tapering, has origin close to the termination of the sacro-lumbalis, from the cartilaginous tip of the transverse process of the sacral or first true caudal vertebra, and lies horizontally along the next eight processes. It terminates in a long but strong tendon upon the surface of the subcaudal muscle (*Sc*), mingling with its fascia.

My interpretation of these muscles is, that the superficial great broad layer represents an expanded *sacro-coccygeus*, in this case extending more than usually forwards, and the caudal tendons (each separate in most quadrupeds) are here coalesced into an aponeurotic sheet, adapted to the osseous and anomalous fleshy tail-formation. The layer beneath is an enormously developed *infracoccygeus*, with which muscle it corresponds in position &c. The anterior pair of small slips agree best with the *quadratus lum-*

borum in every respect save size. The last superficial muscle ought possibly to be included among the dorsal series. It is evidently the homologue of a small muscle met with by Mivart and me in *Galago crassicaudatus*. In that animal it lies outside the origin of the levator caudæ externus, and comes from the lumbo-iliac fascia, and is inserted by tendons on the side of the root of the tail above the sacro-coccygeus. Doubtfully named by us¹, I here denominate it in the Manatee *lumbo-caudalis*. I do not recognize in *Manatus* any division of the infralumbar muscles agreeing with psoas and iliacus. If these are present they are indivisibly fused with the infra and sacro-coccygeus, and, besides, can have no limb-attachment.

The great inferior loin- and tail-muscle of Cetacea Rapp regarded as a psoas; and he describes as costalis one of the outer dorso-caudal muscles. Meckel and others adopt a similar interpretation; but Stannius, in his myology of *Delphinus*, *Phocæna*, and the American Manatee, opposes Rapp. He names in the former a sacro-lumbalis superior and sacro-lumbalis inferior, a longissimus superior and inferior, a transversarius superior and inferior, a caudalis inferior, besides intertransversarii. He regards the Sirenian caudal muscles as nearly equivalent, more particularly laying stress on the so-called transverse muscles, these being below, as I presume, my sacro- and infra-coccygeus, and above the levatores.

Of the deep muscles of the ventral surface of the neck, the *longus colli*, which is altogether broad and flat, may be reckoned as consisting of three triangular parts. These, however, are not very readily separable into distinct portions; but the difference in direction of the fibres and attachments sufficiently define them. The first or posterior portion, homologous with the inferior oblique portion of higher mammals, covers the under surface of the transverse processes of the last two (fifth and sixth) cervicals and roots of the first two ribs. The second anterior or superior oblique slip of fleshy fibres arises widely from the ventral surface of the atlas, and is inserted narrowly and superficially tendinous into the rudimentary transverse process of the fifth cervical vertebra. The third inner and largest moiety of the *longus colli* has origin apically from the middle of the body of the atlas, and, widening on the surface of the neck, is attached to the inferior surfaces of the bodies of the succeeding cervical vertebræ.

The *rectus anticus minor* is seen on the outside of the *rectus anticus major*, and is fairly developed as a fleshy band whose origin is behind and beneath it cranially. It is inserted on the outer and under surface of the atlas.

Considering the diminished extent of neck, the *rectus anticus major* is remarkably large and comparatively long. As in the Galagos and other aberrant Lemurs, it extends from the basilar process of the skull backwards to the bodies of the anterior dorsal vertebræ. In the thorax it ends in two long, flattened, strong tendons—one to the

¹ In Trans. Zool. Soc. vol. vii. pl. 2. fig. 3, lettered *It.cd*, it is regarded as perhaps an anterior prolongation of the intertransversarii caudæ; but in the tail-dissection, pl. 6. fig. 25, where fully exposed, we leave it unlettered.

middle of the under surface of the third dorsal vertebra, and the other to the under-side of the head of the second rib. At the cranium the muscle is fixed by fleshy fibre. Portions of each longus colli tertius are exposed between the bellies of the recti antici majores from the atlas backwards.

(B) *Those of the Skull or Cephalic Segment: Facial or Supracranial.*—The three muscles of the face respectively recognized by anthropotomists as the *pyramidalis nasi*, the *compressor nasi*, and the *dilatator naris*, each and all appear to be well developed in the genus *Manatus*, notwithstanding that their fibres are indefinitely united. In the remarkably deep but narrow hollow intervening betwixt the maxillary bone and the nasal cartilage there lies a strip of muscular fibres, much intermixed, however, with what appears to be fatty tissue. The fibres possess a partly transverse and partly oblique direction. At the upper part the transverse muscular structure is necessarily short, from the configuration of the parts, but forwards from this by degrees lengthens, becomes more oblique, and as a thick bundle fills the bony depression above the zygomatici. Mesially situated, or upon the nasal cartilages, the fibres curve archedly over the nares and meet those of the fellow muscle of the opposite side.

I am inclined to regard the upper narrow but deep portion of this combined muscle as homologous with the *pyramidalis nasi* (see fig. 12, *P.n*)—those fibres that cross the naris, with the *compressor nasi* of human anatomy (figs. 10, 11, 12, *C.n*)—and the most anterior fibres, or those that deeply encircle the aperture of the nose, with the *dilatator naris* (*D.n*, fig. 12). These last, moreover, appear to include those diminutive human muscles styled the *levator proprius alæ nasi posterior* and *levator proprius alæ nasi anterior*.

The anomalous fibres of Albinus, or nasal rhomboideus of Santorini, may here be represented by a longitudinal slip at the outer border of the above triadherent muscle. The fibres of the said slip arise from the inner aspect and upper surface of the orbit, and, running obliquely inwards and well forwards, mingle with the premaxillary portion of the foregoing.

Unless what has been taken as Santorini's rhomboideus is a displaced zygomaticus minor, then there is present but one well developed *zygomaticus* muscle. This arises from the deep infraorbital fossa, and is inserted into the anterior portion of the naris, there interblending with the depressor labii superioris alæque nasi. The infraorbital arteries and nerves, as might have been expected from the vast size of the muzzle, are of large size, and lie alongside of and upon the zygomaticus muscle.

A *levator labii superioris proprius* I identify in a broad fan-shaped or triangular layer of muscle, which arises apically from underneath the projecting orbit, and expands upon the sides of the nares, front of the muzzle, and upper lip. It is much shorter than the layer covering it, but is equally fleshy, and rather the thicker of the two; in magnitude it is much greater than the zygomaticus, which it overlies and hides. A few only of the fibres of the *levator labii superioris proprius* proceed towards and over the

upper nares, the greater amount going to the lip and anterior infranarial region. The latter are sent inwards in distinct transverse lines, more particularly the deep layer. The section of this part thus resembles, on a small scale, the trunk of the Elephant when cut across—the tissue intervening between the muscular bundles and fibrillæ being fatty and fibrous.

Many vessels penetrate the root and origin of this levator; this, no doubt, led Vrolik¹ to regard “the structure of the upper lip as plainly an erectile tissue.” The true action of this muscle here may most plausibly be assumed to be a dilater of the nares.

Deeper than the last, is a broad and thick plane of muscle, which, issuing from underneath the projecting orbit, proceeds forwards by parallel fleshy fibres, less broad than the preceding. These wind round the anterior portion of the intermaxillary, and lie above the buccinator, being inserted into the incisive fossa. The upper border of this muscle, and its anterior portion, have apparently oblique fibres, which, being difficult to dissect, are readily cut across, and have a coarse aspect. These are what may represent the *levator anguli oris*, or be part and parcel of the combined levator labii proprius and levator anguli oris—here, however, not clearly separable.

I name more than define a *depressor labii superioris alæque nasi* a thick mass of the deepermost fibres of the muscle just described, and partly continuous with the zygomatici. These may represent, in a modified manner, the muscle in question. It is not at all clear or distinct, excepting by an alteration in the inner and narial fibres of these muscles. It seems to constitute a muscular layer directly in front of the intermaxillaries, stretching from the gum round the external aperture of the naris.

The muscular layer the most superficial of those upon the muzzle, I take to be the equivalent of the *levator labii superioris alæque nasi*. It is of considerable thickness and great breadth, and almost throughout fleshy. Trapezoidal in figure, the four unequal sides respectively form the medio-nasal, the orbital, the labial, and the muzzle boundaries. Fibres arise in a longish peaked manner from the outer side of the nasal cartilage upon the superior maxillary bone; thence they spread downwards and forwards, part winding outwards round the orbit, and part inwards to the nares; but the main body of the muscle has a median plane and covers the entire frontal superficies of the nares and upper lip. Below the nasal orifices, towards the median line, the fibres pass inwards curvilinearly, and are dovetailed with those of the levator labii superioris proprius, and partially inserted into the intermaxillary bones. They likewise cross above the nares and decussate with those of the opposite side of the face.

Concerning this muscle's action, the attachments and direction of its fibres show that it is an elevator, retractor, and dilater of the nares.

Mandibular Arch and Side of Skull = Infracranial.—The muscles clothing the symphysial portion of the mandible greatly increase the remarkable appearance and unusual form of the bone of this region. Of these the *levator labii inferioris* is

¹ Memoir cited, p. 59.

represented by a short but fairly developed mass of muscle and fibroid tissue, which covers the anterior inferior blunt point of the mandible and mingles with the submucous tissue of the lower lip.

Laterally, covering the outside of the swollen symphysis, and reaching the concavity of the horizontal ramus, is the *depressor labii inferioris*, a broad, fleshy, and most unusually developed plane of muscle. From its inferior attachment the fibres incline upwards and forwards, and intermix with the submucous tissues of the mouth and under lip. The two muscles of opposite sides traverse round the downwardly projecting symphysis and unite behind; but in front of this union there intervenes a strongish connecting fascia.

The homologue of the *depressor anguli oris* is a thick cap of muscle which projects on the lateral and anterior surface of the symphyseal knee and overspreads the depressor labii inferioris. The fibres of the former have quite a different inclination from those of the latter, which cross them at a right angle upwards and backwards. The two depressors of the angle of the mouth are connected by a wide, strong aponeurotic fascia on the under aspect of the bone; and each as it ascends narrows, and is inserted by membrane on the side of the lower lip.

The nerves and vessels emitted from the mental foramina are distributed to this and the preceding muscle. They are very numerous and of considerable size.

In Whales neither of these three lower-lip muscles can be differentiated; the mylohyoid and fibres of panniculus cover the rami. The moveable lower lip of the Elephant partially derives its power from an extension forwards of the platysmal (facien and cervico-facien of Cuvier¹) panniculus; but there is besides a broad and fleshy combined elevator and depressor of the inferior lip².

There is not much difficulty in recognizing the homologue of the *orbicularis oris*, which, as usual, surrounds the oral fissure. Its fibres are in intimate union with the anterior part of the buccinator and that portion of the fleshy panniculus or platysma which covers the cheeks.

It is merely represented by a few indefinite fibres in Cetacea; but is a broad band in the Elephant (*l. c.* pl. 274. 1), chiefly arching to the upper lip.

The *buccinator* (*Bu*) is large, long, and very thick. Its line of attachment above is the beak-like process of the maxillary and intermaxillary bones; and below the eye it fills the great vacuity overarched by the projecting orbit. It comports itself to the deep bay formed by the ascending ramus of the mandible, and thence proceeds forwards, by a broad attachment, to near the front of the upper lip. Single, thick, and fleshy in *Globocephalus*, wider flat fibres in *Elephas* as in *Manatus*.

Upon the surface of the buccinator, but inferiorly, there lies a long, ribband-like, but comparatively thick and completely fleshy slip of muscle, which has origin from the fossa on the anterior and inner portion of the ascending ramus. The muscle in question

¹ Myologie, plate 272. 2.

² *Op. cit.* pl. 274, n.

is covered in great part by the facial portion of the panniculus; but its fibres are quite separate, and differ in direction from those of the panniculus. It passes downwards and forwards between the depressor anguli oris and the depressor labii inferioris, terminating among the fibres of the former and upon the surface of the latter. It appears to counteract and check the action of the two previously mentioned muscles. Provisionally I name it *mandibularis* (*Md*, fig. 11).

It may be remarked of the *temporalis* that, considering the great size of the bones and capacity of the temporal fossa, it is relatively small, and covered with a great mass of fat. The temporal muscle, of fair size in the Elephant¹, is upwardly elongate, as is the skull; but in Whales it is the reverse of this, being set obliquely backwards in direction, short and thick.

There is a double *masseter*. The broadest and strongest portion, relatively weak in itself, is that which, fan-shaped, and with an obliquely forward and upward direction, stretches from the outer surface of the broad mandibular angle to the descending process of the malar arch, where it is most strongly tendinous. The narrower deeper portion or layer is attached to the ascending ramus and to the hinder half and lower border of the malar arch. The fibres of this portion run counter to the upper layer; that is, they assume a downward and forward course. Thus the linear arrangement of the upper and lower muscular fibres is contrariwise or X-shaped, the diagonal of the forces between which necessarily acts in an up-and-down direction.

The facial artery, nerve, and Stenon's duct, as usual, cross the masseter, but parallel to each other, and in a nearly horizontal line. These and the muscle are entirely covered by the thick extension forwards of the panniculus carnosus.

In *Elephas* the masseter unequivocally has two layers²; the fibres, however, are more nearly alike, and vertical, than in the Manatee. In my own dissection of *Globiceps* and *Lagenorhynchus* I have considered this muscle to be single, as does Stannius³ in *Phocæna*, with some additional fibres which he terms *malaris externus*; but in the Pike Whale⁴ the masseter is stated to consist of two planes of fibres, superficial and deep.

(C) *Those of the Costal Arches: Thoracic*.—The *intercostal* muscles, seventeen in number on each side, are remarkably strong and fleshy. The external series are by far the thickest of the two. They are oblique in direction, but not so much as the internal series. The diminished length of the costal cartilages causes the above muscles to stop short wide of the median line of the abdomen; but, with this exceptional circumstance, they agree with their ordinary situation and attachments.

There is an arterial intercostal plexus, as Stannius has noted, betwixt the various ribs. This at first lies within the external intercostal muscle, covered by the pleura costalis, then dips between the internal and external intercostales.

¹ Recueil, pls. 276, 287, b.

³ L. c. pp. 4 & 5.

² Recueil, pl. 276, j, j'.

⁴ Phil. Trans. 1868, p. 323.

From the extraordinary thickness of these respiratory muscles it would follow that they possessed equal increment of power on the movements of the chest and belly. This quality undoubtedly belongs to them; but their contractive efforts must in a great measure depend on the coordinate action of the remarkably placed diaphragm and the potent thoracico-abdominal muscles. The ribs are each and all firmly fixed at their vertebral ends, although comparatively free abdominally.

The *scalene* muscle bounds and is closely adherent to the inner and median side of the serratus magnus. It is a long, strong, fleshy slip, more than an inch broad, and has origin at and partially covers the three anterior ribs from their angles inwards. In the neck it passes along the tips of the transverse processes of the cervical vertebræ, and is inserted into all but that of the atlas.

Although described as single, there appears to be an imperfect division into an *anticus* and *posticus*. The attachments of the inner and smaller portion are the transverse processes of the three posterior cervical vertebræ and the first rib. The outer, broader and stronger portion has three cervical tendons—namely, two large and an intervening very diminutive one. The anterior large and small tendons, separated by the third cervical nerve, are attached to the outstanding process of the axis; the posterior large tendon is fixed to the succeeding vertebra. The latter portion of the scalenus in question arises from the second and third ribs and interspaces.

The rudimentary tiny slip of tendon referred to above, as being inserted into the axis alongside but rather behind the first tendon, is not without interest. Its presence demonstrates that the regular number of tendons exists in spite of the remarkable deficiency of a cervical vertebra, compared with what obtains in other mammals. The inferences derived therefrom have been discussed in connexion with the bones of the neck.

A vascular plexus of considerable extent intervenes between the scalene tendons and the cervical plexus of nerves at their issue from the vertebral foramina.

Rapp¹ says that the scalenus is wanting in the Manatee—a statement quite at variance with my dissection. He admits its presence in the Porpoise; so does Stannius², who names both a scalenus *anticus* and *posticus* to the first and second ribs. This agrees with what Macalister³ and I have found in the Pilot Whale; but Carte⁴ and he only mention a single scalene in *Balænoptera rostrata*. The relations of the nerves and cervical vascular plexus in the Cete bear much resemblance to those of Sirenia.

There appears to be a double scalenus in the Elephant⁵—the superficial one, answering to the serratus *anticus*, being fleshy, of great size, and spreading upon the chest by digitations as low as the fifth rib.

So far as strength and action are concerned, the superficial throat-portion of the panniculus replaces the *sterno-mastoid* in the Manatee; but the latter muscle, notwith-

¹ 'Cetacea,' already quoted, p. 86.

² *Loc. cit.* p. 36; and Meckel, vol. vi. p. 156.

³ P. Z. S. 1867, p. 481.

⁴ Phil. Trans. 1868, p. 219.

⁵ Myologie, pls. 276 and 287. 6, 6^a.

standing, is present, though greatly reduced in size. It arises as usual from the manubrium, but in front of the pectoralis major. Hence with a diminutive thin flat muscular belly, 3 inches long and $\frac{1}{2}$ an inch broad, it proceeds forwards anteriorly to about a level with the outer border of the scapula, where it bifurcates (see fig. 9, *St.m.*). The outer limb, a thin, strong, round tendon (shown in figs. 29, 30, *St.m.*), pierces the substance of the parotid gland, and is inserted into the paramastoid; the inner fork, a broadish aponeurosis, joins the deep cervical fascia of the neck, superficial to the carotid artery, and posterior to the thick fleshy digastric muscle. The shortening of the neck, great vascular rete, &c. give peculiar relations to the parts in the Manatee.

From the unusually flat and wide arched form of the ribs, the *serratus magnus* muscle appears to have a different position from what it has in deep-chested animals, though in reality it departs little, if at all, from its normal situation; it is nevertheless comparatively short and thin. The costal attachments are from the sixth rib forwards. On the scapula it is fixed underneath the rhomboideus the whole length of the vertebral border and to a triangular corner of the posterior inferior angle for about an inch in extent. Anteriorly in firm connexion with the fleshy scalene muscle it extends forwards, and is inserted into the outer and posterior surface of the enlarged transverse process of the atlas (*S.my.*, fig. 29). The nuchal portion of the muscle has a twist upon itself, and is overlain by the broad belly and insertions of the scalenus, so that only a small segment of it is seen on the ventral surface of the neck when the parts are examined in position.

The serratus in the Elephant¹ is very massive, and extends backwards to the tenth or eleventh rib. Meckel² says it is very small in Cetaceans, only fixed to at most four ribs; but my own researches agree rather with Carte and Macalister³ and partly with Stannius⁴, in their being an apparent twisting or duplicity of the muscle and greater costal attachment.

The *latissimus dorsi*, as in the Cetacea, is entirely hidden by the superimposed layer of the panniculus, and it itself overrides in part the costal portion of the serratus magnus. On the surface of the chest it presents a broadish fan-shaped fleshy expansion, relatively short, upon the ribs from the fourth to the eighth; there is a deficiency of tendon or fascia at this costal attachment, the muscular fibres being well defined, and reaching no higher than on a level with the post-inferior scapular angle, below the sacro-lumbalis. It continues fleshy anteriorly to where it joins the teres major, the two muscles (as mentioned further on) being fixed together (*La.d.*, fig. 8) to the middle of the shaft of the humerus.

Abdominal.—Previous observers concur in noting the strange reptilian-like lengthening of the lungs and diaphragm, and consequent relatively altered position of the heart and upper or anterior abdominal viscera in *Manatus*; the same obtains in the two other

¹ Pl. 267. 9.

² Vol. vi. p. 246.

³ Memoir, p. 224.

⁴ Under serratus anticus major, *l. c.* p. 13, and Rapp. p. 89.

genera of the group, *Halicore* and *Rhytina*, examined in the flesh. From the apparent correlation of rib-structure in the ancient *Halitherium*, doubtless it also was similarly constructed.

. This characteristic formation of the thoracico-abdominal parts, alluded to by many, has hitherto not been figured, at least its position to the viscera *in situ*. The desideratum I have to some extent supplied in the several sketches Pl. XXVI. figs. 44, 37, 49, and 50, and also partially in Pl. XXIV. fig. 30.

These demonstrate, as regards the *diaphragm*, that it extends in a retrogradent tolerably horizontal plane from the first to the last rib, and forms a nearly mesial septum separating the lungs within an upper, and the rest of the viscera within a lower compartment. Altogether it is very tendinous—though Daubenton¹ says “*je n’y ai point aperçu de centre nerveux*,” meaning, I apprehend, that there is no ordinary free central tendon; but instead, as fig. 44, Pl. XXVI. exhibits, the elongated middle tendinous raphe is fastened to the vertebral bodies, and to the keels from the fourth to the last dorsal vertebra.

The fleshy portion of the diaphragm forms a narrow band on each costal margin for its entire length. In the larger (female) specimen the muscular breadth measured one inch anteriorly, by degrees increasing to two or more towards the posterior end. On the inner costal wall the fleshy attachment reaches to the roots of the very shortened forwardly median-directed cartilages (see figs. 37 and 44 respectively). Posteriorly the diaphragm forms two short crura and pillars. The external, broader one of these crosses outwards from the body of the last dorsal to the under surface of the hindmost rib, partially covers the diminutive representative of *quadratus lumborum*, but debars entrance of the *depressores caudæ*, though giving egress to, or rather separated by the abdominal aorta. The diaphragm at this point folds somewhat on itself, and, fastened to the three last ribs, but not to their tips, constitutes a pocket, by the intrusion, so to say, of the thick fold of the external oblique muscle. The œsophageal and caval apertures of the diaphragm are far forwards and wide apart from the crura and pockets in question.

The deepest layer of the outer wall-muscles of the abdomen, the *transversalis*, has broader and stronger fleshy fibres than the internal oblique, though less so than those of the external oblique. It has origin in a digitate manner by attachments from the inner surfaces of all the ribs but the second—extending inwards, and joining the diaphragm an inch to the vertebral side of the rib-cartilages, and rather more than that on the five posterior ribs. The muscular substance extends inwards to near the outer third of the *rectus*, or to within about three inches of the middle line (fig. 9, *Tra*), that measurement being equivalent to its inner aponeurosis.

A cross section of the abdominal wall shows that the fleshy part of the *transversalis* and of the *rectus* are coequal; each muscle thus viewed has a flattened biconvex shape, the

¹ *Op. cit.* p. 428.

rectus, as aforesaid, slightly overlapping the transversalis. The peritonæum and a slight layer of fat cover these muscles internally; and it is noticeable that the fat is thickest at the median line and rib-cartilages. Between the transversalis and the internal oblique muscles is the rete mirabile (*Ab.Rete*, fig. 9), which lies parallel to the inner fleshy edge of the former.

The superincumbent layer of the *internal oblique* is narrow and shallow. Like the external oblique, presently to be described, it has a digitate appearance externally, and arises by muscular detachments from the third to the last rib; posteriorly the origins are in close contact with those of the external oblique but anteriorly. The fleshy part of the muscle extends inwards to the edge of the rectus, and ends in a strong glistening tendinous fascia; this passes chiefly over the surface of the rectus to the linea alba, or forms the anterior sheath of that muscle, which joins and is lost in that of the external oblique. The said aponeurosis is here and there arranged in stronger bundles; and the whole has a forward and inward direction contrary to that of the external oblique.

The *external oblique* muscle of the abdomen manifestly differs in appearance from that of ordinary mammalia in not being spread in a thin uniform sheet over the whole abdomen, but rather may be said to be relatively narrow, thick, and composed of a series of elongated digitations clasping the extremities of the ribs. Thus it has origin, in the manner indicated, from the costæ above the cartilages, from the third to the last rib inclusive. Its coarse fibres in broad bundles, which mask or imitate separate digitate parts, pass inwards and backwards, and end in or are inserted by strong slips of fascia into the outer border of the superficial surface of the rectus. These tendinous fibrillæ are moreover continued in broadish strips over the surface of the rectus, parallel to the direction of the fleshy fibres. These latter, it may further be observed, with the oblique direction spoken of, proceed from one rib back towards the second behind it—that is, embrace three ribs. Posteriorly the external oblique tapers in a wedge-shape manner; and this part is inserted upon the surface of the inferior caudal muscle, and besides, by the intermuscular fascia, deeply between the last muscle and the long tapering muscle coming from the median side line of the ribs. Finally, the wedge terminates opposite the second chevron bone.

In the Sirenian under consideration the *rectus abdominis* comports in most respects with the condition of this muscle in the Cetaceans, *e. g.* Globiceps and the Porpoise. Throughout its entire length, however, it retains its breadth more than in the Whale tribe. This may be partly owing to the body of the latter narrowing more posteriorly, or partly, no doubt, to the muscle itself serving mesially as a chief support of the visceral organs in the land-waddling Manatee, the ribs of the latter being widely apart compared with those of the former group. The rectus has origin forwards by a very strong tendinous fascia from the outer edge of the sternum, from its projection to the ensiform cartilage, and by some sparse muscular fibres from the first, second, and third ribs and their sternal cartilages. At this place the pectoralis minor is immediately

superficial to it, a slight portion of the pectoralis major only covering its inner edge behind the pectoralis minor. The muscle in question occupies the inner half of the abdomen (in the female specimen being four inches across) between the linea alba and the cartilage-tipped rib-extremities; and posterior to the pectoral muscles, or from the fifth rib, it is overlain on its outer border by the tendinous fibres of the external and internal oblique muscles. Posteriorly it is inserted into the cleft of the pelvic bone by a thickened pyramidal point.

The rete mirabile derivative from the internal mammary artery lies underneath the rectus abdominis, as shall be described with the vascular system.

2. *Muscles of the Accessory Skeleton.*

(A) *Those of the Shoulder-girdle.*—The *supra-* and *infraspinatus* are each long, narrow, and thick; they are of about equal size. The former is inserted broadly and muscularly into the summit and front of the head of the humerus; the latter, narrower, rounder, and more tendinous, is implanted on the outer tuberosity.

The *subscapularis* occupies the whole of the subscapular fossa excepting the space where the serratus magnus and the rhomboideus are fixed. It is entirely fleshy, and overlaps the lower border of the bone. A short, but strong, tendon forms its insertion into the inner tuberosity of the humerus.

The fleshy and strong *teres major* has origin from the lower dorsal edge and border of the scapula, posterior to the spine. In close union with the latissimus dorsi it is inserted into the inner aspect of the middle of the shaft of the humerus. The latissimus partly overlaps the teres; and besides the approximation of these fibres, there is a distinct fleshy slip which passes from the upper border of the former and penetrates the latter close to where the tendon of insertion commences.

No *teres minor* was observed.

A single plane of broad, but short, muscular fibres, and but little tendon, the *rhomboideus*, arises from the inner surface and vertebral border of the scapula, and extends for an inch or more over the inner surface of the serratus; it forms a shallow, wide muscular arch spread over the sacro-lumbalis and below the posterior end of the limited trapezius.

A *trapezius* is present in the Manatee, the muscular portion of which is in some degree circumscribed; for although broad and fan-shaped, the shortness of the neck reduces it anteriorly. The fleshy part is attached the whole length of the spine and dorsum of the scapula and the acromion process; therefrom it radiates, and peripherally is bounded by fascia which, with less distinct aponeurotic fibres than commonly obtains in mammals, is lost in that of the dorsal region above and behind the scapula. It is thickest and most muscular in the neck, and is fastened to the occiput.

As in Cetacea, notwithstanding the shortness of the neck, a broad, moderately thick, but powerful muscle, homologous with the so-called *cephalo-humeral*, is present in the

Manatee. This has a fleshy origin from the entire length of the prominent ridge of the outer occipital, thence is directed nearly vertically outwards and backwards, marked by limiting the anterior flattened surface of the shoulder. It continues obliquely round the head of the humerus immediately in front of the deltoid, at this part resembling the latter in shape, and is inserted on the inner and anterior side of the neck of the humerus by a very short, but strong, tendon. The humeral attachment is on a level with that of the deltoid, above that of the pectoralis major, and close to the front upper edge of the biceps.

Although a clavicle is absent, a muscle corresponding to a levator claviculæ(?) exists. It is a narrow fleshy slip arising from the paramastoid directly behind the stylo-hyal and origin of the digastric. Coursing downwards and backwards parallel with the anterior border of the cephalo-humeral, it becomes fused with this last at the head of the humerus. There is a slight transverse fibrous line of demarcation where the levator terminates; and this, it may be, is a representative of an osseous clavicle. At the head the muscle is in close relation with the hinder part of the parotid gland; and a small portion of the glandular substance and several vessels separate it from the cephalo-humeral.

The two above muscles apparently have a combined action, and drag the pectoral extremity forwards, upwards, and fully rotate it outwards. They doubtless oppose the latissimus dorsi and teres major; but the shortness of their leverage must detract from any great power.

The *pectoralis minor* agrees with the pectoralis major in being relatively long and narrow. It springs from the anterior portion of the rectus abdominis over the fibrous cords or sternal cartilages of the second and third ribs, and from the projecting sharp angle of the sternum, not reaching, however, the median line. As the muscle trends forwards it narrows slightly, and finally is inserted into the head of the humerus.

Several large glands lie beneath the muscle; and axillary vessels and nerves pass beneath it, the rete mirabile being closest to its deep surface.

The *pectoralis major* muscle is thick and powerful, though relatively narrow. It has origin from the whole length of the sternum, and from the median line of the abdomen two inches beyond the ensiform cartilage, where it overlaps a small inner portion of the anterior inner edge of the rectus. The muscular fibres take a direction obliquely or sharply forwards and outwards, and are inserted, by a very strong short tendon, into the upper portion of the lower third of the thoracic aspect of the shaft of the humerus. There is only an indistinct division into sternal and manubrial portions, which might be overlooked, except that the former rolls somewhat round, or rather dips beneath, the anterior more fleshy moiety at the axilla.

The humeral tendon of the pectoralis major while firmly implanted into the deep pit or continuation of the bicipital groove on the inner and lower aspect of the shaft of the bone, also possesses continuity with the radial segment of the forearm. Adduction of

the arm towards the chest is mainly effected through the upper attachment ; but increased leverage is gained by means of the more distant fascial fixed point. The continuation into the forearm is by a strong aponeurosis, which stretches in a bridge-like manner from the humeral tendon over the bend of the elbow, and is fastened to the neck of the radius at its tuberosity.

The pronator radii teres shoots obliquely over this radial insertion ; and the diminutive tendon or second portion of the biceps joins and terminates along with it. On its outer surface the aponeurosis in question is covered by and adherent to the flesh of the brachialis anticus. The thick cord of the rete mirabile and the brachial nerves are lodged securely, and pass downwards beneath the aforesaid aponeurotic bridge ; for as extension of the forearm occurs the expanse of fascia is rendered tense, and thus prevents undue pressure or strain upon the vessels beneath.

(B) *Those of the Pectoral Limb.* *Dorsal=Extensors.*—As respects the *triceps*, the long scapular head is fleshy, its origin extending for one and a half inch from the capsular ligament, to which it is firmly attached. The middle head arises the whole length of the back of the neck of the humerus, and has a flat broad belly. The short head occupies the whole of the back of the shaft of the bone ; above it is narrowest, and inclines obliquely inwards. The three heads, as usual, unite below, and proceed to a short flat tendon to the olecranon process.

No *anconeus* was observed.

The obliquely triangular elevator and retractor of the humerus, the *deltoid*, is of considerable size and moderate thickness. Its fibres are not very coarse or disposed in protuberant bundles as obtains in Man. Origin, the whole length of the short spine of the scapula, its lower border ; and it is firmly fixed to the loose acromial cartilage. From this last point its fibres trend downwards, those behind slanting forwards, the front of the humerus projecting beyond its anterior edge. The muscle bifurcates slightly above the middle of the humerus, at the position of the here absent deltoid eminence ; the insertions, each tendinous, embrace the biceps, and are fixed to about the middle of the shaft ; but the posterior portion continues towards the elbow.

The *supinator longus* is fair-sized. Origin, humerus above outer condyle, close to the brachialis anticus. It runs along the outside of the radial shaft, and round the styloid process, being inserted into the trapezium. It is tendinous where passing along the radial groove, and at insertion spreads out aponeurotically. If a *supinator brevis* obtains, it is with difficulty separated from the brachialis anticus ; muscular fibres apparently continuous with the latter cover the orbicular ligament and neighbourhood a little downwards.

Extensores carpi radiales longior and *brevior* appear to be represented by a single muscle with a condylar origin, a flat belly continuing three fourths the length of the radius. The distal tendon, also flat, lies in the middle radial groove and widens out over the carpus, being fastened into the proximal ends of the second and third digits,

the tendons of the *primi internodii pollicis* and long supinator obliquely crossing it at the wrist.

An *extensor communis digitorum* has an origin, as usual, from the outer condyle and ulna; its well-developed muscular mass lies mesially in the forearm, filling the broad hollow thereon. It becomes tendinous as it approaches the wrist, and divides into four flat broadish slips, which proceed in an expanded manner to as many of the outer digits. That to the third finger is rather the broadest and strongest; and the two ulnar tendons come off together somewhat higher than the radial ones.

Differentiated from the last is an *extensor minimi digiti*, which, like it, is flat. Springing chiefly from the radio-ulnar ligament of the joint, it runs at first below and then alongside the *communis digitorum*. Its tendon occupies the groove on the radial side of the ulna, and at the wrist splits into two,—the short, broad, stronger division being inserted into the proximal end of the fifth metacarpal—the second, longer tendon proceeding to the proximal phalanx of the same digit.

An *extensor carpi ulnaris* springs from the back of the outer humeral condyle, at first lying upon the pollicial extensor and then obliquely on the surface of the ulna. Its flat tendon widens as it courses round the outer distal ulnar extremity, and becomes incorporated with the strong carpal aponeurosis. Its fibres, moreover, mingle with those of the *carpi radialis*, whilst it finally has distinct insertions into the *unciforme*, *os magnum*, and proximal end of the fifth metacarpal.

There is barely a division between what appears to represent the *extensor primi* and *secundi internodii pollicis*. The former may be differentiated as a flat, broadish-based, lanceolate-shaped, fleshy muscle, which has origin in an oblique position along three fourths of the shaft of the ulna. Its tendon, also broad, flat, and strong, passes as usual in the styloid groove, and over that of the long radial extensor to be inserted into the proximal end of the first metacarpal. The latter, *secundi internodii pollicis*, has also a lanceolate (but much smaller) muscular belly, which fills the deepish interosseous interval, and at the radial groove emits a tendon which joins deeply that of the first-mentioned muscle. The difference in direction of the fleshy fibres distinguishes the above conjoined muscles.

Ventral Surface=Flexors.—The *biceps* has a large, long inner muscular belly, and a comparatively short, diminutive, chiefly tendinous outer belly. The first or main portion of muscle arises by a short, but strong, tendon from the rudimentary coracoid process. Proceeding over the insertions of the *subscapularis* and the conjoined tendon of the *teres major* and *latissimus dorsi*, it is inserted by a flat oblique tendon into the lower third of the inner side of the humeral shaft, on a level with the *pectoralis major*. The second portion of the *biceps* springs from the outer or anterior border of the first belly, and, with a short rounded thin muscular development (B^2), ends in a narrow tendon. The latter is continued to the radial tuberosity, but mingles with the *infundibular* or

bridging aponeurosis of the bend of the elbow already described in connexion with the insertion of the pectoralis major. The thick humeral rete mirabile partially overlies the biceps muscle.

The *coraco-brachialis* is absent, or indivisibly united with the first head of the biceps.

Compared with the other muscular structures of the humerus, the *brachialis anticus* is enormously developed, and, as it is entirely fleshy, causes the lower and outer aspect of the upper limb to have unusual breadth. The deltoid embraces it above; and lower than that the brachialis anticus occupies the outer and anterior surface of the humerus. It moreover covers the anterior outer aspect of the elbow-joint, being inserted muscularly into the upper half of the radius forwardly on its radial side. It is a powerful flexor of the forearm.

The *pronator radii teres* is of fair size; its origin is by a strong flat tendon from the radial side of the inner condyle; and, with only a moderate amount of fleshy belly, it is inserted obliquely upon the inner surface of the middle third of the shaft of the radius. Its power of pronation is very limited.

The *flexor carpi radialis* is long, narrow, and flat, both in tendons and belly. Origin, the inner condyle to the ulnar side of the pronator teres; its distal tendon commences at the lower end of the radius, and is inserted broadly into the proximal extremities of the indicial and pollicial metacarpals. There is no special groove for its reception on the scaphoid and trapezium.

The *flexor sublimis*, *profundus*, and *longus pollicis* muscles form a complex mass, whose origin is single and extends from the lower part of the inner condyle down the whole length of the inner flat surface of the shaft of the ulna. The thick fleshy belly, without possessing any clear separation, is nevertheless divisible, chiefly by tendon, into an upper and a lower layer. The upper layer, by a semidivided expanse of palmar fascia, supplies the second, third, and fourth digits. The fascia or united tendinous mass lies upon and is fixed to the broad interosseous muscles, and it is continued on to the proximal ends of the first phalanges of the second, third, and fourth digits. The aponeurosis is not finely interwoven and smooth on its surface, but is easily torn up into parallel coarse threads. The lower layer of this united muscle is fleshy for a short distance further than the upper layer, and does not become tendinous until reaching the palm, whereas the upper layer is tendinous above the wrist. It is inserted into the third and fourth digits, being closely adherent to the superficial tendinous mass.

From the slightly bent or oblique position assumed by the fifth metacarpal to the ulna, and the very flat condition of bones of the forearm, the *palmaris longus* and *flexor carpi ulnaris* appear to lie both on the dorsal and palmar surface of the limb. They together project, as it were, and fill the angle whose two sides respectively are the bones above mentioned. Origin by a flat tendon from the surface of the inner condyle immediately above the flexor communis. The bellies commence

above the middle of the shaft of the ulna, and end in long triangular pyramidal fleshy masses inserted broadly into the upper half of the ulnar border of the fifth metacarpal. At the lower part they are much compressed. They act as powerful flexors and abductors of the manus, and give extraordinary breadth to the wrist. The palmaris enwraps the ulnaris, and is in continuity with the tough superficial fascia of the forearm.

The *interossei* are most extraordinarily well developed, contrary to what might be expected in such an immoveable encased manus as is possessed by the Manatee. Not only are they large, but they are also found in a manifestly double layer; and while true flexores breves, there are also a set of dorsal interossei or extensores breves. After removal of the palmar aponeurosis of the combined sublimis and profundus, they are seen arising by tendon from the wrist, and altogether form a broad, flat, fleshy sheet, which covers the palmar surface of the second, third, fourth, and fifth metacarpals—the small flexor brevis and abductor minimi digiti muscles bounding the ulnar side of the plane. The fibres on the second, third, and fourth digits seem to possess a slight tendency to subdivide or divaricate; but those on the fifth are quite single. It is possible these superior palmar muscles may represent enlarged lumbricales or be an anomalously developed flexor brevis manus. Beneath this another equally thick muscular layer of better-defined and somewhat double interossei exists; they pass to all the digits, excepting the first, and are shorter than the superficial interosseous layer. Part of the fibres between the second and third, third and fourth, and fourth and fifth digits obliquely cross the intermetacarpal spaces, and simulate dorsal interossei. These portions approximate the bones. The dorsal interossei are four, and go to the second, third, fourth, and fifth digits respectively.

The *flexor brevis* and *abductor minimi digiti* are each represented by thin muscular bands which run parallel to each other, arising individually from the cuneiform. The latter partly covers the fifth digital interosseous muscle; and the former is in close approximation with the insertion of the flexor carpi ulnaris: they are inserted by aponeurosis together, along the ulnar edge of the fifth metacarpal.

(C) *Those of the Hip-Girdle: Pelvic and Generative.*—Each pelvic bone is suspended abdominally from the first chevron process or that from the fourth lumbar vertebra, by a strong sheet of glistening membrane, and is held in place fore and aft chiefly by two muscles. The anterior one is the rectus abdominis, already described, which terminates in the anterior V-shaped concavity of the female pelvis—and in the male similarly, excepting the difference in the bone's shape. The posterior one continues as it were the line backwards from the rectus to the chevron bones behind the anus. This post-pelvic muscle is a long, broad band, throughout fleshy, whose origin, in the female as in the male Manatee, is from the posterior border of the pelvic bone. Thence it trends inwards and backwards, passing outside and then behind the rectum towards the middle line, where it is inserted, or becomes incorporated, with the rearward

extension of the panniculus carnosus. Rapp¹ mentions, under the head of retractor ischii, or ischio-caudalis, that he found this in the Manatee thin and weak, springing from the hæmal spines of the first two caudal vertebræ and inserted into the pelvic bones. I apprehend he alludes to the above-described muscle, which, as far as action and attachments are concerned, is rightly named by him. If, however, we seek its homology among the four-limbed and long-tailed Vertebrata, we find it representative of the *ischio-* or mayhap *ilio-coccygeus*, possibly these two combined.

Stannius regards the *sphincter ani* as double, inasmuch as he refers to the existence of an internal and an external anal sphincter. This I have found so far true that thick, fleshy, circular fibres, besides its ordinary muscular coat, surround the intestine. Above the anus, and at the external orifice, these expand broadly as they become superficial. Virtually, less or more continuous, these may be regarded as outer and inner sphincter from position. The same disposition and unusually developed condition of the anal muscle is met with in Whales. In them, as in the Manatee, the gut is firmly compressed at its outlet and above, leaving in the contracted condition but a very narrow orifice. The fæces in these two groups are consequently of small calibre, and very different from the scybalous masses of the Elephant. The lower gut in it seems altogether more capacious; but it is nevertheless provided with a broad muscular sphincter, as Laurillard's figure shows (pl. 285, Q).

I mention in my description of the panniculus that in the female a fleshy slip, about an inch wide, is posteriorly derived from it. This offshoot of the panniculus carnosus, but most probably representing a separate perineal muscle, diverges from the more backwardly extended caudal fibres about opposite the generative fissure. Directed obliquely inwards towards the median line and posteriorly, it is inserted into the fascia beneath the skin of the perineal raphe, between the vaginal and anal sphincters. This muscle, although apparently a continuation of or derivative from the panniculus, I regard as the homologue of the *levator ani*; for, besides the dermal slip in question, an additional short portion comes from the rectal surface near the pelvis and joins the former.

In the female a *transversus perinæi* appears to be represented by a longish narrow muscle springing from the inner border of the pelvis and going forwards to the outside of the sphincter vaginæ and inside and behind the lesser slip of the erector clitoridis. In the male the levator ani and transversus perinæi were more or less united, and with a greater transverse direction of fibre.

Other muscles connected with the generative parts in the female as follows:—a *sphincter vaginæ*, consisting of a thick layer of fibres surrounding the vagina and vestibule, and which are strongest towards the perinæum; an *erector clitoridis* (*E.c.*), divisible into two slips: the external fleshy fusiform bundle arises from the apex of the inner pelvic horn; the smaller inner slip lies alongside the last, but has no pelvic

¹ *Op. cit.* p. 83.

attachment; both pass round the vagina towards the clitoris, partially decussating with the fibres of the sphincter vaginæ.

In the male, as Vrolik¹ more particularly has noted and figured, there is a well-defined fleshy *ischio-cavernosus* and long *retractores penis*. Moreover I readily recognized a *bulbo-cavernosus*. While fully developed and normal in attachment, these three muscles correspond with the somewhat altered position of the pelvis &c. from that of quadrupedal Mammals.

3. *Muscles of the Dermis.*

The superficial fleshy investment to which the name of *panniculus carnosus* has been given, is enormously developed in the Manatee. Indeed, as Stannius justly observes, the ventral portion of it represents in a certain degree a supplementary belly-muscle, supplying the voluminous entrails with an additional powerful support, which is so much needed owing to the extraordinary shortening of the rib-cartilages. In the female, as also to some extent in the younger male, the depth of muscle varied in different regions. The muscular fibre in the former specimen, at its posterior abdominal or genital portion, had a thickness of $1\frac{1}{2}$ inch; but further forwards, towards the middle of the body, it decreased to 0.6 inch, thinning upwards on the back to 0.2 inch or thereabouts. On the side of the neck it equalled the midventral part in volume, thickening considerably, however, on the side of the cheek.

Although the panniculus forms a uniform whole, I shall prefer, for several reasons, to describe it piecemeal.

As indicated above, the extensive panniculus carnosus forms a great broad fleshy wrapper of longitudinally directed fibres, covering the entire abdominal surface (*P.c'*) from the pectoral limbs backwards to beyond the anus (*P.c****). On the side of the posterior half of the body the muscle stops short of the tips of the ribs, where part of the external oblique is exposed; but forwards from this it rises higher, the fleshy part reaching almost to the level of the vertebral border of the scapula. The line of demarcation of this lateral or costal border, however, is not so abrupt, as exhibited in fig. 8, Pl. XXI., but trends, and is lost dorsally in a strong aponeurotic fascia. The muscular fibres of the outer shoulder portion pass forwards along the neck and side of the cheek, and partly become inserted by aponeurosis on the broadest surface of the malar bone, and, partly fleshy, are continued onwards and commingle behind the angle of the mouth with a deeper throat-layer of the muscle presently to be described.

A few inches behind the axilla the belly portion of the panniculus splits into two segments, the outer or upper fork of which is that already spoken of as covering the outer surface of the shoulder. From this a slip runs towards the humerus (*P.c**).

The inner sternal fork, at its divarication, possesses an external tongue-shaped corner (*P.c***), mesially to which the muscle lies over the sternum (in the female being

¹ Bijdragen, p. 77, pls. 5 & 6. figs. 22, 23, b, d.

2½ inches broad and 1½ inch thick at this point); thence it passes forwards and outwards (*P.c²*) on the neck, beneath the platysmal cross fibres, ultimately being inserted as a broad and strong tendinous sheet into the malar bone, posteriorly and inferiorly to the first portion of the panniculus, as already detailed.

Superficial to the shoulder and sternal segments, and as it were forming a bridge between them in front of the pectoral extremity (*P.c³*), is what appears as a platysma myoides. This is represented by a coarse thin sheet of muscle interspersed with much fatty tissue. The fibres may be said to arise from the inferior median surface of the neck and mandible for several inches in breadth, intermingling there with those deeper segments of the panniculus mentioned above. Crossing the neck in a transverse direction, the fibres radiate slightly, and are firmly but superficially intertwined with those of the lower border of the outer nuchal panniculus, whilst fibrous tissue and fat connect them with the infraspinus. A narrow slip of the muscle extends downwards on the anterior border of the limb as low as the middle of the biceps, whence, becoming fibrous, it descends as a cord-like body as far as the base of the metacarpal bone of the first digit (*P.c^{3*}*, fig. 13).

At the anal or posterior end the fibres of the panniculus diverge triradially (*P.c^{***}*), a broad portion curving gently outwards; and the intermediate portion (larger) ends wedge-shaped with inwardly inclined fibres, which, along with its fellow of the opposite side, are inserted by strong aponeurosis between the depressores caudæ into the sixth chevron bone.

In the female there was also observed another fleshy slip, about an inch broad, which was given off from the body of the muscle opposite the generative outlet; and this proceeded downwards and backwards, being likewise inserted into the skin on the median perineal region.

Connected with the action of this subdermal muscle it may be remarked that, as in Cetacea, it can have little or no power over the skin itself, not being fastened thereon, a thick coating of fat intervening. On the other hand the attachments of the muscle point to its subserving the bodily force of various parts. For instance, the fixed points to the malar bones must give the advanced segment of the muscle a very long leverage for movements of the head; at the same time the insertion on the facial bones and lips must lend power to the labial muscles, and in some ways act as a dilatator oris, and impart additional strength to the thick muscles of the great muzzle.

V. THE DIGESTIVE TRACT.

1. *Interior of the Mouth, and Tongue.*

The very curious structure of both the exterior and interior parts of the mouth has been a favourite topic of those who have contributed memoirs on *Manatus*. Stannius's account is, on the whole, the most explicit, though brief. In treating of the mandu-

catory and lingual apparatus, then, I propose to append to the remarks of Rapp, Vrolik, and Stannius reference to sketches of the palatal and mandibular arches. These I have had illustrated, I believe for the first time, both as viewed in conjunction, in a longitudinal vertical section (fig. 37, Pl. XXVI.), and as separated (Pl. XXII. figs. 18 & 19). I shall also offer some observations on the composition of the parts, particularly as respects the so-called horny plates, and their bearings towards those of the edentulous *Rhytina stelleri*.

If the section made lengthwise through the cranium, and slightly to the left of the median vertical line, as given in fig. 37, be examined, the relations of the parts will be easily comprehended. Confining a survey to the mouth-cavity, the lower lip, with its sinuous, bristle-clad, thick epidermis, points forwards. Each bristle springs from a considerable-sized lenticular hair-sac. The fibro-muscular tissues beneath are unusually well developed. The mandibular pad (*i. e.* inner lower lip) is composed deeply of a thick gristly or fibrous layer, and a thinner superincumbent epidermis. In front it is separated from the outer lip by a deepish furrow, and behind stops short at the tip of the tongue, though, as afterwards shall be shown, it is continuous with the gums. The tongue is bound down behind the pad, and is incapable of being protruded. Forwards, from the soft membranous uvular curtain, the fleshy palate, to just in front of the molars, is only moderately thick, whence it by degrees increases in thickness and fills the deep concavity of the premaxillary bones, its anterior smoother portion forming the upper inner lip-pad. This latter is separated by a deep furrow from the true bearded lip and truncated muzzle. The palate and the said pad are equally made up of a thick substratum of firm fibro-elastic material overlain by much thinner derm and epiderm. What has been termed the horny plate is alone distinguishable by warty elevations. The lips and cheeks, from opposite the superior pad backwards to the front molar, have a clothing of long stiffish hairs, thickest set along the outer border of the gum; these are chiefly directed downwards and backwards.

Turning now to the view of the mandible when removed (fig. 18), the outer true lip is notably dotted with short truncated bristles and longer hairs. The coriaceous pad has a deep and straight longitudinal median groove its whole length. Each moiety of this is again partially divided by a wavy but shallower furrow, which anteriorly and posteriorly curves outwards. The outer raised segments of the pad are only moderately roughened—but the inner ones remarkably so, being studded with short, erect, hard papillæ of two sorts. The larger kind are conical, and about 0·5 inch high; the smaller setose sort are nearly as long, and abundantly fill the interstices between the first mentioned.

The tongue quite agrees with Rapp's statement, having long brush-like retroverted filiform papillæ towards the tip, many irregularly dispersed and different-sized fungiform papillæ, and a very numerous, closely arranged, double set of circumvallate glands situate at the root. The series of circumvallatæ, as noted by him, also extends linearly

and laterally forwards to the anterior third of the organ, and they lie in close approximation with the dental portion of the gum.

In the younger male the lengths of the tongue and symphyseal pad mesially were 3.2 inches and 1.4 respectively, in the female 4 inches and 2; the breadth of the tongue of the latter was 0.8, and the widest portion of the inferior pad 1.3 inch.

On the palato-dental arch (fig. 19) the cheeks and lips, as before mentioned, are bestrewn with hair and short stiff bristles. These latter form a scattered row, reaching from the upper external labial clump (seen on the front of the muzzle, figs. 6 & 7) backwards slightly beyond the angle of the mouth. The thick brush of hairs in the deep hollow just outside the palate is well shown in fig. 19, *bh*. The long narrow palate is divisible into three portions. The anterior, somewhat horseshoe-shaped, is the smoothish, convex, elastic pad regarded by some as the inner upper lip. The middle portion is the rasping horny plate, which is slightly concave longways and across, and does not extend to the front molar by half an inch. Its surface is very rough and warty-looking, being almost entirely covered by thick, flattish, V-shaped, retroverted elevations. Some of these are rounder than others on the summit, many are acerate, and all are fringed by short setæ from base to tip. The intervening palatal spaces have a less rasping surface, but are not altogether smooth. The largest V-shaped papillæ in the female measured 0.2 inch long and 0.1 inch in diameter at the base. In front and behind their size diminishes as they merge into the smoother anterior pad and posterior palate. The posterior third portion is equal to the preceding two in length, and is smoother; in it there is a longitudinal mesial and linear elevation, which runs backwards from opposite the anterior molar tooth.

Leaving the histological consideration of these buccal appendages and mouth-armature for further inquiry, I shall meantime, in the superficial relations of parts, compare what obtains in the other Sirenian genera and some neighbouring orders of mammals.

According to Huxley¹, Messrs. Quoy and Gaimard² first paid attention to the horny jaw-plates of the Dugong. Be this as it may, from their and subsequent researches it is now known that in *Halicore* bristles and hairs are found in the mouth almost identical in position with those above described. The bent-down symphyseal portion of the mandible and palatal surface of the premaxillaries are also each covered by a coriaceous tuberculated plate; and the tongue is bound down behind. Both Dugong and Manatee possess a series of molar teeth; and in both, upper and lower incisors are present. But it is further to be observed that these latter bear a gradated development, inasmuch as in *Manatus* they are quite rudimentary, only discovered in the fœtus, and never protruded, whilst in *Halicore* they are diminutive and functionless in the female, but two upper ones in the male form powerful tusks.

With respect, therefore, to the formation of the lips, mouth-armature, and dentition, the homologous parts coexist in the above two forms.

¹ Hunterian Lectures, Lancet, 1866, p. 180.

² Voyage de l'Astrolabe, 1830, vol. i. p. 146.

Of the fossil genus *Halitherium*, besides other observers, the valuable researches of Professors Kaup and Krauss prove its being furnished with a full complement of molar teeth and tusks, as in *Halicore*. From the construction of the palate, intermaxillaries, and symphyseal portion of mandible, I think we are justified in believing it was also provided with horny plates akin to those of the living *Sirenia*. This granted, a hairy and possibly a full, truncate muzzle may likewise have characterized it.

On carefully studying Steller's admirable description of the muzzle and interior of the mouth of the now extinct northern *Rhytina*, I have been struck with the similitude to that of the *Manati* examined by myself. Indeed, excepting in size, slight variation of the rasping-plates, and absence of teeth, what he says perfectly accords with the formation of parts in the latter species.

It has been reserved for the very able and learned Professor Brandt, of St. Petersburg, to correct the otherwise accurate Steller upon an important point, viz. the structure of the palatal and mandibular laminae. These Steller regarded as two osseous plates, not true teeth, but rather as it were supplying the place of these in mastication. But although their function may undoubtedly have been trituration of the food, still Brandt, after a very elaborate microscopic examination, has satisfactorily demonstrated their indurated epithelial character, quite wanting in bony or dental substance.

Steller's figures of them when removed convey but a hazy impression of what they must have appeared when in the mouth. Brandt's illustration of the palatal plate *in situ*, however, enables a clearer conception and estimate of it to be made. From this, and what he himself states, the structure in question can be no other than the homologue of that found in *Manatus* and *Halicore*. It certainly does not appear to me to be the representative of teeth, nor of the baleen plates met with in the true Cetacea (an idea some are disposed to accept). Although *Rhytina* was edentulous in the adult condition, I strongly suspect that, like the other Sirenian genera, rudimentary teeth may have existed in its earlier stages of growth. Nordmann seems favourably inclined to this opinion. The maxillary alveolar ridges are narrow and quite behind the bruising plate, the latter occupying the intermaxillary and not the maxillary bones.

Among Cetacea the toothed and whalebone groups necessarily present differences. As exemplifying the former, *Globiocephalus* has no hairy bristles on the snout or within the lips—these parts superficially exhibiting a moderately smooth, tough, jet-black membrane. The alveoli are well defined, and the gum-tissues highly ridged betwixt the numerous teeth. The front V-shaped arch formed by the junction of the upper gums is callous, and evidently homologous with the front pad or inner upper lip already alluded to. The anterior third of the membrane of the hard palate is dense and fibrous beneath, and beset with irregular rows of hardened, closely placed excrescences; posteriorly the roof of the mouth is smoother and of a lighter colour. The anterior part, therefore, in external appearance and structure, is the homologue of the

Sirenian manducatory plate. The lower masticatory plate, again, may have its homologue in the firm membranous portion of the symphysis, which is toothless.

In the Rorqual (*Physalus antiquorum*) bristle-like hairs are met with on the lower lip, and there is a protuberant chin. The mucous membrane of the roof of the mouth is indurated, transversely arched, and about a foot wide behind, but flattened, more callous, and only half the width in front. The baleen-plates and vasculo-fibrous root-matrix spring from outside the palate, and, though in close relation, are not a differentiated portion of it. The baleen, in fact, at its hindermost end, is little else than a matted tuft of hairs; and quite in front it shortens and resolves itself into isolated patches composed of aggregated clumps of bristles, there being mesially a distinct but small-sized pad¹.

We learn, moreover, from the extensive researches of MM. Eschricht and Reinhardt², that in the foetal and very young *Balæna mysticetus* short stiff hairs are distributed on the outer anterior surface of the upper and lower lips; and besides these there are median bald spaces, apparently corresponding to the pads of *Manatus*. The palate is much narrower than in *Balænoptera* and *Megaptera*; nevertheless it is strictly defined by the raised membranous fold or "wreathband" (*Kranzband*). This circumstance, and that of the baleen-plates and matrix forming two long strips outside, and not merely occupying the anterior midpalatal space, militate against the baleen being the homologue of the Sirenian horny rasping-plate. The above authorities affirm that in the foetus the subsidiary whalebone-blades "consist each of a fasciculus of hairs agglutinated by the gum;" and as there is no special cortical tissue, this serves as "a sufficient proof that the hairs are the primitive formation of every baleen blade." Hence the conclusion arises that the homologues of the baleen, in the so-called herbivorous Cetacea, are the long hairs and bristles found inside the mouth, and situated, like the baleen, lengthwise outside on each side of the palate.

Reverting to the structure of the Ruminant mouth (for instance, that of the Sheep), the palate is smooth behind, transversely ridged (or covered by short, double, somewhat V-shaped arches³) in front of the molars to as far as the terminal well-known semilunar pad. This last, when seen in front, quite resembles the so-called inner lip of *Manatus*. The fringed part appears as the homologue of the bruising plate of that genus; and the posterior part corresponds in each as the smooth portion of the palate. It is true there are no hairs developed within the buccal region in the Sheep, but, instead,

¹ In this species also Professor Flower (P. Z. S. 1869, p. 606) has found a fringe of short, stout, coarse fibres or hairs basally and outside the baleen, corresponding with which in the Manatee short hairs and bristles obtain.

² Ray Soc. 1866. Translated from the Danish Roy. Acad. Mem. 1861 and 1862.

³ Professor Turner (Trans. Roy. Soc. Edinb. vol. xxvi. p. 222) holds that these palatal folds in Ruminants are the equivalent of whalebone. But in the Cetacea we have palatal structures with which they seem more allied; hence the homologue of the whalebone must be looked for external to them.

numerous conical papillæ, elevations of the mucous membrane, which find their counterpart in the trapezoidal ridges of the Manatee, between which the hairs and bristles sprout. Furthermore, from Eschricht and Reinhardt's statement that the soft portion of the baleen is only an excessively developed condition of mucous membrane and epithelial cells, it may be presumed that the ruminant papillæ and the identical structure in the mouth of *Sirenia* are the homologous constituents of the Cetacean gum. Continuing the comparison of parts, the pad behind the lower incisors in the Sheep accords with the symphyseal pad in the Manatee, and the fringe of roughened skin-texture on the edge of the lower lip of the former with the broader, thicker, semilunar patch in the latter. Both have a hairy muzzle and beard; and the cleft tendency of the upper lip in *Oris* recalls the wider, semilunar, truncated muzzle of *Manatus*.

Lastly, if the oral cavity of Pachyderms be considered, homologous parts are discernible. In *Elephas* the palatal pads are much softer and smaller in proportion than in the Lamatins, the muzzle is elongated into a prehensile trunk, the lower lip is likewise lengthened. But long bristly hairs are largely developed within the buccal region, especially in the African Elephant.

From the facts which have been particularized, I think that with some show of reason the following inferences may be drawn:—

1st. That the upper horny masticating-plate of *Manatus* is homologous with the roughened, warty, or retroverted papillary portion of the palate of Cetacea, Ruminantia, Pachydermata, &c.

2nd. That the horny baleen plates of Cetacea find their homologue in the *Sirenia* and some Pachydermata, in those developments of hairs and bristle-strips within the mouth and cheeks, existing either in bunches or as more separate filaments.

3rd. That the folds of mucous membrane within the inner upper lip of the *Sirenia* are represented by buccal papillæ in Ruminants and other forms, and that the greater development of similarly constituted mucous membrane in the interior of the mouth of some Cetaceans forms the intermediate substance of the baleen.

2. *Alimentary Canal.*

Beyond the constrictor muscles of the pharynx to within an inch of the stomach, the œsophagus is very narrow, not large, as it is said to be in *Rhytina*¹, being no more than half an inch in diameter in the ordinary undistended condition. But its muscular walls are uncommonly thick at its lower end, agreeing in this respect with the Dugong, as mentioned by Owen². There is an outer layer of longitudinal fleshy fibres, and beneath that the usual decussating oblique layers. For eight inches or more in the female specimen the average thickness of the walls was a little over 0.1 inch; the relative depth of the cuticular and submucous lining to the fleshy fibre lining is as one to two. Near and at the cardiac orifice, however, the muscular covering increased

¹ Steller, *op. cit.* p. 310.

² P. Z. S. 1838, p. 30.

amazingly, forming, as Owen has justly said of the same structure in *Halicore*, a powerful sphincter "to defend the cardia against the pressure of the contents of the stomach." This latter organ, indeed, is almost gizzard-like as respects its strength, of which more hereafter. The œsophageal tube in the older female measured 10 inches long from the posterior border of the inferior constrictor to the gastric extremity. Its mucous membrane has quite a Cetacean aspect, there being some half a dozen longitudinal furrows, and as many flattened ridges throughout its course. There are besides innumerable very minute rugæ disposed in wavy transverse striæ, giving a kind of velvety appearance to the ridged portions of the tunic when in the contracted condition. The inner epithelial lining, as Steller also has noted in *Rhytina*, is pale-coloured and slightly corneous in texture. I did not observe in *Manatus* any of those deep glandular pits or crypts in the mucous lining which I have found scattered here and there in the œsophagus of *Physalus* and *Globiocephalus*.

Before reaching me, each Manatee had the stomach cut open and the contents removed. Consequently this very muscular organ had shrunk considerably, and on cursory inspection exhibited any thing but the enormous relative proportion assigned to this viscus in its congener the Great Northern Manatee. To Steller's surprise, four stout men with difficulty dragged out the stomach of the latter animal examined by him. The entire length of its carcass, however, was 24 feet 8 inches; and the stomach, full of fucus, measured 6 feet long by 5 feet across. But he further notes in the table of dimensions, "Ventriculus latus seu longus potius" 44 inches. I suppose, therefore, that this diminished capacity applies to the empty and contracted stomach, and to that portion which corresponds to the so-called cardiac cavity of the Dugong and Southern Manatee. If so, the cavity in question in the *Rhytina* has its long diameter in proportion to the length of the body as 149 is to 1000, or rather more than $\frac{1}{7}$. In the male Dugong, 6 feet $10\frac{1}{2}$ inches long, dissected by Professor Owen in 1838, the first or cardiac cavity was 9 inches in greatest diameter, equivalent, therefore, to one ninth the animal's length. Taking the same portion of the contracted viscus in the female Manatee as about four inches, this gives but one sixteenth as its proportion scale.

Of the compound stomach and bifid cæcum Daubenton's, Home's, and Vrolik's original figures are suggestive, though not quite in accordance with my inspection; nor have they shown the interior arrangement of the parts (*vide* sections, Pl. XXIII.), which are as remarkable as the exterior configuration. The first cavity is the most capacious, and not unlike the human stomach in shape. Immediately to the left of the œsophageal entrance, and bulging upwards to the side and partly behind the gullet, there is a protuberant *cul de sac* lined interiorly by corrugate mucous rugæ. Beneath this is the constricted orifice of the cardiac gland. From here, the narrowest part, the first stomach widens to its middle, beyond the bend narrowing by degrees to the distal end, which is guarded by a sphincter-like narrow passage communicating with the fourth digestive compartment about its upper third. The inner tunic is composed of a pale-

coloured, thickish, tough material—mouths of gastric glands being promiscuously scattered throughout its surface. A considerable median area has few folds; and this smoother space with increment of muscular walls gives the cavity a gizzard-like character. The folds of the greater end are chiefly longitudinal, and at the lesser end increase and interdigitate more. The large cardiac diverticular gland is thumb-shaped or cylindrical, and perforated in its long axis by a compressed central channel with side pockets and sacculi, which wend obliquely and irregularly upwards. With the latter there are connected short secondary recesses into which the mouths of innumerable small flask-shaped glands open. Thus in longitudinal section this secreting apparatus has a dendritic appearance, whilst cut transversely it exhibits radii whose limbs are highly convoluted. The glands secrete abundantly a viscid creamy substance, as in the *Rhytina* and Dugong; but unlike them, as Steller and Owen mention, the passages contained no parasitic worms.

The subequal smaller-sized tubular appendages or cornua, which may be regarded as second and third accessory gastric cavities, are situate above and on either side of the further extremity of the lesser curve of the first stomach. Their parietes are only moderately thick, their internal coat chiefly thrown into longitudinal folds; and the two chambers, by thick-walled passages, end together in a pouting enlargement (comparable to the os uteri) at the summit of the fourth gastric compartment. The latter, elongate and intestinform, possesses a series of softish, florid, mucous plications abundantly glandular, and sinuously longitudinal and furcate. The pylorus is a firm ring. The duodenum has a moderate expansion and a relatively smooth inner coat for several inches; the pancreatic and common bile-ducts enter wide apart.

The empty small intestines have an average diameter of rather over half an inch; and their muscular coat is uncommonly thick. In the female their length is 25 feet, and in the younger male 24 feet 4 inches. Valvulæ conniventes are absent; but commencing near the duodenal loop in the circumference of the gut are five or six longitudinal mucous ridges, which, with sinuous lines, continue straight on as far as the ileum. Between these are short transverse interdigitations and corresponding depressions. Each short Peyer's patch is from $\frac{1}{2}$ to 1 inch apart; and, besides being distributed in an opposite zigzag manner as obtains in *Halicore*, they follow straight lines in the long furrows. In the ileum the longitudinal rugæ frequently fork and pass obliquely to each other; and the short spurs from these enclose in profusion scattered loculi and glands of Lieberkühn. The ileo-cæcal orifice is guarded by a powerful tumid muscular sphincter; and there is a pouched ileo-colic agminate gland resembling that of the Giraffe and Hippopotamus. The cæcal appendages are thick-walled, ridged, glandular within, and outwardly look like a pair of conical teats. Lengths $1\frac{1}{2}$ and $1\frac{3}{4}$ inch and 0.65 inch in diameter, and their roots 1 inch from the ileo-cæcal valve. At the commencement of the colon there is a dilatation for a couple of inches or so, with a diameter of above three and a half inches distally, where it is constricted; and then follows a second, but

narrower, expansion. The first is very glandular, and with convolute rugæ; the second, thinner walled, assumes interiorly the character of the rest of the great intestines. These in the female, including cæcal appendage, are 17 feet 9 inches long, and in the male 18 feet—the greater muscular contraction of the former probably accounting for the difference. The rugæ are very numerous, close-set, and chiefly longitudinal, and obliquely interdigitate, forming shallow elliptical depressions, among which are glandular patches. Halfway on the gut the rugæ and glands diminish in size and number.

To supply a desideratum as regards the abdominal viscera in their natural position, I have given in fig. 20 a reduced copy of a diagrammatic sketch taken from the young male animal. It represents the parts as seen when a median longitudinal section has been made from near the anus forwards to the middle of the sternum, the fleshy walls being dragged outwards. Anteriorly the heart appears to occupy the full breadth of the chest, the severed pericardium stretching across at its bifid apex. Behind is the liver, segmented into four divisions,—a very large triangular portion of the right and another equal-sized portion of the left lobe filling respectively the right and left sides of the cavity; whilst between them, in the triangle bounded by the pericardium and their anterior borders, are two much smaller lobes, the right one of which contains the rather large gall-bladder. No lungs or diaphragm are exposed, the apparent and not real absence of the latter doubtless having deceived Dr. G. A. Perkins¹ in his examination of Wyman's² *Manatus nasutus*. Mesially situated and betwixt the hinder fork of the great liver-masses, a small piece of the stomach and curved appendix are exposed. The remaining posterior half of the abdominal cavity shows only intestinal coils, and partially the urinary bladder when this viscus is distended.

When, however, the thoracico-abdominal cavities with the entrails *in situ* are examined sideways, a representation of which has been given in the body-section (fig. 37, Pl. XXVI.) with the ribs in place and the intervening tissues removed, a widely different view is obtained. The relations of the parts mentioned (heart, liver, intestines, and bladder), to some extent, remain good. But above them is brought out in relief the enormous lung, which reaches from the first to the last rib, and extends more than midway downwards, just permitting a fringe of the elongated diaphragm to peep through below and be the barrier line betwixt the dorsal pulmonary and ventral cardo-alimentary compartments.

3. *Glands concerned in Digestion.*

Of the secretory apparatus connected with the mouth, the most conspicuous bodies are the parotid glands. As briefly noted by Stannius, these are very large and lie at the sides of the lower jaw. They have a coarse granular texture, are broad and flat, and reach from the insertions of the cephalo-humeral and levator claviculi muscles forwards to beyond the angles of the mandible. In the vertical and horizontal direc-

¹ Proc. Boston Soc. Nat Hist. (1845-48) vol. ii. p. 198.

² Ibid. vol. iii. p. 192.

tions they stretch from the temporal part of the malar arch downwards to the digastric muscles and the stylo-hyoid cartilages. A portion of each gland also wraps round the stylo-hyal rod, and dips into the hollow continuous with the foramen lacerum posterius. The internal maxillary artery dips beneath them and forms a vascular network, partly enveloping their deep and superficial surfaces; while behind is the cervical rete mirabile. The narrow tendinous cord of the sterno-mastoid pierces and goes quite through the posterior half of each gland. Superficially the neck and cheek portions of the fleshy panniculus cover and completely hide the parotids as well as their Stenonian ducts.

The submaxillary gland is also flattened, and of no mean size. It has a horseshoe-shape, the anterior convexity of which is lodged in the postsymphysial angle, whilst the posterior concavity reaches the transverse bar of the hyoidean arch, and partly covers the thyro-hyoid muscles. But the body of the gland chiefly lies upon the mylo-hyoidei, the two limbs of the crescent filling the deep hollows of the mandible in front of the angles. At this latter point, however, a portion of its substance is in close apposition with the anterior twigs of the inframandibular plexus of vessels, with the facial artery, and with the subjacent pterygoidei.

I regard as representatives of sublingual glands a series of partially separate, small, lenticular bodies, which lie near and backwards from the frænum linguæ; but I did not detect their excretory duct. My observations support Rapp's account of the tonsils, viz. flat elliptical laminae, their numerous orifices having a sieve-like aspect. The velum pendulum palati is a broad membranous fold without appreciable uvular thickening of muscular fibres.

The pale-coloured firm pancreas has the usual situation, within the duodenal loop. Its duct opens into the intestine close to the pylorus.

The liver of the larger specimen had been hacked in pieces, so that nothing but its weight, $3\frac{3}{4}$ lbs., and apparent long diameter, fully 8 inches, could be made out satisfactorily. In the younger male this gland was more intact. Its relative position towards the neighbouring organs has already been mentioned. Vrolik's description of the Manatee's liver corresponds more with what I have found than does Daubenton's: the latter having but examined a fœtus may account for this. *In situ*, but still more so when removed, the entire liver has great resemblance in shape to the inflated lungs of an ordinary mammal. Thus the posterior broad surface of the main right and left lobes forms a deep arched hollow, enclosing the stomach and duodenum, and which may be compared to the dome-shaped concavity of the lungs as they rest on the diaphragm. The anterior partially segmented lobules and the gall-bladder simulate the upper pulmonary lobes overlapping the base of the heart. What I gather from Steller's and Owen's words concerning the mainly trifold hepatic organs of *Rhytina* and *Halicore* leads me to infer that this gland in *Manatus* differs little, if at all, from them. In the latter the two large somewhat triangular and much separate right and left lobes possess few emarginations. There is a short, shallow notch on the middle of the ventral

margin of each; and the left possesses a small subtriangular lobule at its posterior spinal corner. The third smaller anterior and semidivided lobe, transversely bitriangular or ∞ -shaped, Steller's anvil-formed and Owen's quadrate-figured portion, may either be regarded as the homologue of the so-called cystic lobe of some mammals, or as representing additional upper or anterior lobules of the right and left lobes, bridged together by a diminutive *lobus quadratus*. This last, as in the human subject, is that portion bounded dorsally by the transverse fissure, laterally by the gall-bladder on the one side, and the round ligament and short longitudinal fissure on the other. There is a compressed boot-shaped diminutive lobule immediately to the right of the inferior vena cava, and a second rather elongate, but terminally flattened, lobule attached to the left wall of the same vein. Both of these small lobules spring from the root of the main right lobe, and respectively appear to be homologous with the caudate and Spigelian lobes.

Owen remarks that the small Spigelian lobulus in the Dugong is continued from the root of the left lobe. This origin, however, according to my observations in those mammals where the liver is deeply cleft, would not precisely correspond with the Spigelian lobule, which arises from the right moiety, and is separated from the left lobe by the ductus venosus. Notwithstanding, it does not militate against the Professor's clear definition that "the homologue of the 'Spigelian lobule' is shown by its relation to the lesser curvature of the stomach"¹.

All the hepatic fissures are shallow. The most marked ones, the longitudinal and that of the ductus venosus, being filled up by strong fibrous tissue, covering the vessels therein. As to the ligaments, the *suspensorium hepatis* is moderately broad, and firmly fixes the organ to the pericardium and the diaphragm. The round ligament, as usual, forms the anterior or ventral one positionally. In the young male it was a narrow cord, nearly impervious, 1 inch from the liver. The two lateral ligaments diverge from the vena cava, and traverse lengthwise the right and left lobe about an inch outside their vertebral margins.

The pyriform but forwardly projecting gall-bladder lies superficially on the ventral aspect of the small anterior right lobule. When distended it is $2\frac{1}{4}$ inches long and 1 inch in diameter at the fundus. The cystic duct, of considerable calibre, winds in an S-shaped manner, and at about three quarters of an inch distance from the neck of the gall-bladder receives singly the united hepatic duct on its left wall, as Daubenton and Vrolik have recorded. In the Dugong the cervix of the gall-bladder is said to be obliquely pierced by two hepato-cystic ducts, entering, as the ureters do, into the urinary bladder. The ductus communis choledochus in the male Manatee was as thick as the barrel of a goose-quill, and penetrates the intestine about three inches from the pylorus.

¹ 'The Anatomy of Vertebrates' (1868), vol. iii. p. 483. See also Owen "On the Anatomy of the Cheetah," Trans. Zool. Soc. vol. i. p. 131.

On section the liver exhibits a fine glandular structure, and not a coarse lobular substance as in some Ruminants. The interior of the gall-bladder is smooth.

VI. ORGANS OF CIRCULATION.

1. *The Heart.*

The following tabular arrangement expresses in inches and tenths the several dimensions of the heart of the female Manatee when contracted as ordinarily after death, in this case, however, having been very slightly preserved in spirit:—

| | Right auricle. | Left auricle. |
|--|------------------|-----------------|
| Extreme length | 1·3 | 1·6 |
| Extreme breadth | 1·7 | 1·5 |
| | Right ventricle. | Left ventricle. |
| Extreme length, anteriorly | 2·4 | 2·8 |
| Extreme length, posteriorly | 2·0 | 2·8 |
| Extreme breadth at base, anteriorly | 2·7 | 2·3 |
| Extreme breadth at base, posteriorly | 2·4 | 2·5 |
| Extreme breadth at apex | 1·1 | 1·5 |
| Extreme thickness of walls | 1·0 | 1·5 |

This organ has been so repeatedly described that I can add nothing material to the statements of previous observers, and agree with them as to its cleft nature.

2. *Blood-vessels and Lymphatic Glands.*

The arterial distribution of the American Manatee has been so lucidly explained in the masterly compendium on the vascular system by Professor Hermann Stannius¹, that, were it illustrated, I should be content to leave the subject untouched. But the remarkable character of the vessels, splitting up, as they do, in certain parts into multifarious plexuses and rete mirabile, is a sufficient reason why they should be figured and further commented on.

According to the above author, and as my dissection (fig. 30, Pl. XXIV.) demonstrates, a short, wide, innominate trunk springs from the arch of the aorta, and divides into a right subclavian and common carotid. From the summit of the arch the left common carotid is derived; and, lastly, further beyond is the left subclavian. As regards the carotid and branches, he states only that the common carotids have tolerably long stems, which, at first glance, appear to simulate division into an external and internal carotid, although this does not truly take place. The first main branch of the carotid proceeds inwards, and supplies the larynx, the hyoid apparatus, and the tongue.

What I have found obtain is as follows:—The stem of the fair-sized common carotid is branchless until about opposite the deep hollow in front of the shoulder or supra-

¹ *Op. cit.* p. 31 *et seq.*, also Von Baer, *Mém. d. l'Acad. St. Pétersb.* 1835, tom. ii. p. 199.

scapular region, where an artery (transverse humeral) of small calibre strikes directly outwards, and terminally subdivides into a broad radiate rete mirabile, covering the subscapularis, supraspinatus, &c. The single arterial tube is superficial to the cervical nerves, but is itself enwrapped by portion of the vascular neck-plexus. Beyond and on a level with the cricoid is a division apparently equivalent to internal and external carotids. The former dips in among the rete mirabile at the posterior base of the skull just behind the cranial series of plexuses. Among others, one occupies the posterior portion of the great fissure between the occipital and tympano-periotic bones; and whilst mingling with the cervical and spinal rete, complex branches are lodged within the skull at what corresponds to a groove or recess of the lateral sinus, where also venous channels obtain. The external carotid at the stylo-hyal and under cover of the digastric and parotid gland bifurcates; and plexuses are derived from both of these. The branch agreeing with the facial runs towards the angle of the mandible and at the concavity of the body of the bone turns upwards and is distributed with a plexiform arrangement on the face. From its proximal end, and in fact enwrapping it, are retia, which may be regarded as submaxillary, submental, &c. subdivisions; and these lie within the concavity of the jaw, twigs supplying the muscles and other parts, while some inosculate with their fellows of the opposite side. The other, widest branch of the external carotid ascends behind the mandibular angle, previously supplying plexi to the parotid gland, superficies of the digastric, &c. Other plexi, which were not followed in detail, spread over the tympanic, temporal, and malar areas. At the pterygoid region there is separation of the external carotid into several thick retial bundles, whereof the inferior dental, lingual, and internal maxillary are most conspicuous by their volume. The vascular network, as it pierces the large vacuity of the lower jaw, has a remarkably open character, resembling a meshwork of fibrous tissue; and, as in Cetacea, the interstices are partially occupied by fatty tissue and nerves. This vasculo-nervous mass issues at the mental foramen, and supplies the lower labial parts. The numerous capillaries of the internal maxillary division pass on to the pterygo-maxillary fissure, and send inwards superior dental arterioles; whilst the main mass, lying in the lateral groove of the maxilla, is continued on through the orbit and emerges at the infraorbital foramen, spreading amongst the fleshy and other structures of the face and snout. Ciliary branchlets from the above are given off to the eye &c.

Stannius says that the subclavian artery divides into two main branches—a descending large internal mammary, and the axillary. Before these divide, a very short twig is sent upwards over the head of the first rib. Both arteries are equally split up into narrow channels, which intertwine among the rete mirabile of the cervical region and thorax. Von Baer likewise shows that the axillary artery becomes broken up into minute vessels which overlie and are partly distributed to the shoulder and partly continued on to the anterior extremity, mingling like the last with the rete cervicale.

This is certainly the case, and the complexity and quantity of parallel channels is

truly astonishing. Besides an axillary, however, I observed another trunk derivative of the subclavian, and which may be representative of a thyroid axis, terminating in axillary rete. In tracing continuations of the axillary rete I could distinguish circumflex anterior and posterior bundles. The brachial rete diminishes as it reaches the elbow and passing beneath the pronator radii teres, forms an ulnar rete. This keeps close to the bone, under the forearm-muscles, and crosses obliquely to the proximal end of the fifth digit. Here, besides muscular radicles, a bunch goes to the palmar aspect of the wrist, and by intricate partition helps to constitute the palmar arch. The radial rete appears less complicate, but unfortunately its manner of palmar division was not satisfactorily made out.

The multitudinous networks, nuchal, spinal, thoracic, and caudal, are sufficiently like those of whales, and have been so frequently referred to by other authors, that I need not dwell on them. As regards the intercostal plexuses, these do differ from those of Cetacea, inasmuch as, instead of great contorted coils lying superficial to the ribs, each intercostal artery dips singly between the ribs, and in the space covered by the pleura and muscles divides arborescently. With all due respect therefore to the accuracy and acumen of our great leader, Professor Owen, I venture to predict the presence of similar rete in the Dugong, where such arterial modification is denied. When uninjected the closely-packed vessels so simulate coarse muscular fibre as readily to deceive one unless critically inspected.

There is an abnormal rete, hitherto unrecorded, in continuance of the internal mammary. The latter vessel issues beneath the rectus abdominis, opposite the third costal interspace, and proceeds upon the transversalis as a rete, which posteriorly anastomoses with a returning epigastric series. Anteriorly the rami run outwards in parallel radii like the plume of a pen. The abdominal surface of the posterior half of the diaphragm is supplied with vessels and nerves arranged in a like fashion. I may advert to a retal offshoot of the deep lumbo-caudal mass of vessels, which, for distinction's sake, may be named either sacral, pelvic, or hypogastric rete. Derived from where the costal channels strike within the chevron bones, it forms a thin but wide sheet of arterial and venous rami, which cover the sacro-coccygeus and parts beneath the urino-genital organs. From it vesical and other supplies are given off, the most characteristic being a hypogastric, obliterated beyond the fundus of the bladder, a uterine, and in the male spermatic plexus, with marked arteria dorsalis penis.

Circumstances already mentioned prevented my observance of the giving off of the abdominal aortic trunks or following the visceral distribution. The mesenteric vessels appeared to split into primary, secondary, and tertiary arches without any striking peculiarity in the vasa brevia, and the hæmorrhoidal arterioles have inosculation with the hypogastric rete.

The veins of the face and head were not followed in detail. Branches, however, were observed to return from the submaxillary region and outer side of the jaw; these con-

verge below the parotid gland and join the external jugular opposite the paramastoid. The brachio-cephalic vein comes inwards from above the insertion of the pectoralis minor; and another marked tributary is derived from the vascular plexus covering the inner subscapular region.

The course of the external jugular vein is from behind the cranial end of the stylohyal and the thereupon attached portion of the digastric muscle, backwards and slightly obliquely outwards, uniting with the internal jugular near the first rib. The external almost equals the internal jugular vein in calibre; and it lies over the tendon of the sterno-mastoid muscle and the suprascapular artery.

The internal jugular vein commences at the cranial aperture, foramen lacerum posterius, near to the attachment of the rectus lateralis and cephalo-humeral muscles, where there is a large venous plexus as in Cetacea. As it traverses the neck backwards it lies chiefly to the inner side of the carotid artery, crossing it, however, about the level of the bifurcation of the trachea, posterior to which it converges to the large innominate trunk formed by it, the external jugular, and the subclavian vein. There are several oblique bridging communications between the ecto- and entojugular veins. No valves were observed in the above veins of the neck.

The deep cervical glands are very voluminous, and fill the intervening cleft, bounded anteriorly by the cephalo-humeral muscle, externally by the subscapularis, deeply or dorsally by the short neck-muscles, the lateralis and obliquus externus, and within or mesially by the extension forwards of the serratus magnus. The cervical plexus of nerves passes over the glands in question, the latter being enveloped amidst the rete mirabile.

VII. VOCAL AND RESPIRATORY APPARATUS.

1. *The Air-passages.*

Stannius has been successful in his exposition of the structure of the larynx. I may refer, however, to two points he and Rapp have failed to notice, viz. the existence of a small recess or pseudo-sacculus laryngis at the anterior extremity of the vocal cord, as in the Dugong; and to the presence of small nodular cornicula laryngis or cartilages of Santorini, surmounting the arytenoid bodies. As these authors and Vrolik state, the epiglottis, unlike the Cetacean, is of the most rudimentary character; the thyroid cartilages are united anteriorly by a narrow bridge, and anterior and posterior cornua are well developed; the cricoid is a complete ring posteriorly, very broad, and with a marked prominence for the attachment of the thyroïdal posterior cornu; the arytenoids are trihedral; the vocal cords are the reverse of prominent, and deficient in inferior excavation. The several ligaments are composed of tough yellow and fibro-elastic tissues; and the diminutive epiglottis, curiously enough, consists of like material, void of a cartilage basis.

The dozen tracheal rings, and, as far as I could make out, the bronchial also, are not

continuously spiral, as obtains in *Halicore*, but, as Stannius figures in *Manatus*, there are some which bifurcate and obliquely cross the long axis of the tube. In my female specimen the trachea, $\frac{3}{4}$ of an inch in diameter, split at about 5 inches distance from the lungs, and each bronchus entered almost at the summit of the pulmonary organ. Within the lung it goes in a straight line to the posterior extremity, lying a little to the inner side of the middle. About a dozen bronchia branch outwards, these again subdividing in the pulmonary substance.

There is a narrow and moderate-sized thyroid gland on each side of the upper portion of the trachea.

The lungs, their shape and singular relation to the diaphragm, &c. have often been commented on since Daubenton's original description. My illustrations of the parts in their natural position, figs. 20 and 37, supplant verbal detail. Some two or three indentations, $\frac{1}{2}$ to 1 inch deep, are the only trace of segmentation; but anteriorly they terminate in a short rounded lobule (*l*, fig. 41). In the uninflated state the greatest thickness of the lung-substance of the female was 1 inch; extreme length 23 inches; breadth towards the anterior extremity $2\frac{3}{4}$ inches, about the middle $3\frac{1}{2}$ inches, and rearwards $1\frac{1}{2}$ inch, tapering finally to an obtuse termination sunk in a pocket at the lumbo-vertebral end of the diaphragm.

2. *Hyoid and the surrounding pharyngo-glossal fleshy parts.*

The hyoidean arch comprises three bony pieces—to wit, a small, flat, oval basihyal, and a pair of long subcompressed stylohyals. Each of the latter measured 1.7 in the young male, and 2.2 inches in the older female. To the upper narrow extremity of the stylohyal a strip of cartilage an inch long is fixed, by which it is fastened to the inferior tubercle of the exoccipital. Betwixt the other (broader) end of the bone and the basihyal is a >-piece of cartilage representative of ceratohyal. This extends continuously along the outer border of the basihyal, and forms a retrocurrent wing to it on either side; and to these the anterior cornua of the thyroid alæ are attached. The thyrohyals or connecting ligaments between the hyoid and larynx are tough thickish membranes, and apparently contain a considerable amount of yellow elastic tissue.

I examined the intrinsic muscles of the larynx carefully, and found that, notwithstanding the rudimentary nature of the epiglottis and comparative absence of laryngeal pouch, I could differentiate superior and inferior aryteno-epiglottidei, and even noted fibres equivalent to a thyro-epiglottideus. Indeed, each and all of the laryngeal muscles are relatively well developed. The extrinsic laryngeal muscles maintain a fair size, with attachments of the ordinary kind. The keratic muscles, so notably developed in Cetacea, are feebly represented in *Manatus*; and the hyoepiglottidei of the former are entirely wanting in the latter, as might have been expected from the condition of the epiglottis.

The sterno-hyoid and sterno-thyroid are interblended. An omo-hyoid was not indis-

putably traced from origin to insertion; the anterior remnant remained, its posterior fibres being lost among the tangled vessels and deep cervical fascia. Stylo-hyoid and stylo-pharyngeus are somewhat adherent, the latter broad and well developed. The digastric, single-bellied and broad anteriorly, fills the hollow at the inflection of the mandible, and thence passes rearwards to the junction of the stylo-hyal with its cranial cartilage. The horseshoe-shaped submaxillary gland abuts on its inner, and the parotid on its outer margin. The stylo-glossus is large, and the constrictores superior and medius are full and fleshy. The thin sheet of fibres of the levator palati cover the Eustachian enlargement, and are spread out and lost in the posterior palate. The tensor palati, better marked, arises near the tympanic bulla, passes round the pterygoid process, and, by a strong flat tendon, widens out on the posterior palatal membrane. The pterygoidei and plexuses lie outside. The palato-glossus is moderately broad, and the palato-pharyngeus fairly developed. Mylo-hyoidei, as a thin fleshy plane, stretch and fill the angle betwixt the ramal bodies. Long and thin genio-hyoidei pass from the basihyal to the concavity of the chin, a vascular plexus existing beneath. A distinct hyo-glossus was not observed; but genio-hyo-glossi and lingualis are both well represented.

VIII. THE NERVOUS SYSTEM.

When treating of the interior of the skull I dwelt upon the dura mater as it lines the bones and the foramina piercing it basally. Its upper surface, when the calvarium is removed, is tolerably smooth, a superior longitudinal sinus being but faintly indicated. On each side the membrane is tucked into a deep Sylvian sulcus, which traverses well across the cerebrum; another, marked but shallow, depression is manifest about the centre of the posterior cerebral division. The dura mater is tough, strong, and rough at the vascular sinuses and plexuses. While it is intact, the cerebrum leaves the bulging cerebellum uncovered to a considerable extent.

The encephalon of the younger male was so destroyed as to be unfit for examination. While the membranes surrounded the brain of the female specimen a tolerably accurate idea of the cerebral contour was got; but on raising the dura mater the brain itself was found to be softened, and with difficulty extracted. No measurements or weight were taken, but the whole placed in spirit as rapidly as possible. A cast of the cranial cavity with its enclosed dura mater was subsequently made; and by the help of this cast and the shrunken brain the sketches (Pl. XXV.) were drawn.

I may remark, *en passant*, that the views (figs. 31 & 33) of the upper and under surface of the brain slightly exaggerate the relative breadth of the anterior to the posterior lobes, by the former not being approximate enough at the longitudinal fissure. With regard to dimensions, the drawings are given as nearly as possible of the size of nature; the cranial interior, its model, and the preserved brain respectively yielding the scale of relations.

From above and below, the outline of both cerebral hemispheres is somewhat qua-

drangular, but rounded at the corners; and the crescentic cerebellar posterior margin lengthens this behind. The breadth to the cerebral length is absolutely great, but less than in the Delphinidæ. In profile view the height of the cerebrum is nearly equal to the length, and the figure, as a whole, remarkably Elephantine. The posterior cerebral lobes cover but half of the cerebellum, thus leaving a considerable portion of the latter free at the posterior end of the superior longitudinal fissure.

Four lobes may be distinguished, viz. frontal, parietal, occipital, and temporal. The frontal lobe (*F*) is remarkably deep and perpendicular in direction, but of considerably less diameter antero-posteriorly. Its orbital division fills the anterior fossa of the cranial cavity; and its frontal part abuts against its anterior wall, the large olfactory bulb being situated towards the lower end of the latter. The parietal lobe (*P*), as defined by cerebral anatomists, may be said in *Manatus* to consist of two parts—to wit, that anterior and that posterior to the deep transverse Sylvian fissure. The former is a broad coronal band; the latter is a markedly three-sided area, occupying chiefly the vertex, but also partially the lateral surface of the brain, and appears to represent the angular lobule of some authors.

The occipital lobe (*O*) forms chiefly the rounded broad knuckle of the hinder surface of the cerebrum, and is scooped out considerably below and mesially for the reception of the cerebellum. The temporal (*T*), like the frontal lobe, is very deep, but of smaller antero-posterior diameter than it, and not quite so perpendicular in its long axis. In fact, it forms a thick, somewhat conical, mass which lies obliquely downwards and forwards, and occupies the wide sunken anterior area of the posterior fossa of the skull's basis.

The so-called central or median lobe, said to be of good size in the Elephant, I could not differentiate in this Manatee, in consequence of the unsound condition of the cerebral substance. Its existence, however, I cannot question.

The cerebral mass, as a whole, is fair-sized, full, and with very convex surfaces in all directions. The hemispheres are divided by a deep, widish, great longitudinal fissure, and each, moreover, possesses a most trenchant division into anterior and posterior half by the Sylvian fissure.

As regards parts at the base of the encephalon, the pituitary body, when first examined, appeared relatively large, was very vascular, flattish, and of a trefoil figure. It occupied a greater area lengthwise and across than *pi*, figs. 33, 34, represent. The transverse lozenge-shaped interpeduncular space, bounded by the optic tracts and crura cerebri, is fair-sized. What appears as corpora albicantia, and possibly tubera cinerea, are two antero-posterior, moderately large, oval eminences, situated in the middle of the space, and behind and at the sides of these, respectively, distinct posterior and anterior perforated spaces. Each crus (*cr*) is long, full, and prominent, and the two diverge rather obliquely, not separating entirely till a short distance from the pons. The pons Varolii (*pv*) is rather flat-surfaced, as, to a less degree, are the cerebral

peduncles; it is wide and crescentic, but moderately narrow from before backwards, and the posterior border is slightly concave. The medulla oblongata is not remarkable for size; at least, like the pons, it is not prominent superficially at the anterior pyramids (*ap*); and these have a very shallow longitudinal median depression. The olivary and restiform bodies are individually well represented, though imperfectly defined in our drawing, on account of the membrane having partially been left attached to the nerve-roots.

Of the cranial nerves I may remark that the olfactory root comes into view at the basal end of the Sylvian fissure as a great, broad flattened tract. This narrows forwards and then expands into a large pyriform bulb (1), which curves upwards and protrudes, as an adpressed mass, against the antero-inferior surface of the frontal lobe. The optic tracts (2), of moderate calibre, approach each other nearly transversely from the inner borders of the so-called central lobes, and form a short, narrow commissure. The third nerves (3) have a usual situation from the crural junction close to the pons. The trochlear (fourth) nerve (4), a particularly fine filament, was but partially traced as it wound round the right peduncle. Relatively and absolutely the fifth (5) nerve is of enormous size, and, as it leaves the side of the pons, appears composed of a great number of funiculi; but among these I did not discriminate its sensory and motor roots. The flattened nerve passes sharply outwards and pierces the dura mater at the recess beneath the posterior margin of the alisphenoid transverse band, where the Casserian ganglion is lodged. The sixth nerve (6) appeared large, as certainly was the facial motor branch of the seventh pair (7). The glossopharyngeal and pneumogastric branches of Willis's eighth pair of nerves (8), as also the hypoglossal or ninth nerve (9), issued as numerous filamentous cords from the side of the medulla oblongata, and, unless from their more anterior situation, undistinguishable from the spinal series. The different direction and deeper situation of the spinal accessory branch (8*) of the eighth enabled it to be distinguished with ease.

The interior of the brain I examined in two sections, viz. horizontally and vertically. When the lateral ventricle is exposed, as in the left hemisphere (fig. 35), it is seen to be a large chamber, and altogether spacious. The anterior cornu (*ac*), a sweeping semi-circle, is both deep and wide. The portion of the corpus striatum (*cs*) is a considerable ovoid and prominent mass, leaving, however, a large cornual space in front. At its posterior border, between it and the thalamus (*th*), the tænia semicircularis (*ts*), a narrow linear strip, crosses it obliquely outwards and backwards.

The middle descending cornu (*dc*) is a moderate-sized cavity, with a more than usual vertical curve in the usual directions. The eminence of the hippocampus major is very prominent, convex, and well defined; and continuing on to almost the tip of the temporal lobe, it forms a not very distinctly notched pes hippocampi. A narrow fillet in front I took to be a corpus fimbriatum. There is an undoubted posterior cornu (*pc*), a fully developed hippocampus minor, and an eminence I am inclined to recognize as eminentia collateralis.

The internal face of the encephalon, in longitudinal meso-vertical section, is shown in fig. 34. In this view the body of the corpus callosum presents well-marked arching from before backwards, being highest in front. It is of considerable depth throughout, thickening very much as it sharply or subangularly bends downwards and backwards in a prominent knee. This latter descends, moreover, by a rostrum of some magnitude, which unites partially with the so-called "precommissural fibres"¹ of the body of the fornix. The posterior or splenial end of the fornix increases very much in volume, and terminates by a beaked process. At this point the returning commissural or "psalterial fibres" of Flower², which are shallow as compared with the splenium, pass horizontally forwards and constitute the fornix. This latter augments in thickness and sweeps gently down as its precommissural fibres trend towards and unite with the rostrum and genu of the corpus callosum. Below their angle of junction is a circular connecting band, the anterior commissure. This is of fair size, in this respect unlike that of the Porpoise (*Phocæna*), where Professor Huxley avers it is no more than $\frac{1}{25}$ inch in diameter.

I regret, for many reasons, I have been unable to work out thoroughly the cerebral convolutions of *Manatus*, as it would have formed a standard of comparison of the Sirenian Order with the other Mammalia. At the same time my faulty material has served as a sketch map sufficiently complete to recognize the type of folds. Whilst the numerous secondary fissures and folds were in great part destroyed by the firm adhesion of the pia mater, subsequent coalescence of the neighbouring walls, and scaling of the cerebral substance superficially, yet I have been successful in elucidating the main sulci and gyri. Thus, with other points, I offer more than a mere passing glimpse of the structural organization of the brain of this remarkable group, and supply a desideratum craved for by all biologists whose attention has been directed to their internal soft structures.

As to fissures the main and most striking feature of each hemisphere is the great deep Sylvian cleft (*sy*). On whichever face the brain is examined it is a conspicuous landmark, and cuts, as mentioned, each cerebral half into two well-defined areas, anterior and posterior. Commencing at the middle lobe (island of Reil), on the brain's base, the Sylvian fissure sweeps round to the outer face and ascends almost perpendicularly half-way up, then splits into an anterior and posterior division. For other fissures and gyri consult the figures in Pl. XXV. and their descriptions. I may remark of the brain as a whole, that, in shape and type of gyri &c., it appears to follow more that of the Elephant than those of Cetacea generally. Compared with the figure of the Dugong's brain, it is shorter, higher, and proportionally broader.

The pneumo-gastric nerve issues from the foramen lacerum, at its posterior part, close to the rectus anticus minor. An inch below it sends upwards a laryngeal branch; and

¹ Huxley, Hunterian Lectures, 1864.

² "Commissures of the Central Hemispheres of the Marsupialia and Monotremata," Phil. Trans. 1865, p. 634.

the main nerve goes down the neck, and on the right side crosses the subclavian artery ere dipping into the thorax.

A descendens noni lies alongside the latter, and appears to issue from the same foramen. It has a doubtful ganglion and a branch communicating with the pneumogastric, the hollow of exit lying inside the stylo-hyal.

A hypoglossal nerve pierces the inner portion of the parotid gland, and passes forwards and round the carotid artery lying upon the surface and inner border of the stylo-hyoid muscle. There is a long recurrent laryngeal branch on each side.

The facial nerve is of large size, and escapes from the skull at the stylo-mastoid foramen. It passes over the paramastoid process and the meshwork of vessels behind the angle of the jaw, here piercing the substance of the parotid gland. It passes forwards over both portions of the masseter muscle, and goes under the fossa of the downward portion of the malar arch, where it is distributed on the surface of the buccinator and other facial muscles.

The cervical and brachial plexus of nerves. In discussing the number of cervical vertebræ, as opposed to De Blainville's statement that there are seven, Stannius says¹, "I counted also only seven pairs of cervical nerves; the strong phrenic nerve arises from a bundle of the third and fourth cervical nerves, but it also receives a strongish bundle from the second. The brachial plexus arises from bundles of the anterior branches of the fifth, sixth, and seventh cervical and the first dorsal nerve; the bundles of the sixth and seventh cervical nerves are thick and strong; but the fifth cervical and first dorsal nerve are weak and thin."

From the very elaborate reticular network of minute blood-vessels (which in the male specimen I injected with tolerable success) I encountered some difficulty in tracing the nerves issuing from the cervical foramina, but, with patience, I unravelled the interwoven tissues, and was rewarded with a fair view of them. Figs. 29 & 30 exhibit their relations; but the first, or suboccipital twig, is hidden by the vascular rete in the latter figure. The following are my notes of the dissection:—The first nerve, of small size, comes out between the rectus lateralis and rectus anticus minor muscles and gives twigs to them and the neighbouring parts. The second nerve, much thicker than the first, issues between the atlas and axis, and crosses over the atloid attachment of the serratus magnus muscle, and then over the lateralis to the anterior border of the shoulder, giving branches to the suprascapular and other muscles in that region. The third cervical nerve emerges between the second and third vertebræ, posterior to the upper (larger) tendon of the scalenus, but anterior to the diminutive additional tendon which is inserted along with the larger into the axis—the same spoken of in discussing the absent neck-vertebra. It divides into several filaments, and is distributed to the shoulder-region like the second. Twigs connect the second and third and fourth nerves. The fourth nerve, smaller than the second and third, but rather larger than

¹ *Op. cit.* p. 8.

the first, has its exit from the same foramen as the third—namely, betwixt the second and third cervical vertebræ; but it lies posterior to the tiny second tendon of the scalenus. It joins outwardly the fifth nerve. The above four roots may be regarded as constituting the cervical plexus.

Of the nerves forming the brachial plexus, the fifth is of considerable calibre, and issues between the scalene tendons, marking the third and fourth cervical vertebræ. After a short course it joins the sixth nerve. From this union a broad nervous cord is derived, which proceeds to the shoulder, dividing into several branchlets, which supply the inner surface of the supraspinatus, &c. The sixth nervous trunk comes from the intervertebral foramen, between the fourth and fifth cervicals. It is a thick, flat cord, compared with the others, and joins, as aforesaid, the preceding fifth nerve.

The seventh nerve, a large cord at first, is situated between the fifth and the sixth cervical vertebræ, and has the vertebral artery lying above it.

Lastly, the eighth cervical nerve, counting from before backwards, has exit from the foramen immediately above the first rib and between what appears to constitute the sixth cervical vertebra and the first dorsal. The two nerves, seventh and eighth, continue outwards parallel to each other, deeper than but immediately anterior to the arch of the axillary artery. A twig from the chest or costal nerve joins the last on the scalenus muscle above the rib.

The phrenic nerve, as already intimated, does not come either from the third or fourth branch of the cervical plexus, but instead appears to be the continuation of the bridge of junction betwixt the fifth and sixth. It leaves the latter with an outward flexure, being fastened by a loop of the cervico-axillary fascia over the artery, which may represent a thyroid axis. The nerve proceeds towards the chest, and enters it over the first rib, close to where the axillary artery is derived. What I presume to be the long thoracic is derived from the seventh and eighth nerves, and traverses the chest superficially to the enlarged lymphatics of the axilla, encompassed at first by the rete mirabile and further on lying upon the surface of the mammary gland.

The dense mass of vessels matted to the brachial nerves prevented the composition of the primary cords being efficiently noted; but some of their tracks lower down were easier to follow. The median nerve, of moderate thickness, goes below the pronator radii teres, then on the flexor primi internodii pollicis, &c. to the wrist, underlying the flexor communis. Distally it splits into three branches, with subdivisions to the digits. The anterior interosseal division keeps company to beyond the pronator, thence, lying on the interosseous ligament, proceeds to the wrist and splits into twigs. A branch, apparently from the median, leaves it above the elbow-joint, runs to the brachialis anticus and distributes other twigs to the cubital joint and neighbouring parts. The musculo-spiral, a large thick cord, before reaching the humerus, splits into funiculi, part of which enter the triceps, brachialis anticus, &c. The radial nerve passes alongside the latter muscle, then beneath the pronator, and along the radius to the root of

the indicial and second digits. Twigs from it, moreover, supply the parts at the wrist-joint. About the head of the radius the posterior interosseous division from the radial takes a course along that bone. The ulnar nerve on reaching the inside of the olecranon, thereafter divides into three. A large cord goes to the root of the fifth digit and supplies the parts on it and the fourth. The second, also a thick cord, is imbedded within the dorsal aspect of the palmaris and flexor carpi ulnaris muscles, accompanying them to the pollicial metacarpal, and then breaks up on the same. The third division is muscular, chiefly devoted to the palmaris and flexor ulnaris.

IX. SENSORY ORGANS.

1. *Nose and Nasal Passages.*

The Sirenia differ very materially from the Whale tribe in the form, structure, and general nature of the nasal organs. Neither has their nose close outward resemblance to the great nasal trunk of Proboscidea, nor even to the more curtailed appendage of the Tapiridæ. In fact, it might as deftly be compared to the snout of the Suidæ as either of these, though, strictly speaking, it is unlike either. The great furrowed and bristle-clad semilunar upper lip and truncate snout of *Manatus* have been fully described by preceding writers; and each notes the pair of narial orifices on the top of this, just as it shelves to the perpendicular. This position of the nares is a seeming rather than real approach to the type of Cetacea, yet altogether dissimilar. Examination shows that were the trunk of an Elephant cut short at the root, or, better still, left entire, but contracted to a minimum of its long diameter, and with the terminal tactile appendage aborted, structurally the Manatee's naso-labial organ would assimilate with it.

The nasal and facial muscles I have described and compared with those of Elephant and Whale in the chapter on the myology, and, before treating of the interior nares, repeat that there are no appendicular sacs whatsoever as in the latter marine form.

The nasal cartilages are very simple. There is a thick septal cartilage (*sp*, fig. 38, Pl. XXVI.), the continuation of the vomerine rostrum, and which fills the grooved canal on the floor of the nares. It slopes down from the anterior mesial edge of the frontal bones to the proximal part of the osseous premaxillary rostrum, where it stops short.

Upper lateral and alar cartilages cannot be separated; but what represents the former or both (*nc*) is a superior cartilaginous narial roof or outfolding of the septum. On each side this covers the large anterior narial vacuity or chamber (*n.ch*, fig. 37) in a convex manner, being fastened to the bone exteriorly from the frontal along the inferior inner edge of the nasal and premaxillary to the root of its rostrum. On nearing the latter point it splits; or its mesial portion, that in connexion with its fellow of the opposite side, continues as a splint along with the septal cartilage forwards, and is separated from the outer fork by a long and narrow oblique fissure (*cf.* fig. 38).

The two anterior cartilaginous fissures, as looked at from above, have an acute V-figure, and fall short of the outer nares, the nasal passages being continued forwards

from them by narrow canals, each nearly a couple of inches long, and which open by two crescentic horizontally placed orifices on the summit of the truncated snout. Each narrow anterior canal, and its terminal crescentic narial orifice, are surrounded by and perfectly under the control of the powerful nasal muscles already detailed. The anterior nares are situated about half an inch apart from each other (rather less in the young male), and they individually have about as much vertical and transverse diameter when dilated. When contracted they appear simply flattened semilunar transverse slits at the top of the corrugated fleshy snout.

The olfactory passages may conveniently be regarded in the Manatee as consisting each of three compartments. Behind is the postnarial chamber, partially divided in front from its fellow of the opposite side by the vomer and septal cartilage. Below, it is wide and somewhat tubular; above, it is narrowed and outwardly curved, or follows the outline of the turbinal, thus forming a lower and an upper meatus.

In advance of the postnares, and without any decided constriction from the posterior, is the median narial chamber (*n.ch*, fig. 37), namely that portion covered by the nasal cartilages. In front this is very narrow; and its floor forms a kind of *cul de sac* just behind the prominent premaxillary rostrum, above which, or at its top, is the narrow cartilaginous opening already spoken of. From this point forwards is the anterior compartment, or narrow tubular passage heretofore described.

A highly vascular layer of Schneiderian membrane lines the two so-called posterior nasal chambers; but as it reaches the anterior canal it assumes more of the character of an ordinary mucous membrane, and at the semilunar nasal orifice is livid, and apparent less delicate and sensitive than are the internal chambers.

As regards the sense of smell possessed by *Manatus*, I am not aware it is gifted with delicate olfactory perception; at least I do not know of any observations on the living animal to substantiate such an assertion. If, however, size of olfactory bulb tally with the function of smell, this faculty is far from deficient.

2. Ocular and Auditory Apparatus.

Compared with the orbital cavity the eye is most diminutive; around it, however, are fatty tissues, a manifest vascular rete, a great bunch of infraorbital nerves, &c.; so that the space is well packed. Divested of adventitious structures, the ball of the eye has a diameter a trifle over half an inch, and is nearly spherical. The pupil, as far as I could judge, inclines to a transverse oval, and is less than 0.2 inch in diameter. The crystalline lens is proportionally small, and with an antero-posterior compression. Anteriorly the sclerotic thins, but posteriorly (as in Cetacea) is relatively very thick and dense. The convexity of the cornea is but moderately protuberant, the aqueous chamber therefore small or perpendicularly high; the vitreous chamber also has a vertical diameter greatly in excess of its horizontal one. Ciliary processes are abundant, and furnished with pigmentum nigrum; and the tapetum, though lighter in hue, nevertheless has a delicate choroidal layer of pigmentary matter. A third eyelid or nictitating

membrane is present; to this, as in the Elephant, a cartilage is attached; and the chief opening of what represents a Harderian duct is at a recess below the inner middle of the lid. A lachrymal gland was not distinguished. The choanoid muscle is divided into an upper and a lower pair of strong bands; and the superior inner one, with an oblique course, has a partial attachment to the cartilage. The antagonist to this is the levator palpebræ, a narrower slip, obliquely directed inwards and downwards from the tarsal membrane. The remaining orbital muscles are much weaker, and posteriorly are lost in the dense sheath of the long optic nerve. Taken as a whole the eye is very elephantine, yet combining, in thickness of sclerotic, outline of chambers, rete, &c., whale-like characters.

In the absence of pinna a small orifice, a line in diameter, into which a probe could be passed, alone represents the external meatus. It is situated on a level with the posterior end of the malar bone, 4 inches behind the eye. A narrow cord-like fibrous tube, 3 inches long, with an S-shaped bend, leads to the membrana tympani. The latter is a wide ellipsoidal thickish membrane, the fibres of which from above and below obliquely meet the tube as it passes across the centre. A thin narrow edge of the malleus abuts against the inside of the membrane in the same oblique direction, and divides the tympanic cavity into an upper and a lower chamber. The swollen malleolar head rests in the anterior cavity of the periotic; and, with a tricuspid facet, the much smaller but wide-limbed incus is attached superiorly and posteriorly to it. The fork of the incus embraces a descending process of the posterior half of the periotic; and the shorter incudal limb articulates with the stapes. The latter, a nearly solid, straight bone, inferiorly rests in a groove of the petrous portion of the periotic. In both instances none of the small ear-bones was ankylosed to the tympano-periotic. The large Eustachian tube communicates with the auditory chamber just in front of the stylo-hyal cartilage. I was disappointed of further examination of the interior soft structures, the injection having extravasated in the one case, and necessity for destruction of the bones interfering in the other.

X. PARTS RELATED TO GENERATION

(in the Female and Male).

In Sir Everard Home's figure, copied by Frederick Cuvier and others, a very prominent teat is represented as occupying the postaxillary space. This was not the case in either of the Society's specimens, most probably from their juvenile condition, although it is to be remarked that the larger one equalled Sir Everard's in size. The female, however, had a pair of rudimentary axillary nipple-like bodies; but in the male none were found. On removal of the integument in both animals, a careful dissection was made of the subcutaneous tissues and the fat filling the deep interspace between the shoulder and pectoral portions of the panniculus, but no trace of lactiferous ducts could be detected.

Upon the surface of the chest, immediately behind and partially dipping into the

axillary space, was a moderate-sized semidivided glandular mass, lying between the tips of the first and second ribs and the inner border of the latissimus. This exhibited structure more resembling enlarged lymphatic glands than a mammary organ. Part of the mass doubtless belonged to the lymphatic system; but that portion of it which appeared to constitute the mammary gland lay upon the scalenus muscle, between the most anterior digitation of the external oblique and the middle of the first rib. The outer border of the pectorales muscles partially overlapped it; the latissimus, as said, formed its outer boundary; and the panniculus was superincumbent. The lymphatic portion, which dipped into the axilla, was surrounded by a rete mirabile; but that portion which, from position, I took to be the mammary gland, had no such envelope.

The position of the generative outlet is mentioned in the paragraph of measurements. Excepting in proximity to the anus, there is really very little difference between the sexes. An elevated labial rim surrounds the vulva, diminishing behind as it passes into a linear perineal raphe. A few shallow sulci lie on either side of the latter. The clitoris, hidden in the anterior fork, is large and rough, resembling much the prepuce of the male. The vagina, during adolescence, is short, wide, and rugous, the os tinæ large and prominent. The body of the uterus, lengthened, narrow, and with many longitudinal mucous folds, divides above into right and left cornua, the outer extremities of which contain the ovary and fimbriated extremity lodged in the hypogastric fossa at the hinder end of the diaphragm.

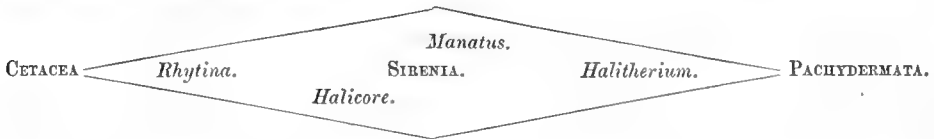
Each renal organ in our female is 5 inches long, the two lying opposite one another. Their figure is simple, with only a superficial indication of lobulation, but in reality absence of division; hilus shallow. The kidneys rest upon the tendinous surface of the diaphragm, close to the spine, the posterior ends reaching the last ribs. The ureter uniform in calibre in its course to the semiglobular bladder, hooks round the uterine cornu and beneath the hypogastric artery (fig. 50), finally piercing the base behind the neck.

As regards the male sexual parts I have little to add to Vrolik's excellent figures and description. On comparing figs. 47 and 48 a considerable resemblance between the glans penis and clitoris is apparent, the meatus urinarius of the male being slightly elongate. The correspondence, again, in general appearance, position, &c. of the testes and spermatic duct with the ovaries and cornua is not a little remarkable; and this is even more heightened by the presence of a hypogastric fossa (*hf*, fig. 49) and rete mirabile in the neighbourhood.

XI. RANK AND RELATIONS OF MANATUS.

It was a most natural conclusion of the earlier naturalists to look upon the Lamatins as modified Whales (Cuvier's Herbivorous Cetacea), still bolder of De Blainville to class them as aberrant Elephants (Gravigrades), but more just and safer of Illiger to group them apart as an order Sirenia. Every animal doubtless has its appointed place and time in the great scheme of creation. Could we but for a moment remove that

misty film which here and there drapes some with tantalizing indefiniteness (leaving them like islands and peninsulas, sea-girt, or but narrowly connected to the, so to say, mainland of typical forms), we should be astonished, and bow in reverence to that fiat which has planned and carried out such a grand design. Probed to its entirety and ramifying links, each vertebrate might yield a life's study; but the more fascinating to biologists of all times have been those strange and uncouth types, leading to all manner of fanciful conjectures. *Manatus* and its kindred are among those piquant forms, fit food for speculation. Is it a retrograde, dwarfed, or undeveloped Elephant? a "true embryonic type of Pachyderms," as the elder Agassiz¹ puts it. Is it a partially converted Cetos? Is it the reflex of unknown and antedated swarms of mammals of intermediate organization, which would fill up the chasms of structural differentiation yielding lines of demarcation to modern systematists? Such interrogations, to be answered satisfactorily, require a more comprehensive knowledge of the embryology of Pachyderms and Cetacea, a far greater acquaintance with allied fossil forms, a better appreciation of what constitute transitional links, and a further profound investigation into the principles of the doctrine of evolution. These gaps in science necessarily limit generalization, and cause reply to be theoretical. The most that can solidly be affirmed is that *Manatus* and three other genera sufficiently differ from other known mammals, so that under the present aspect of classification they best constitute in themselves a separate order, Sirenia. The Sirenia, however, gradate into extremes, or rather may be tabulated thus:—



According, therefore, as we contemplate either end of the lozenge-shaped area does the consanguinity of the Sirenia trend towards marine or land animals. *Manatus*, in the totality of its characters, tends more towards Pachydermata than Cetacea; but in its individuality we cannot strictly say it belongs to either, or predict its being an embryonic type of the former. Between each two of the three above orders are wide intervals. Still, with our scanty knowledge of palæontology, remnants of animals are revealed, combining characters which we are apt to consider appertain but to one. Moreover the relations of the Sirenia are not solely bound by the two orders given, although these seem more direct in their affinities. Such aberrant types as *Trichechus*, *Zeuglodon*, &c. point to other radial lines of alliances. The labours of the veteran Professor J. F. Brandt, in his "Symbolæ Sirenologicæ," are most copious in comparisons of the like kind; but with all his conclusions as regards *Manatus* and its allies I do not coincide. The above diagrammatic view I believe expresses the probable kinship of the Sirenian genera one to the other; but to give full reasons therefore would

¹ Proc. Bost. Soc. Nat. Hist. 1848-51, p. 209.

entail my entering on data which I reserve for another communication. Brandt forms one family, Manatidæ, containing the genus *Manatus*, and a second, Halicoridæ, with three genera, *Halitherium*, *Halicore*, and *Rhytina*. Excluding *Halitherium*, not noted by him, Dr. Gray¹ ranges the others under the family Manatidæ. Professor Kaup's² generalizations I reserve till I treat of *Halitherium*.

I am aware I tread on tender ground, and may evoke the contumely of those who see every group with noonday light, clear and circumscribed, when with others I suggest demolition of boundary lines by upraising past forms to take their place in the alphabet of Zoology. But, however beneficial classification may be to the study of animals, there is a still higher aim when we would discard pretension to system, and strive by patient research to fathom the intricacies of creative organization.

The more important additions to the anatomy of the Manatee contained in this memoir are:—accurate representations of its figure; fresh views of exterior moot points; the peculiar nature of the epidermis; structure of the hairs and bristles; the vertebral irregularities, which cervical is the one missing? the skull's interior, its development; the ligamentous system; entire myology, the limb-muscles being fully developed; the homologies of the mouth-structures with reference to baleen &c.; revision and illustrations of the digestive organs and associated glands; new sectional views of the body, with organs in position; reexamination and depicting of the remarkable vascular distribution; parts connected with respiration and vocalization; the brain, not before known; elucidation of the nerves; the nasal passages and the eye; illustration of the female generative parts and lumbo-pelvic regions.

XII. ADDITIONAL NOTE.

The Zoological Society of London is so much indebted to its correspondents and other kind friends, that I cannot pass in silence the efforts made in this case to ensure safe transmission of what has long been a desideratum. The exhibition of a live specimen of the order Sirenia (a veritable mermaid) in the Regent's-Park collection would, if achieved, form one of the most sensational triumphs incident to the introduction of rare and comparatively unknown animals into Britain. But the chapter of travelling-accidents is a tangled one. Safe transport of living large marine animals, even under the most favourable circumstances, is a task requiring sound judgment and much tact. Moreover obstacles increase proportionally where the clime is different, the distance great, or the place of capture far removed from ready mechanical appliances and abundant manual assistance. In the present instance it may be affirmed that success in a most difficult undertaking was twice well nigh accomplished.

After many endeavours and promises of reward, Mr. George Latimer, of Porto Rico, in 1866 had the good fortune to obtain from some fishermen a young female Manatee which they had caught in one of the neighbouring "corals." The natives, it seems,

¹ B. M. Cat. of Seals and Whales.

² Beiträge, d. urweltlichen Säugethiere, 1855.

after having captured the creature, fastened a rope round the narrow end of its tail, and thus detained it as a prisoner in the water for some weeks. As soon as it came into the possession of Mr. Latimer, a large tank, some ten feet long and several feet deep, was prepared. Animal and tank were shortly afterwards despatched for England, *via* St. Thomas, and *per* Mail Steamers 'Conway' and 'Tasmanian.' Mr. Latimer's very handsome presentation to the Society, however, was not destined to survive the confinement and the angry surge of the Atlantic. Both Captain Hammach and Captain Sawyer, of the above steamers respectively, were much interested in the safe transit of this negro Siren. The latter gentleman, indeed, with true sailor-like generosity and care for the well-being of the creature, on finding the motion of the vessel injurious to it, caused the tank to be lessened, well padded, and slung fore and aft to prevent the Mermaid being rolled about too much. Notwithstanding these precautionary measures, several days' very rough weather had a prejudicial effect, and cutaneous abrasions resulted. Meantime it fed badly. Whether from this cause, from the rapid spreading of the skin-ulcers, or from a sudden change to very cold weather, the Manatee quickly succumbed, and died early on the morning of the 24th March, namely ten days after leaving Porto Rico, and seven from St. Thomas.

The body was disembowelled, filled with salt, and placed in a corner of the ice-house. The entrails were partially cut up and preserved in spirit. In this manner the carcass reached me in tolerably sound condition, the brain alone being rather soft.

Whilst Mr. Latimer was striving to obtain a Manatee for the Society, another correspondent, Herr A. Kappler, of Surinam, was likewise bestirring himself to procure one. Indeed, ere the former gentleman's letters and animal had arrived, our Superintendent's son, Mr. Clarence Bartlett, was on his way out to bring home a young male Manatee from Herr Kappler. This specimen had been captured in the Maroni river, and confined in a creek, an offshoot of the main stream. The mother of this suckling had been killed (the same I have mentioned as now lodged in the Stuttgart Museum), and the youngster transferred to the small sheet of water, where it was duly fed with cow's milk. A few months passed ere Mr. Bartlett had all ready for a start; for great difficulty was experienced in preparing a water-tight tank in that outlandish country, where carpenters were scarce, the wood as hard as iron, and zinc or tin a rare commodity. During this interval, however, "Patchly" (for so the creature was christened) became tolerably tame, and sucked milk freely from a bottle.

On the 19th of June Herr Kappler and Bartlett started *en route*, but nearly lost their charge; for on traversing a dangerous current of the Maroni river the boat, with the great awkward tank lashed to it, all but upset. Reaching Paramaribo, two days' journey from Mr. Kappler's dwelling, this courteous gentleman returned, and Bartlett came on in a Dutch steamer to Demerara. But the danger was not past, as a hurricane well nigh swept tank and Manatee overboard. On the 25th of the month Barbadoes was reached, and on the 29th St. Thomas. Up to the 8th July every thing bade fair that

the Manatee would survive the voyage. It had a supply of fresh goat's milk every day, and occasionally a banana. On the 9th a chilling north-east wind set in, and the Manatee took suddenly ill, and died the next day, just within two days' sail of Southampton.

Thus, unfortunately, was the second attempt to fetch a live *Manatus* to England frustrated.

Before concluding, I shall for a moment glance at the practical points which the reverses above met with teach.

1st. It seems a necessity that such an animal as the tropical Manatee should be conveyed to our climate only during very fine summer weather. A month later or a more favourable season might have saved the young male.

2nd. It is very essential that in the event of injuries or rough treatment being inflicted during capture, some time should elapse before shipment, so that recovery take place prior to transport. Had the dermal wounds of the above female healed before removal, it would have augured better for its safe carriage.

3rd. The size of the animal being roughly known, it behoves that a well-constructed receptacle be prepared beforehand, either in England or some large town where proper material and workmanship are obtainable. This should be strong, but also as light as possible, and with rings or clasps so fixed that the tank could be hoisted or shifted about easily.

4th. Neither too great depth nor length are desirable, as the swaying motion of a vessel so jolts the water and animal about, that injury to the latter is sure to be sustained.

5th. As Mr. Greey, late purser of the S.S. 'Tasmanian,' justly observed, the body in part and the tail might with benefit be encased in blankets to prevent cutaneous excoriations. And if the creature were partially slung hammock-fashion in the tank, there would be less danger of knocks and abrasions.

6th. It is important that the tank be placed in that part of the vessel least subject to oscillation, and lengthwise fore and aft.

7th. A covered tank is preferable to an open one—as curious visitors are sure to poke the animal about, in the event of those in charge being absent.

8th. Fresh and sufficient supply of wholesome food should be provided; and due cleanliness attended to, without disturbing the creature too frequently.

Finally, it is to be remembered that, although unsuccessful in the two above attempts to transport a Manatee to the Society's Gardens, the efforts have not been entirely fruitless. So much experience has now been gained how to manage the difficulties that the whole matter depends on another determined attempt.

I trust, therefore, such an interesting form as *Manatus*, and one which at no far distant period will be reckoned among mammals of the past, may yet ere too late become a denizen of the Society's Gardens.

DESCRIPTION OF THE PLATES.

PLATE XVII.

- Fig. 1. Lateral view of the body of the young male Surinam Manatee (*Manatus americanus*, Cuv.) forwarded to the Society by Herr A. Kappler. Photographed from the dead body, $\frac{1}{3}$ natural size. The tail is seen, not in profile, but slightly tilted towards the observer. *n*, nasal orifice of the right side; *c*, tail-cleft.
- Fig. 2. Abdominal surface of the same animal, also from a photograph: *u*, umbilical cicatrix; *p*, external orifice of the penis; *a*, anus.

PLATE XVIII.

- Fig. 3. Dorsal aspect of the body, the pectoral limbs (as in fig. 2) being outstretched. $\frac{1}{5}$ the size of nature, and from a photograph. *n*, nares; *e*, eye.
- Fig. 4. Pectoral limb of the left side, seen on its external surface, photographed its natural dimensions. *I*, *II*, *III*, first, second, and third digital nails.

PLATE XIX.

- Fig. 5. Head and neck, as far as the shoulder, of the same young male *Manatus*. From a photograph, corresponding as near as possible to the natural size of the animal. *n*, left nose-opening; *ea*, ear-hole, or orifice of auditory canal.

PLATE XX.

- Fig. 6. Front, and consequently fore-shortened view of the head, body, and pectoral extremities of the above specimen. Reduced in size from nature. The body lying on a table while being photographed has necessarily slightly flattened the chest. *e*, eye; *n*, narial orifice.
- Fig. 7. Muzzle with the mouth opened, from a photograph, of the natural size, showing:—*nn*, narial orifices; also the upper and lower lips (=outer), the palatal or upper pad, and the mandibular or lower pad (=the additional labial masses, or inner, extra upper, and lower lips of some writers).

PLATE XXI.

- Fig. 8. Side view of the female Manatee, $\frac{1}{4}$ natural size, with skin and subcutaneous fat removed, exposing the superficial muscular layers. The broad tail, consisting of fibroid and dermal tissues, is necessarily absent.

Muscles of the Body and Tail.

| | |
|---|--|
| <i>Sp.d.</i> Spinalis dorsi+Levator caudæ internus, <i>Lci.</i> | <i>L.cd.</i> Lumbo-caudalis. |
| <i>L.d.</i> Longissimus dorsi+Levator caudæ externus, <i>Lce.</i> | <i>Sc.</i> Sacro-coccygeus. |
| <i>Sp.</i> Splenius; <i>Co.</i> Complexus. | <i>P.c</i> ¹ . } Different portions of the panniculus |
| <i>Tz.</i> Trapezius; <i>Rh.</i> Rhomboideus. | <i>P.c</i> ² . } carnosus muscle; including the |
| <i>S.l., S.l</i> *. Sacro-lumbalis. | <i>P.c</i> ³ . } platysma myoides, or transverse |
| <i>Ei.</i> External intercostals. | <i>P.c</i> *. } nuchal portion of the panniculus. |
| <i>E.o.</i> External oblique. | <i>La.d.</i> Latissimus dorsi. |
| | <i>f.</i> Dorsal layer of fat. |

Muscles of the Head.

| | |
|---|---|
| <i>Te.</i> Temporalis; <i>ac.</i> Auditory canal. | <i>L.s.p.</i> Levator labii superioris proprius. |
| <i>O.p.</i> Orbicularis palpebrarum. | <i>D.l.i., D.l.i</i> *. Depressor labii inferioris. |
| <i>L.l.s.a.n.</i> Levator labii superioris alæquæ nasi. | <i>D.a.o.</i> Depressor anguli oris. |
| | <i>Pc</i> ² . Mandibular portions of panniculus. |

Muscles of the Pectoral Limb.

| | |
|--|---|
| <i>I.sp.</i> Infraspinatus. | <i>Pl &c.</i> Palmaris longus &c. |
| <i>D.</i> Deltoid. | <i>Sl.&E.c.r.l.</i> Supinator longus and extensor carpi radialis longior. |
| <i>T</i> ¹ , <i>T</i> ² . Triceps (first and second portions). | <i>E.c.d.</i> Extensor communis digitorum. |
| <i>T.ma.</i> Teres major. | <i>E.c.u.</i> Extensor carpi ulnaris. |
| <i>B.a.</i> Brachialis anticus. | <i>E.p.i.p.</i> Extensor primi internodii pollicis. |
| <i>E.md.</i> Extensor minimi digiti. | |

Fig. 9. Under surface, showing the superficial muscular layer of the right half of the body, and dissected deeper parts of the left moiety. The letters used in fig. 8 are applicable to similar parts exposed or cut short in the ventral aspect. The following muscles, vessels, &c., besides are seen partly uncovered.

| | |
|---|---|
| <i>R.ab.</i> Rectus abdominis. | <i>C.h.</i> Cephalo-humeral. |
| <i>E.o.</i> External oblique. | <i>St.m.</i> Sterno-mastoid. |
| <i>I.o.</i> Internal oblique. | <i>S.hy.</i> Sterno-hyoid and Sterno-thyroid. |
| <i>Tra.</i> Transversalis. | <i>T.hy.</i> Thyro-hyoid. |
| <i>Is.c.</i> Ischio-coccygeus. | <i>S.</i> Subscapularis. |
| <i>Ifc.</i> Infracoccygeus. | <i>Di.</i> Digastric. |
| <i>P.ma., P.ma</i> *. Pectoralis major. | <i>Ma.</i> Masseter. |
| <i>P.mi.</i> Pectoralis minor. | <i>L.l.i.</i> Levator labii inferioris. |

A, anus; *V,* vulva; *Pl,* pelvic bone; *Ab.Rete,* mammary arteries as a rete mirabile; *C* and *I,* carotid artery and jugular vein; *Ax.Rete,* axillary plexus of vessels; *tr,* trachea; *M.gl,* mammary gland; *P.gl,* parotid gland; *Sx.gl,* submaxillary gland.

Fig. 10. Second layer of the muscles of the head, with portions of the panniculus cut short to show their cranial insertions.

| | |
|---|---|
| <p><i>Te.</i> Temporalis. <i>Di.</i> Digastric, seen in part. <i>Ma</i>¹, <i>Ma</i>². Masseter, two layers. <i>L.l.s.a.n.</i> The levator labii superioris alæque nasi cut short and reflected. <i>L.s.p.</i> Levator labii superioris proprius. <i>C.n.</i> Compressor nasi &c.</p> | <p><i>O.o.</i> Orbicularis oris. <i>Bu.</i> Buccinator. <i>D.a.o.</i> Depressor anguli oris. <i>D.l.i.</i> Depressor labii inferioris. <i>Pc</i>¹, <i>Pc</i>², <i>Pc</i>³. Cheek and lip insertions of panniculus.</p> |
|---|---|

Px, Vascular plexus emerging from skull behind the mandibular condyle.

Fig. 11. Third and deepest layer of cranial muscles as viewed in profile. The same lettering is used as in the preceding. *Z*, zygomaticus; *Md*, Mandibularis muscle; *Ty*, tympanic bulla.

Fig. 12. Muscles of face and muzzle seen from above. On the right side the levator labii superioris alæque nasi has been entirely removed, the dotted line indicating its outline. On the left side the levator labii superioris proprius and maxillary portion of panniculus have been dissected, cut short, and thrown forwards. Additional letters are:—*Pn*, Pyramidalis nasi; and *Px*, infraorbital plexus of nerves, &c.

PLATE XXII.

Fig. 13. Pectoral limb, inner view. The upper layer of the forearm muscles in place, and insertions into scapula and humerus of some of the thoracic ones displayed. *Rh*, rhomboideus; *S.mg*, serratus magnus; *T.ma* & *La.d*, teres major and latissimus dorsi; *P.ma* & *P.mi*, pectorales major and minor; *L.cl* & *C.h*, levator claviculæ and cephalo-humeral; *B*¹ & *B*², biceps, first and second heads; *T*¹, *T*², *T*³, triceps, three bellies; *B.a*, brachialis anticus; *P.r.t*, pronator radii teres; *F.c.r*, flexor carpi radialis; *F.c.d*, belly and palmar distribution of the common flexor of the digits; *F.c.u*, flexor carpi ulnaris; *Pl*, palmaris longus; *Ab.m.d* & *Fb.m.d*, abductor and flexor brevis minimi digiti; *Pc*^{3*}, aponeurosis from panniculus.

Fig. 14. Upper layer, short palmar muscles. Letters as in preceding. *I*, superficial interossei; 1 to 5, the digits.

Fig. 15. A similar view, but with the superficial muscular expanse (*I*¹) hooked forwards, exposing deep interossei: *Id*, deep interosseous series.

Fig. 16. Profile fetal skull of Manatee in the Amsterdam Museum. Nat. size. *Fr*, frontal; *Ma*, maxillary; *Pmx*, premaxillary; *Pa*, parietal; *So*, supraoccipital; *Sq*, squamosal; *Ju*, jugal, and *S* an adjoining sesamoid bone; *Ty*, tympanic; *Md*, mandible. The dotted line indicates continuance of ascending contour,

and 1, 2, 3, separate ossific centres; fo^1 & fo^2 , the parietal and occipital fontanelles; O , orbit; Mf , mental foramen.

Fig. 17. Base of the same, additional lettering as follows:— Bs , basisphenoid; As , alisphenoid; Os , orbito-sphenoid; Pl , palatine; Bo , basioccipital; Eo , exoccipital; fn , foramen magnum; Eus , Eustachian sac; Sf , sphenoidal foramen; Iof , infraorbital foramen; An , anterior palatine foramen; I , incisor-cavity; Mo , molars in dental sacs.

Fig. 18. Mouth view of the partially dissected lower jaw with tongue, larynx, hyoid, and muscles *in situ*. The dotted lines respectively show the approximate limits of the so-called outer lips (consult fig. 7 &c.).

b , bristles on ll , lower lip; sp , spines on lp , lower mandibular or symphyseal pad; T , tongue; id , inferior dental foramen; α , œsophagus; tr , trachea; Cs , constrictor superior; Cm , constrictor medius; Sph , stylo-pharyngeus; $Stg+h$, stylo-glossus and hyoid.

Fig. 19. The palate and portion of the upper lip of the same female Manatee. The dotted lines indicate the contour of the muzzle &c. (see fig. 7).

ul , upper lip partly in outline; up , upper callous pad = inner upper lip; b , bristles; sp , palatine spines; bh , buccal or inner labial hairs.

PLATE XXIII.

Fig. 20. Reduced sketch of the viscera *in situ* of the young male Manatee. The lower left lobe of the liver is partially dragged out by a hook, the better to expose the natural forward tilt of the great curvature of the stomach.

I & IV , first and fourth gastric cavities; and III , placed on liver, points to the third semi-spiral appendicular cavity; gl , cardiac gland; sp , spleen; $C\alpha$, at root of bifurcate cæcum; r , right, and l , left, duplex lobes of liver; Gb , gall-bladder; pe , pericardium; H , four cavities of heart; pa , pulmonary artery; ao , aorta; u , umbilicus; p , aperture for penis; a , anus.

Fig. 21. The compound stomach, sliced open to show cavities and wall-structure.

α , œsophagus; I , first gastric cavity (* and white arrow indicate its upper sacculus); gl , cardiac gland; II , second cornual cavity; IV , fourth cavity; d , duodenum; 1, œsophageal opening into stomach; 2, stylet entering orifice of cardiac gland; 3, communication between I & IV stomachs; 4 & 5, two stylets passing respectively into the II & III cornual gastric divisions; 6, pyloric orifice; dch and pd , ductus communis choledochus and pancreatic duct, to the orifices of which arrows also point; m , gizzard-like thickening of muscular coat.

Fig. 22. Compound stomach, denuded of its serous coat, and exhibiting the direction of the external layer of muscular fibres. Lettering corresponds with fig. 21.

- Fig. 23. Semidiagrammatic view of stomach as it appears on the œsophageal or upper surface.
- Fig. 24. A transverse section, about the middle of the cardiac glandular appendage, showing its irregular diverticulate central cavity and surrounding gland-cells.
- Fig. 25. Piece of the small intestine, towards the duodenal end, showing form of rugæ and *P*, Peyer's glands.
- Fig. 26. Ditto, from the ileum, with glands (*L*) or crypts of Lieberkühn? *m*, muscular coat.
- Fig. 27. Portion of gut from near the rectum: *L*, glands, as above.
- Fig. 28. Ileo-colic segment of the intestine, sliced open to show interior structure.
- il*, ileum; *c*, colon, * its enlarged commencement; *Coe*¹, exterior, and *Coe*², interior of the cæcal appendages; *gl*, compound and sacculate ileo-colic valve-gland; *m*, thickening of muscular coat, the valve's wall.

PLATE XXIV.

- Fig. 29. Short deep muscles of the ventral surface of the neck; intervertebral exit of the cervical and brachial plexus of nerves, and membranous chambers, postero-base of skull. Right side with upper layer and a partial outline of shoulder; left moiety, deeper view, and opened basi-cephalic chamber.

| | | |
|---|--|---|
| <p><i>R.a.ma.</i> Rectus capitis anticus major.</p> <p><i>R.a.mi.</i> Rectus capitis anticus minor.</p> <p><i>Lc</i>¹, <i>Lc</i>², <i>Lc</i>³. Longus colli, its three parts.</p> <p><i>Rl.</i> Rectus lateralis.</p> <p><i>Sca.</i> Scalenus.</p> | \| | <p><i>S.mg.</i> Insertion of serratus magnus into</p> <p><i>Ch.</i> Cephalo-humeral. [atlas.</p> <p><i>St.m.</i> Tendinous insertion, sterno-mastoid.</p> <p><i>S.h.</i> Stylo-hyoid cartilage, cut cranial origin.</p> |
|---|--|---|

- 1, 2, 3, 4, 5, 6, 7, & 8, anterior spinal cervical nerves issuing from the intervertebral foramina; *Ph*, phrenic nerve; *Fn*, facial nerve at exit; *na*, posterior nares; *ptp*, pterygoid process; *Eus*, Eustachian sac, opened on left side.

- Fig. 30. Anterior segment of the body, with the limbs cut short. Dissected so as to lay bare chiefly the heart, main vascular trunks, and complex rete mirabile of the neck and upper limb, The sternum has been dragged outwards to the left side, showing the under surface of its left osseous moiety and trifold cartilages. The mammary gland and enlarged lymphatics partially occupy the right side of the chest. On the left side of the neck the jugular veins are intact, and the rete mirabile, cervical and axillary, superficially displayed. On the right side a deeper view is given. The large venous trunks and portion of the rete mirabile are removed, exposing the cervical and axillary plexus of nerves. The digastric muscle is cut away, and the parotid gland everted.

Heart and vessels:—*v*, right, and *v**, left ventricles; *a*, right, and *a**, left auricle;

p.a., pulmonary artery; *ao*, aortic arch, and *ao**, abdominal aorta; *l.c.*, left common carotid artery; *ls*, left subclavian; *i*, innominata; *r.c.*, right carotid; *th*, thoracic branch; *ic*, internal carotid; *ec*, external carotid; *im*, internal maxillary and plexus; *f*, facial; *rs*, right subclavian; *t.ax*, thyroid axis, and *ax*, axillary trunk splitting into retial divisions; *b.rete*, brachial retial plexus; *im*, internal mammary; *ve*, portion of vertebral artery under the pneumogastric nerve.

I.J., left internal jugular, and *E.J.*, external jugular veins; *CO*, communicating branches of the same; *S.V.*, left subclavian vein, cut short; *BC*, ditto brachio-cephalic; *VCD* & *VCA*, vena cava ascendens and descendens, severed.

Nerves:—Nos. 2 to 8 numerically apply to the individual elements of the cervical and brachial plexus; *ph*, phrenic; *pn*, pneumogastric; *rl*, recurrent laryngeal; *sl*, superior laryngeal; *hy*, hypoglossal; *il*, inferior laryngeal; *fn*, facial nerve; *lt*, long thoracic; *mn*, median nerve; *ec*, external cutaneous; *un*, ulnar nerve.

Larynx, glands, &c.:—*C*, cricoid, and *T*, thyroid cartilage; *bh*, basihyal; *sh*, stylo-hyal, and ***, its cranial cartilage; *tr*, trachea; *Pgl*, parotid gland; *Mgl*, mammary gland; *r¹*, first rib; *st*, sternum reflected; *c³*, the three sternal cartilages; *P*, pericardium opened; *æ*, œsophagus, in part.

Muscles:—*Ma*, masseter; *Stm*, sterno-mastoid; *Pc &c.*, panniculus &c. reflected; *Pma* & *Pmi*, pectoralis major and minor; *Eo*, external oblique, a portion; *D*, diaphragm; *Cth*, crico-thyroid; *Th.h*, thyro-hyoid; *Sh*, stylo-hyoid; *Sph*, stylo-pharyngeus; *Mh*, mylo-hyoid.

PLATE XXV.

Illustrations of the brain of the female, partly from rough sketches when fresh, and partly from the hardened brain, aided by a cast of the cranial cavity. All about natural size.

Fig. 31. Upper surface.

Fig. 32. View in profile.

Fig. 33. The base, with origin of nerves.

Fig. 34. Longitudinal and vertical mesial section, or inner face.

Fig. 35. Left hemisphere, exposing lateral ventricle; the horizontal section of the cerebellum is cut at a lower plane than is the cerebrum.

The following lettering applies throughout:—

Nerves:—1, 2, 3, 4, 5, 6, 7, 8, 8*, 9; that to the olfactory is placed on the bulb.

Parts of base:—*pi*, pineal gland; *al*, corpora albicantia; *cr*, crus, or peduncle; *pv*, pons Varolii; *ap*, anterior pyramid.

Interior horizontal and vertical sections:—*ac*, anterior cornu; *dc*, descending cornu; *pc*, posterior cornu; *cs*, corpus striatum; *ts*, tænia semicircularis; *th*, thalamus opticus; *hmi*, hippocampus minor; *f*, fornix; *cc*, corpus callosum; *g*, its genu, and *sp*, sple-

nium; *a*, anterior commissure; *c*⁴, corpora quadrigemina; *v*⁴, fourth ventricle; *v*⁵, fifth ventricle.

Lobes of cerebrum:—*F*, frontal; *P*, parietal; *T*, temporal; *O*, occipital.

Fissures, or sulci:—*sy*, *sy*¹, *sy*², Sylvian; *if*, infero-frontal; *mf*, midfrontal; *sf*, supero-frontal; *ap*, antero-parietal; *ro*, Rolando, or postparietal; *op*, occipito-parietal; *ot*, occipito-temporal; *ca*, calcarine; *cm*, calloso-marginal.

Folds or gyri:—*Io*, interorbital; *Mo*, midorbital; *Eo*, entorbital; *If*, infero-frontal; *Mf*, midfrontal; *Sf*, supero-frontal; *Ap*, antero-parietal (*premier pli ascendant*); *Pp*, postparietal (*second pli ascendant*); *Lob*, lobule of postparietal; *Ang*, angular; *At*, antero-temporal; *Mt*, midtemporal; *Pt*, posttemporal; *Soc*, Supraoccipital; *Moc*, midoccipital; *Ioc*, infero-occipital; *U*, uncinata; *Ma*, marginal; *C*, callosal.

Cerebellum:—*av*, arbor vitæ; *sv*, superior vermiform process or middle lobe; *f*, flocculus; *ag*, amygdaloid lobe.

Fig. 36. Portion of skull of female Manatee, with calvarium removed to show interior base.

The dura mater is in place on the left moiety, but cleared away on the right.

Lettering applicable to the left half:—1, olfactory fossa; 2, foramen piercing membrane for optic nerve &c.; 3, perforation transmitting third and fourth nerves &c.; 5 & 7, foramina respectively for trigeminal and auditory nerves &c.; *ca*, carotid groove; *t*, temporo-sphenoidal fossa; *P*, pituitary fossa; *j*, jugular groove; *px*, plexus and lateral sinus; *px*^{*}, spinal plexus.

Lettering of right half:—*Fr*, frontal bone; *Mx*, maxillary; *Os*, orbito-sphenoid; *As*, alisphenoid; *Bs*, basisphenoid; *Bo*, basioccipital; *Eo*, exoccipital; *Sq. & Pa*, squamo-parietal; *P*, periotic; *T*, tympanic; 2^{*}, optic groove; 7, meatus auditorius internus; *Sc*², superior semicircular canals; *c*, *c*^{*}, condyles.

PLATE XXVI.

Fig. 37. Longitudinal and partly median section of the body, head, &c., of the young male Manatee, $\frac{1}{3}$ nat. size. The ribs are left in position, but dissected so as to show the remarkable relations of the lungs, diaphragm, and viscera generally.

L, L, L, L, L^{*}, the lung resting on *D, D, D, D, D*^{*}, the lengthened horizontal diaphragm; *lsf*, ligamentum subflavum of dorsal vertebræ; *f*, coating fat and skin of the back; *H*, heart; *St*, sternum; *Li*, liver; *Sto*, stomach; *I*, folds of intestine; *B*, urinary bladder; *P*, penis within its sheath; *Rab*, rectus abdominis and cut fleshy wall; *B.c*, bulbous cavernosus muscle; *Icv*, ischio-cavernosus; *Sp.a*, sphincter ani; *A*, anus; *Is.c*, ischio-coccygeus; *Sc+If.c*, sacro-coccygeus and infra-coccygeus, obliquely cut through; *fc*, fibrous caudal expansion with a rim of the skin left; but on the opposite right side the skin has not been removed; *Pl*, pelvic bone; *Pf*, pelvic suspensory fascia; *C.Rete*, the rete mirabile which proceeds to the end of the tail

within the chevron bones; *L.Rete*, lumbar vascular rete shown in part; *Bc*, brain-cavity; *n.ch*, nasal chamber leading by narrow canal to *n*, external narial orifice; *Pmx*, premaxillary bone in section, covered by the fleshy, fibrous snout; *sy*, mental symphysis; *ul*, upper lip (=outer); *up*, upper pad (=inner lip); *ll*, lower lip (=outer); *lp*, lower pad (=inner lip); *bh*, buccal hairs; *T*, tongue; *Eus*, orifice of Eustachian tube; *Sgh*, stylo-glossus and hyoid muscle; a double-headed arrow beneath leads from the fauces to the œsophageal and laryngeal passages, each partially laid open; *la*, cut larynx; *æ*, œsophagus; *Rete &c*, portion of rete cervicale; *J & C*, jugular vein and carotid artery severed; *M & F*, muscle and fat between the fore limbs; *cv*, cervical vertebræ.

Fig. 38. Front segment of the skull, showing the nasal cartilage on the right side, and the open nares, diminutive nasal bone, &c. on the left.

Fr, frontal bone; *Na*, left nasal; *Tu*, turbinals; *O*, right orbit; *nc*, nasal cartilage; *sp*, septal cartilage; *cf*, cartilaginous fissure; *Px*, infraorbital plexus of arteries.

Fig. 39. A transverse section of the tail behind the anal constriction, but in advance of the caudal expansion. It shows:—*c*, centrum of a vertebra, its articulating surface surmounted by the neural arch (*a*) enclosing the spinal cord, which is surrounded by a vascular plexus; *t*, cut surface of transverse process, between which and centrum is another rete mirabile; *ch*, lamina of chevron bone enclosing subcaudal rete; *Lci*, *Lce*, levatores caudæ internus and externus or continuation of the dorsal muscles; *L.c*, lumbo-caudalis; *Sc* and *If.c*, sacro-coccygeus and infra coccygeus, lower tail-muscles; *Sk*, skin, fatty fibro-fatty layer, &c.

Fig. 40. A cross section of the flat expanded tail: *vt*, vertebra; *t'*, levator caudal tendons, and *t''*, depressor caudal tendons surrounding the bone; *f*, fatty and fibrous tissue, containing the open mouths of nourishing vessels; *sk*, skin, its fibroid subdermal layer, covered by a black line representing the derm and cuticular covering.

Fig. 41. A portion of the root end of the lung, with its vessels minutely injected: *B*, bronchus; *bb*, bronchia; *v*, pulmonary vein, and *a*, artery; *l*, lobule.

Fig. 42. The right eyeball, mesially and vertically divided, and posteriorly other orbital contents. Parts about natural size, and from the female Manatee.

O.Rete, orbital vessels; *m*, muscles; *on*, optic nerve; *ion*, infraorbital nerves; *ca*, ciliary artery; *sc*, sclerotic; *cp*, ciliary processes; *l*, lens.

Fig. 43. A transverse section of the same eye behind the ciliary processes and iris.

Fig. 44. A ventral view of the female body eviscerated and dissected, chiefly to show the long tendinous diaphragm and kidney thereupon, the intercostal vascular plexuses, and the lumbo-caudal muscles.

1, 2, 3, 4, 5, 6, the cervical vertebræ; *cc*, costal cartilages of the sternal ribs; *ao*, arch of the aorta; *IcRete*, intercostal rete; *Ii*, internal intercostal muscles; *D, D**, diaphragm of right side, *in situ*; *K*, kidney thereupon; *V*, renal vein; *u*, ureter; *Eo*, posterior termination of external oblique muscle; *Ql*, quadratus lumborum, internal to which portion of lumbar and caudal rete (*C. rete*) is seen; *Sc*, sacro-coccygeus entire on right side, and cut edge on left; *If.c*, infra-coccygeus; *L.cd*, partial view of lumbo-caudalis.

Fig. 45. The uterus, minus ovaries and fimbriæ, seen deeply, or on its dorsal aspect. The parietes are cut open: *Ut*, uterus; *os*, os tinæ; *lc*, left cornu; *R*, rectum; *Rete*, lumbar rete; *Px*, uterine plexus.

Fig. 46. A continuation of fig. 45, displaying the pelvic parts from below the muscles, the retial vessels as they spread out, and part of that which runs under the tail.

L.Rete, lumbar or hypogastric rete; *C.Rete*, caudal rete; *Pl*, pelvic bone; *Rab*, portions of rectus abdominis; *Isc*, ischio-coccygeus; *Pc*, termination of panniculus carnosus; *pn*, nerve piercing the tissues close to pelvis.

Fig. 47. The glans penis in its sheath, or male parts corresponding to those of the female shown in the succeeding figure: *s*, sheath slit open and dragged out; *g*, glans; *mu*, meatus urinarius.

Fig. 48. A reduced sketch of the vulva, the skin and superficial tissues having been removed: *cl*, clitoris; *mu & v*, vulva and meatus urinarius; *Spv*, sphincter vaginae.

Fig. 49. Sketch of the posterior abdominal region in the male, the parietes &c. being removed, and a deep dissection made on the left side. The penis has been cut away near its root; and what remains, along with the bladder, are seen turned backwards.

P, penis, and *pa*, its artery; *B*, bladder; *vd*, vasa deferentia; *Te*, testicle; *H.Rete*, rete mirabile of loins and pelvo-generative region; *r*, tips of three hindmost ribs; *R*, rectum; *K*, kidney; *gl*, gland; *u*, ureter; *v*, vein; *a*, artery; *D*, diaphragm.

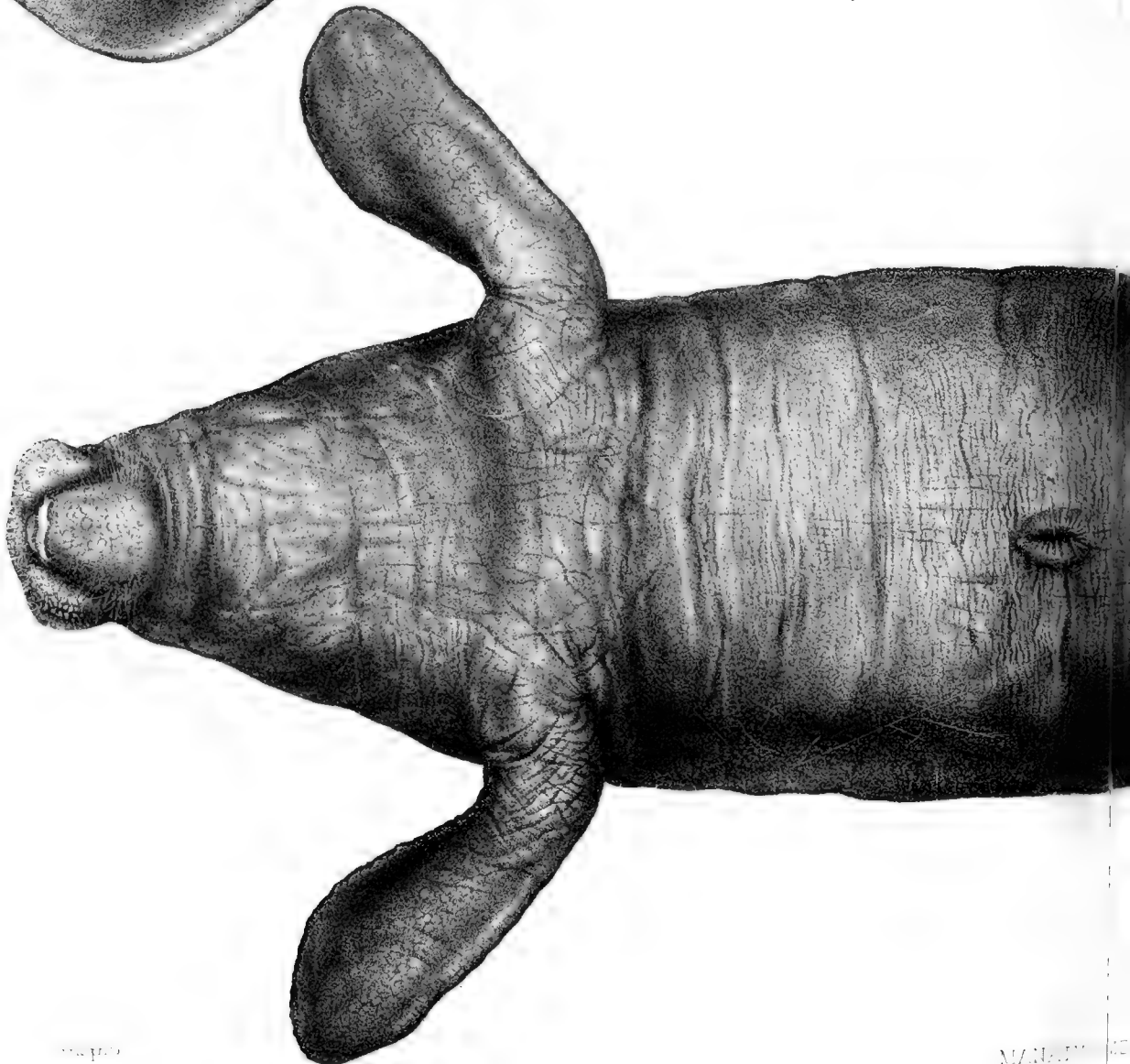
Fig. 50. A dissection of the left moiety of the pelvic region of the female, exhibiting the pelvic bone in place, its muscular attachments, the vast lumbar rete mirabile, and relation of the uterus, kidney, and bladder to each other.

*D, D**, diaphragm; *K*, kidney; *v*, renal vein; *a*, artery; *u*, ureter; *B*, bladder; *V*, vulva; *A*, anus; *R*, rectum; *Pl*, pelvic bone; *c*, cornu; *f*, fimbria; *o*, ovary; *ha*, hypogastric artery; *H.Rete*, hypogastric or lumbar vascular plexus; *Pc, Pc*, panniculus, severed; *Rab, Rab**, rectus abdominis; *Eo*, external oblique; *L.cd*, lumbo-caudalis; *Sc*, sacro-coccygeus; *Is.c*, ischio-coccygeus; *Sp.a*, sphincter ani; *Sp.v*, sphincter vaginae; *L.a*, levator ani; *Tp*, transversus perinaei; *E.c*, erector clitoridis.





Fig. 1.



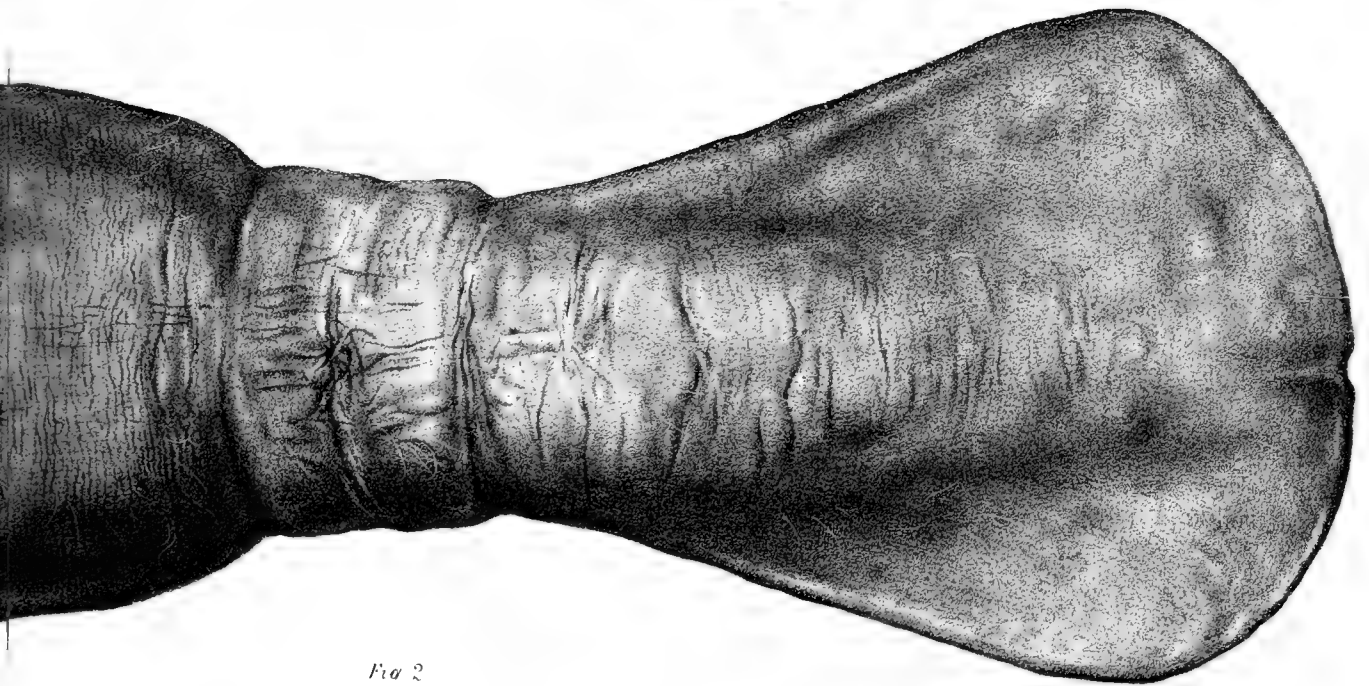
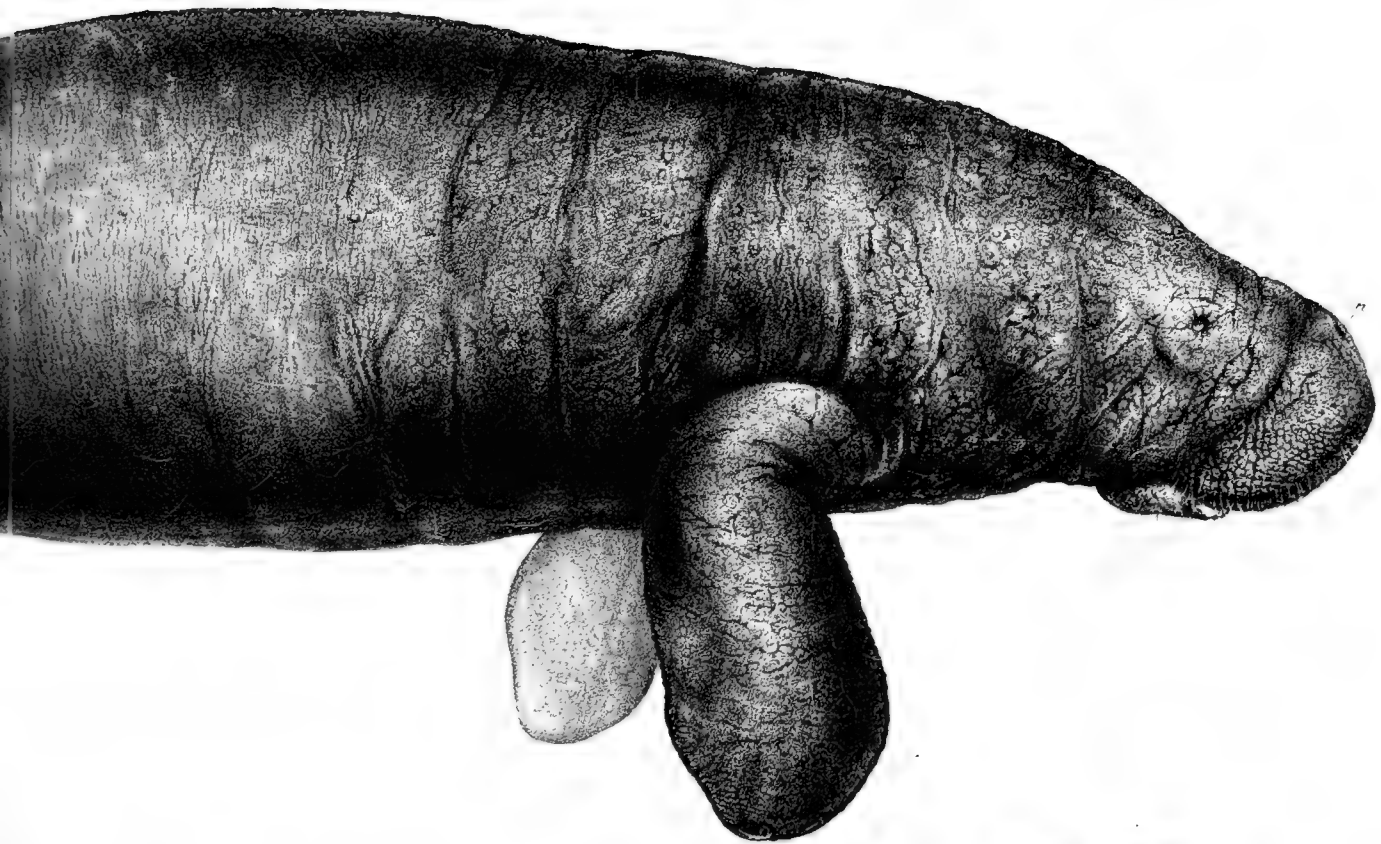


Fig 2



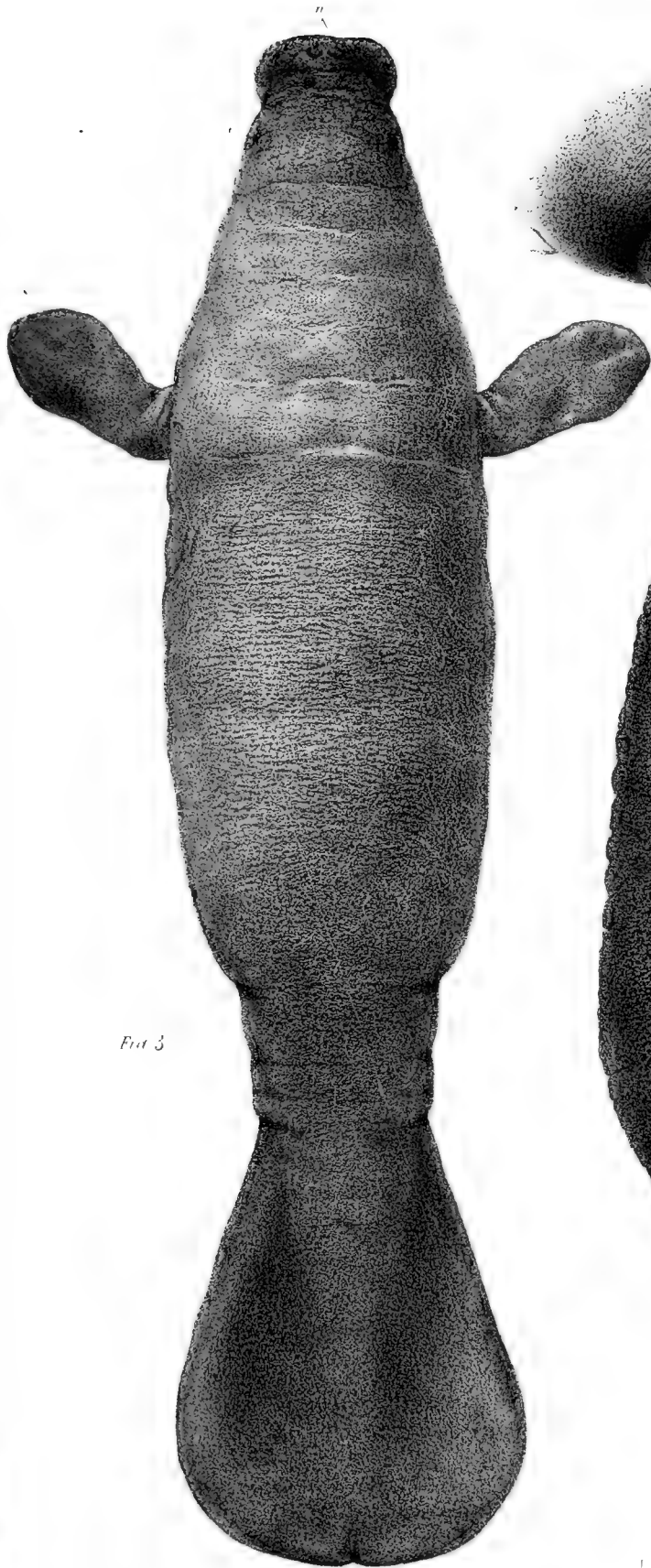


Fig 3



Fig 4

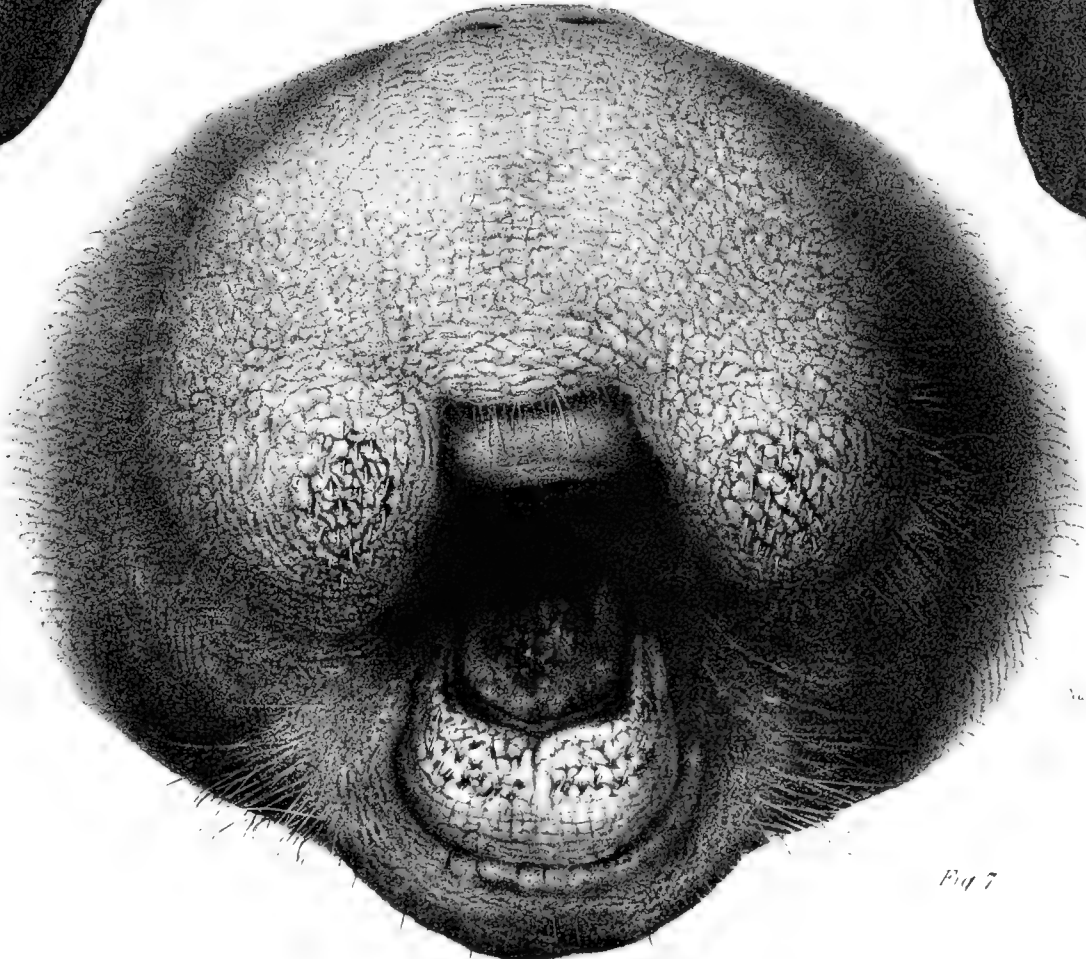
I Snail life







Fig 6



Net Size

Fig 7

J. Murie photo. J. Smit del.





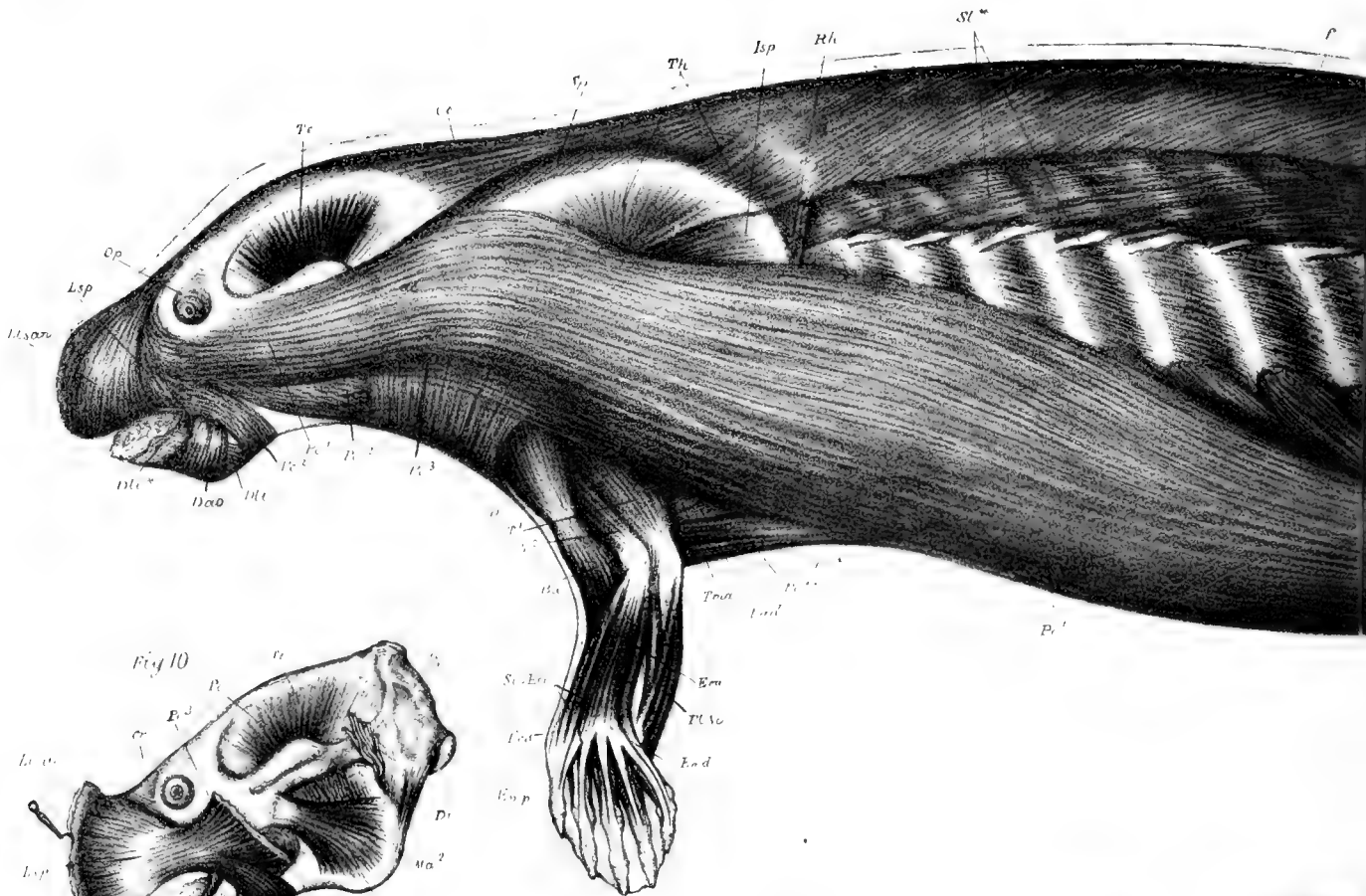


Fig 10

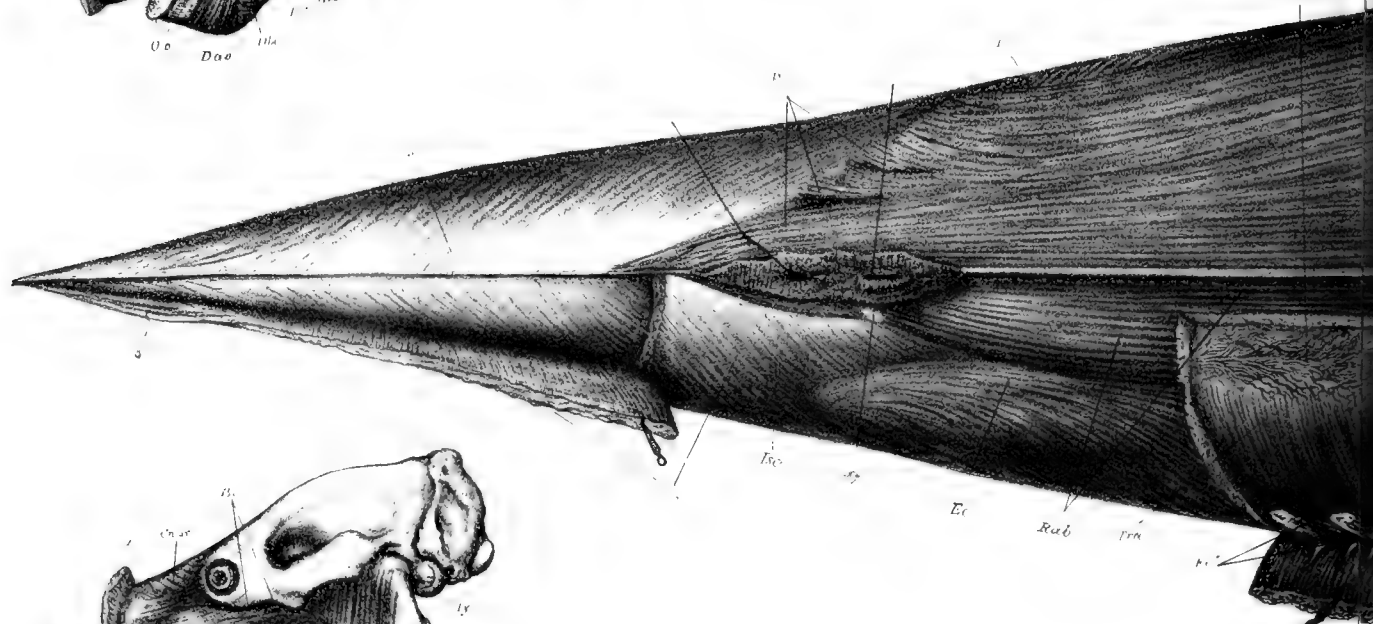
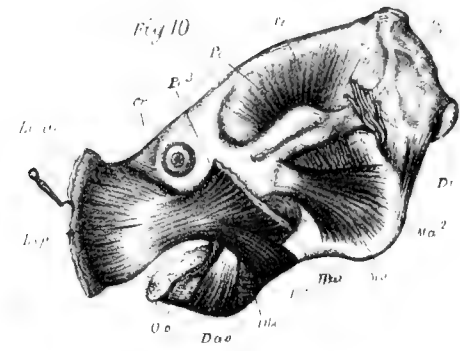
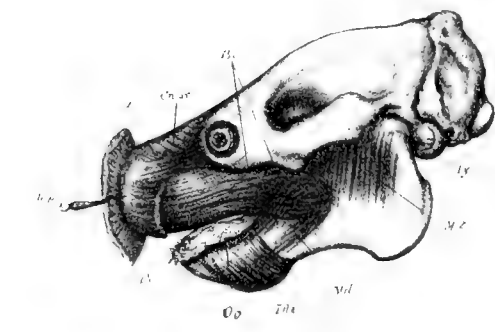


Fig 11



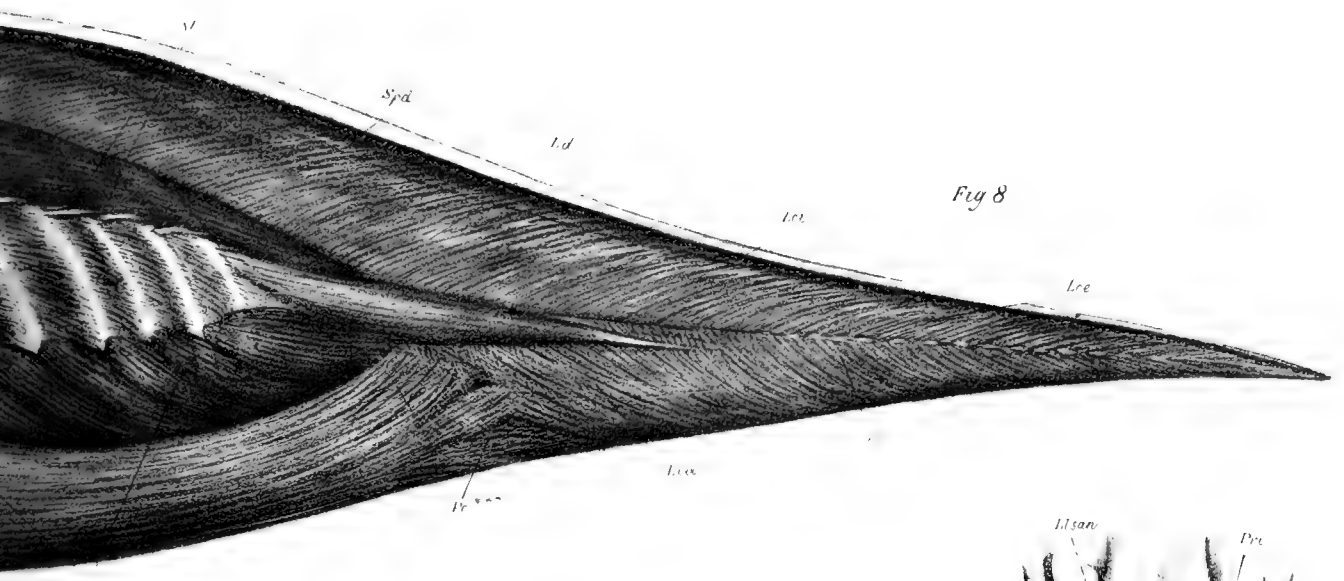


Fig 8

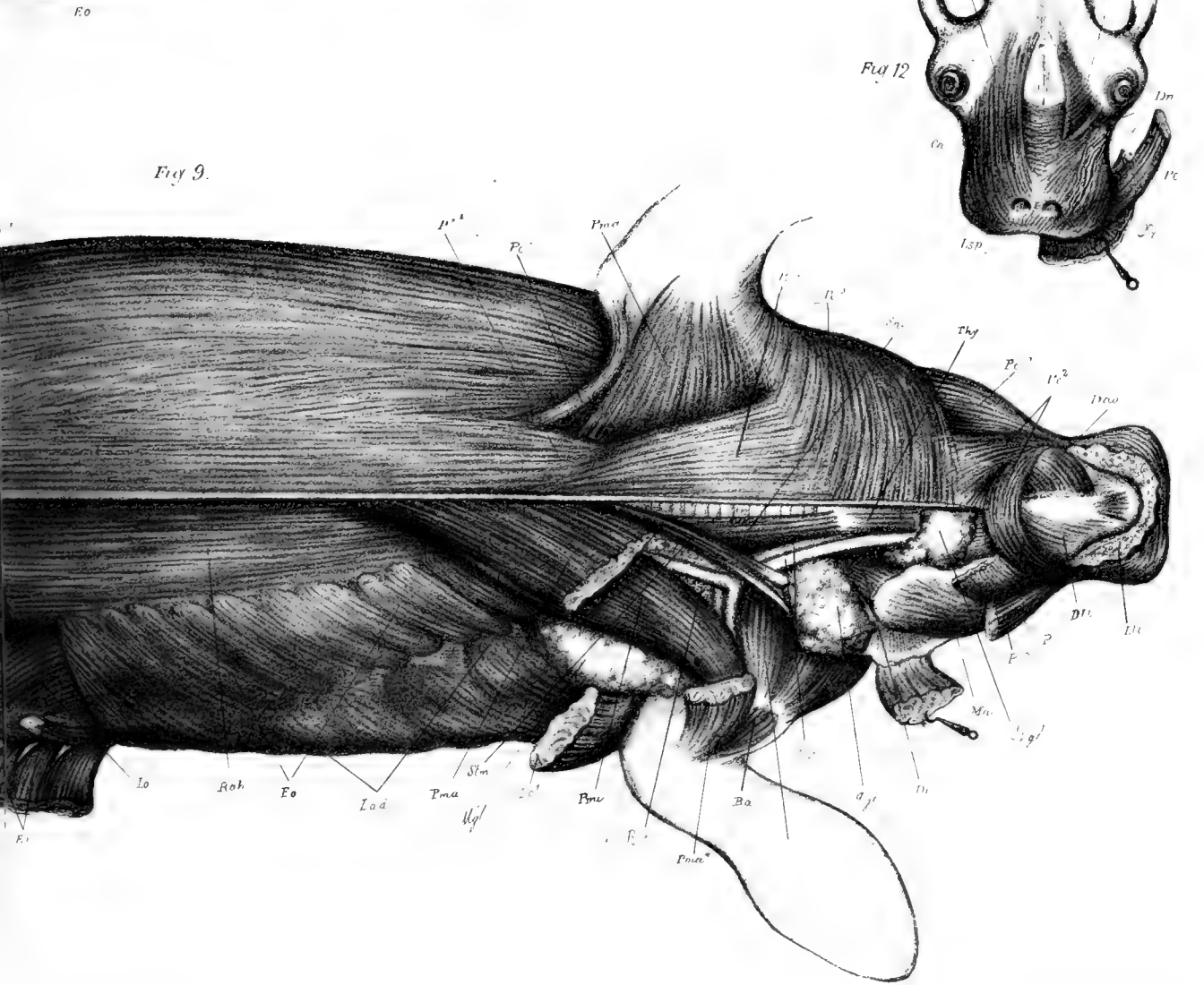


Fig 9

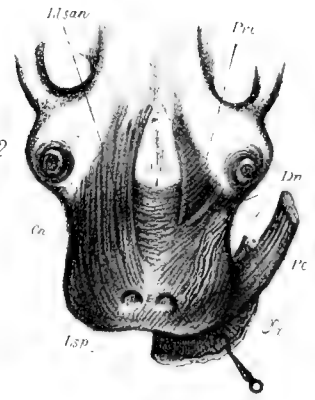
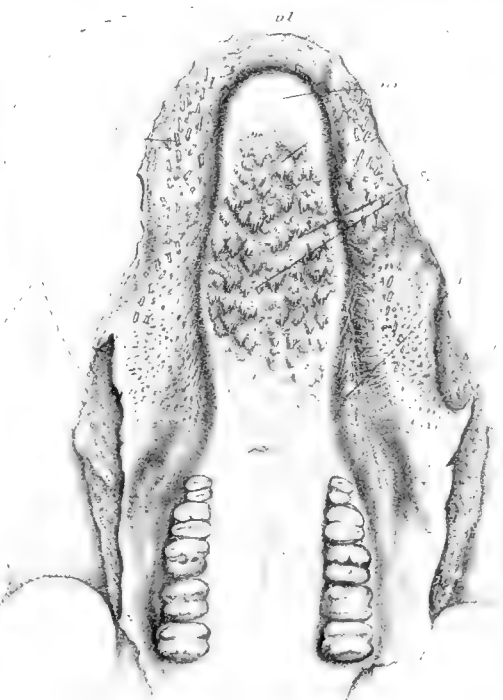
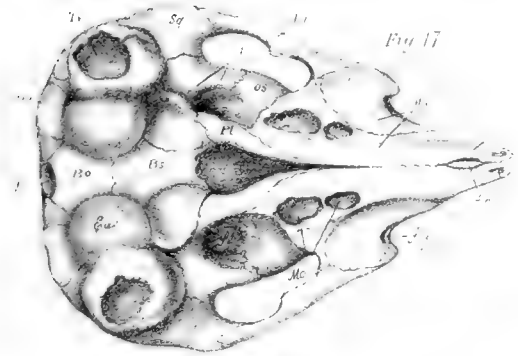
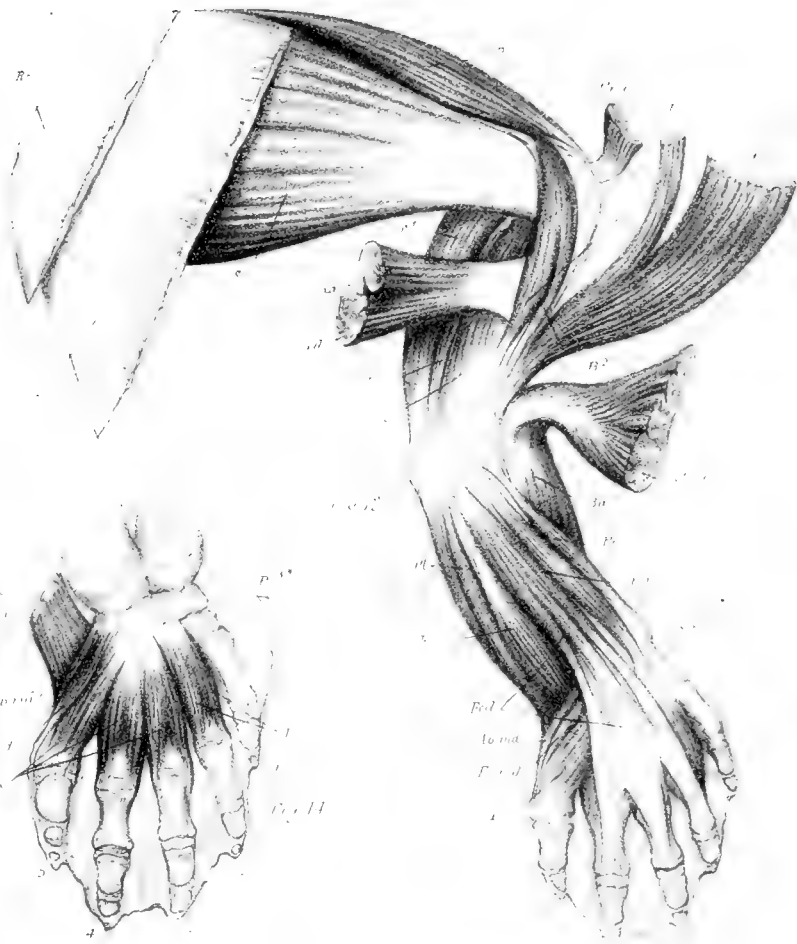


Fig 12







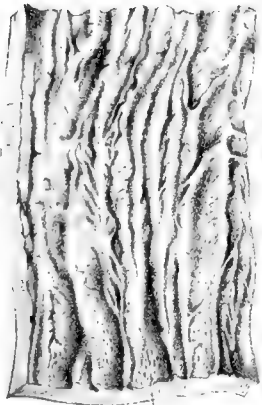


Fig. 27

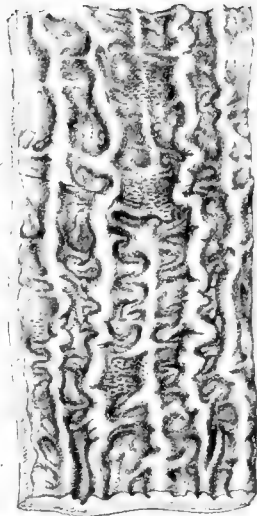


Fig. 28



Fig. 29

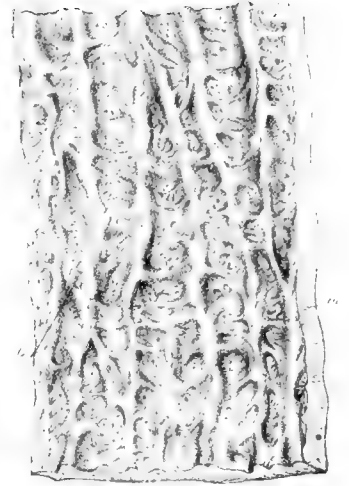


Fig. 30

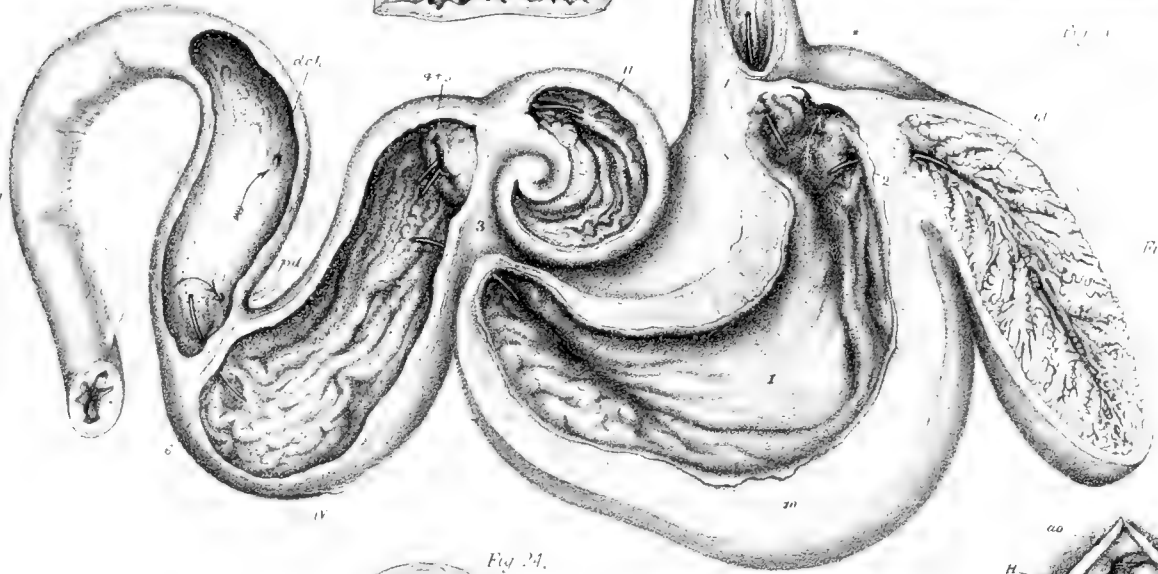


Fig. 19



Fig. 24

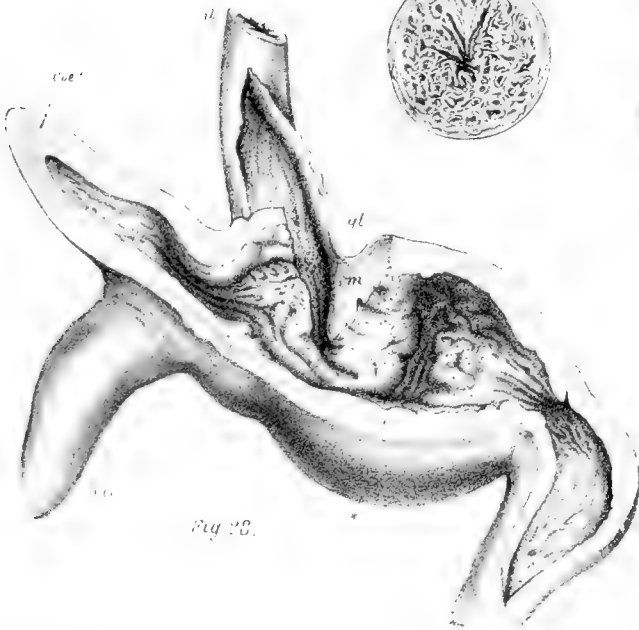


Fig. 25

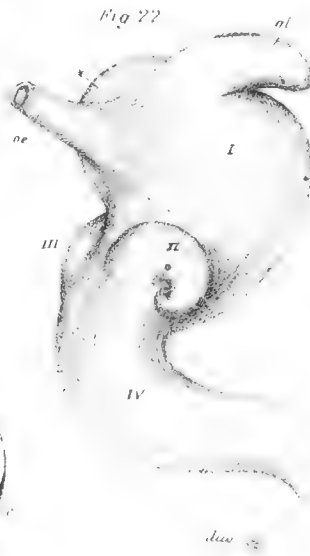


Fig. 27

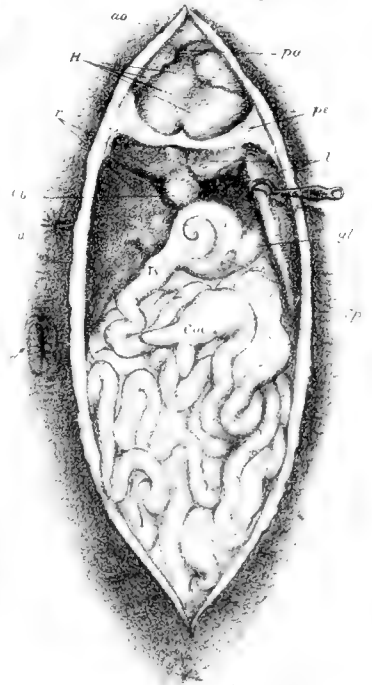


Fig. 20



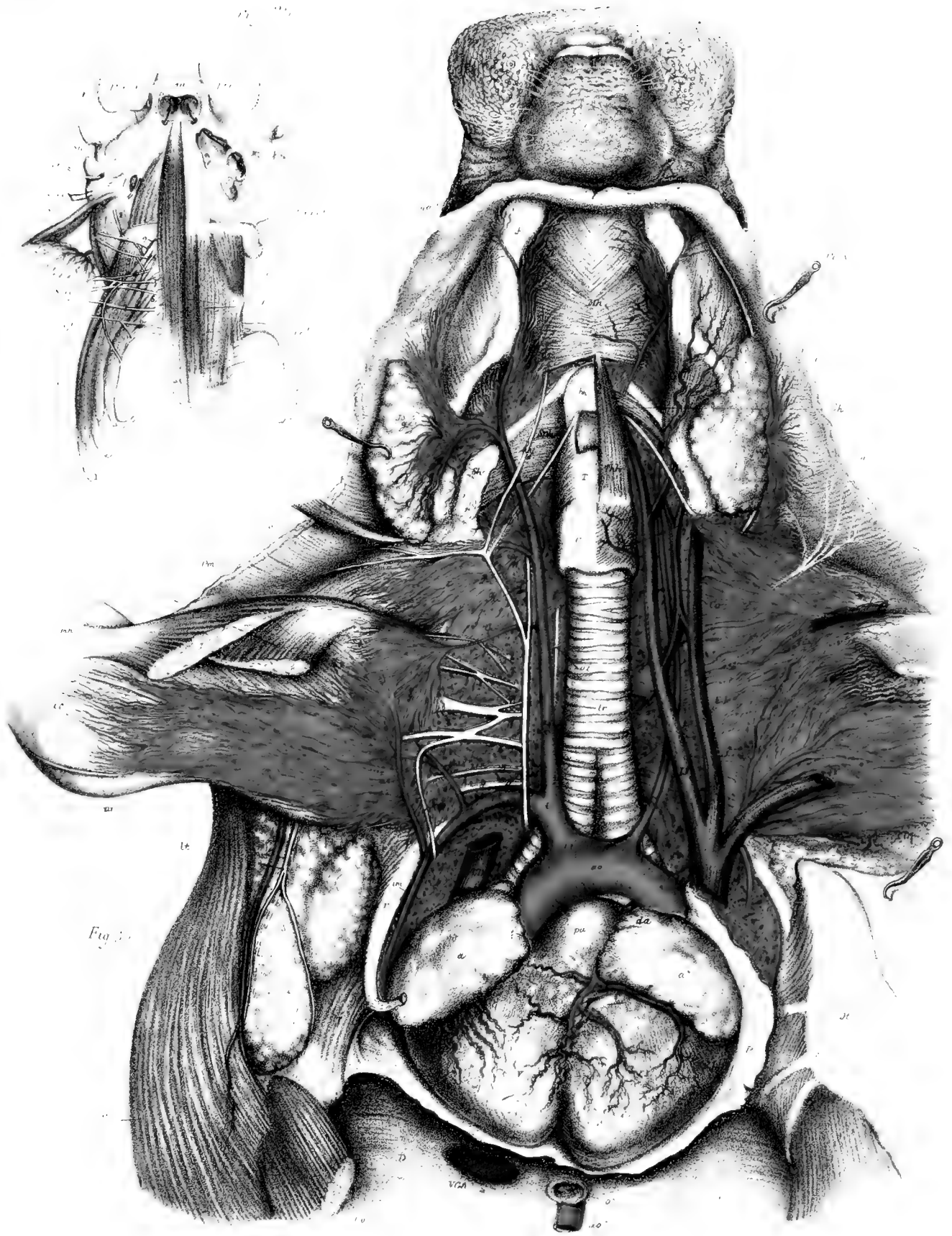


Fig. 3.



Fig. 35

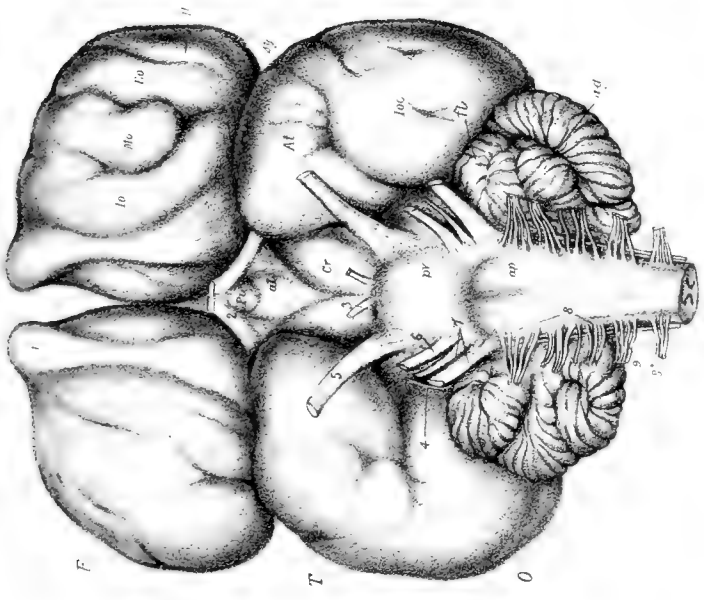


Fig. 30

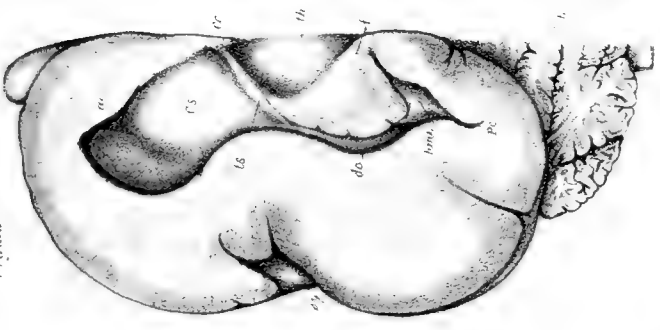


Fig. 27

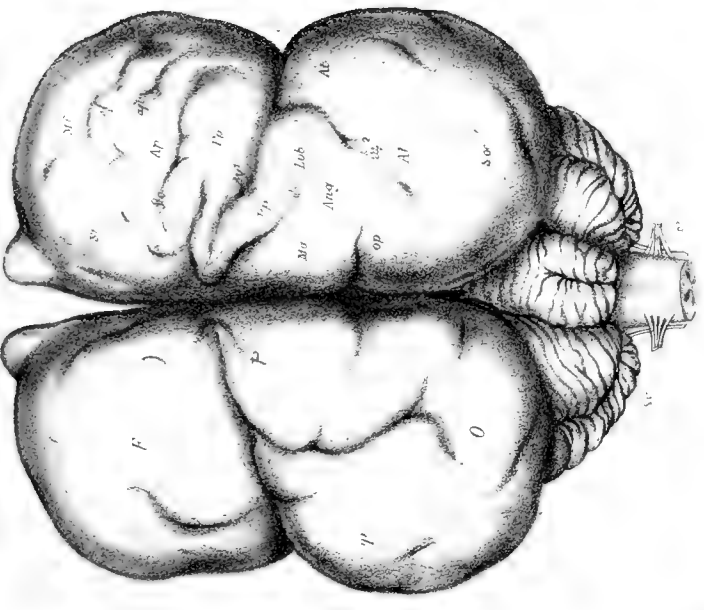


Fig. 34

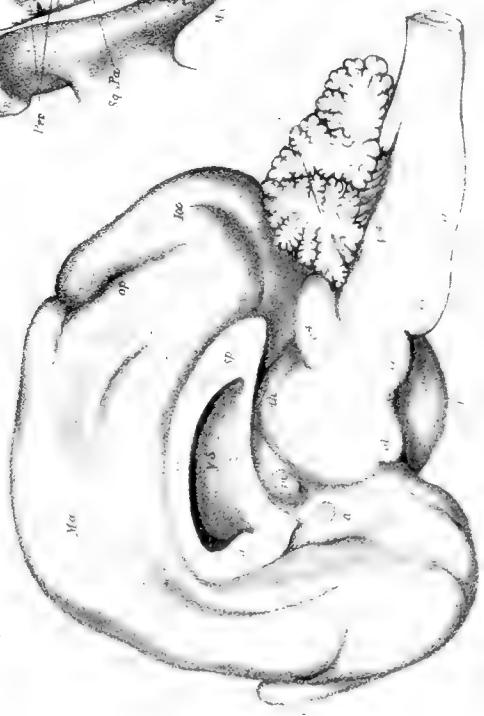


Fig. 36

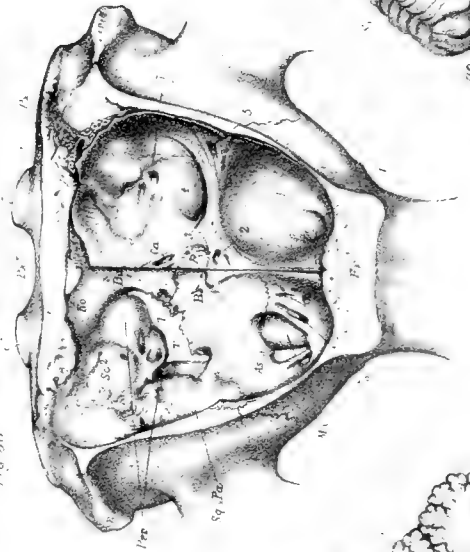
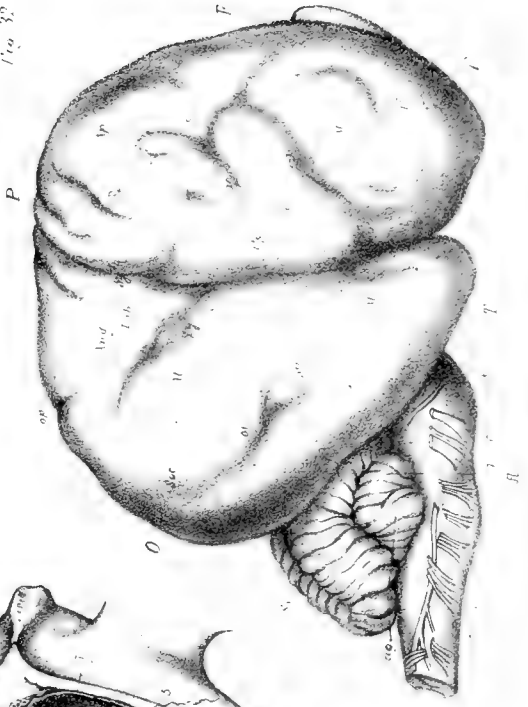


Fig. 32



torpax alb.





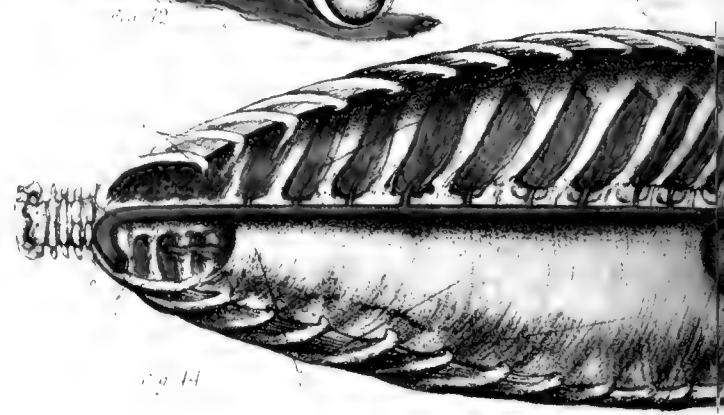
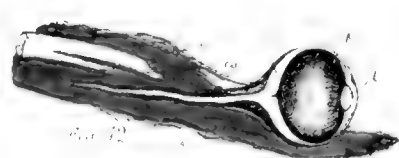
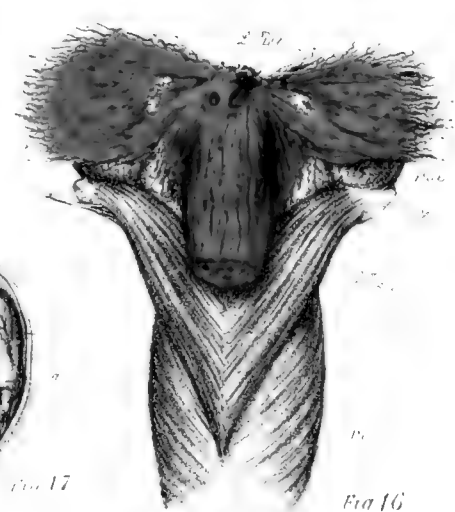
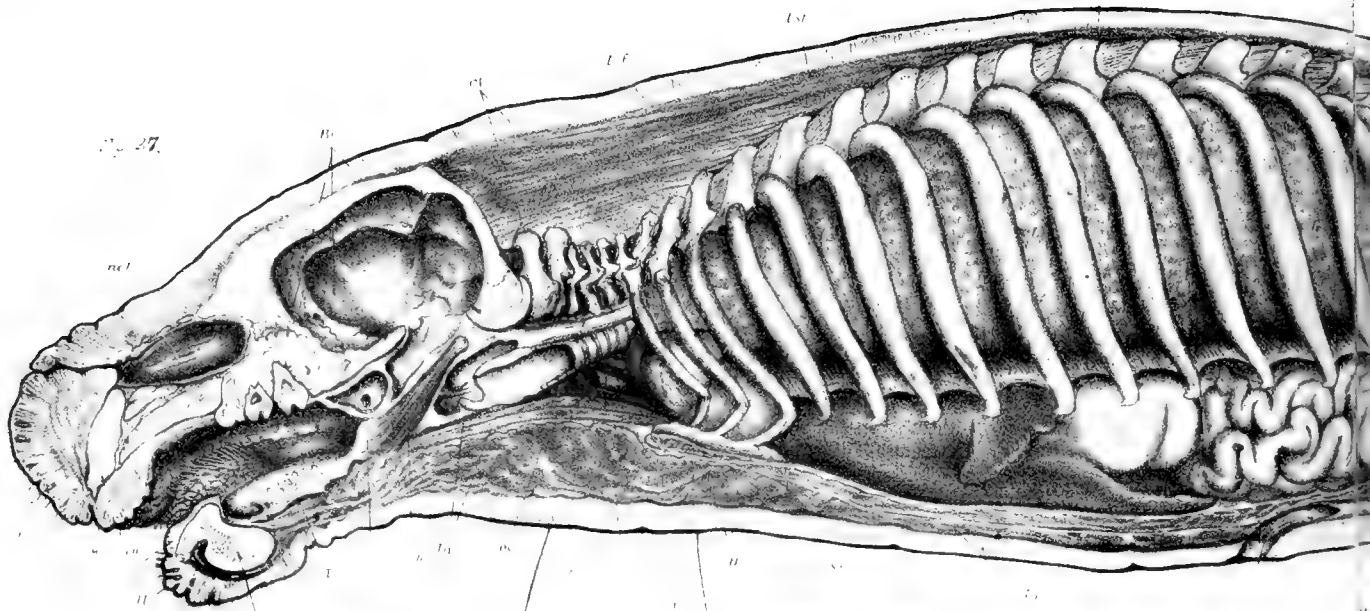


Fig. 40

Fig 40

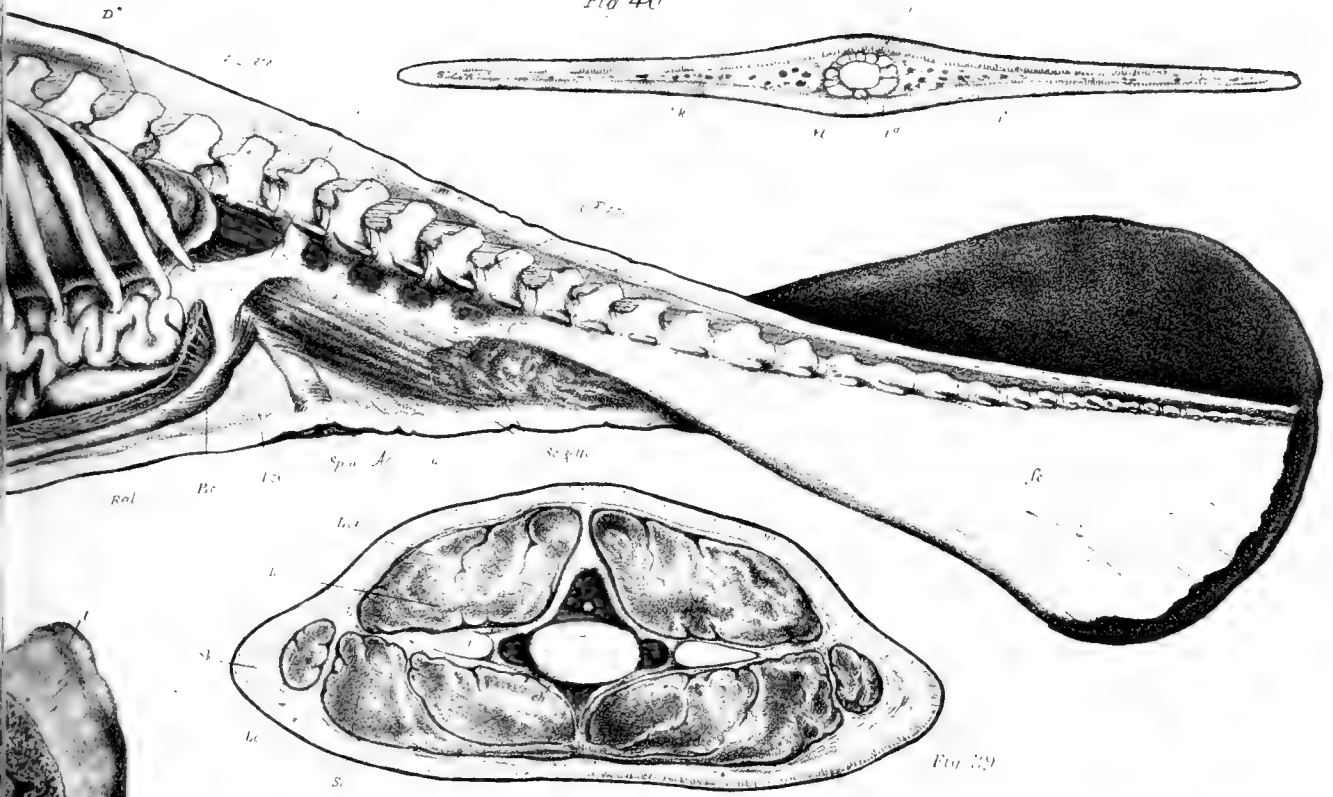


Fig 39

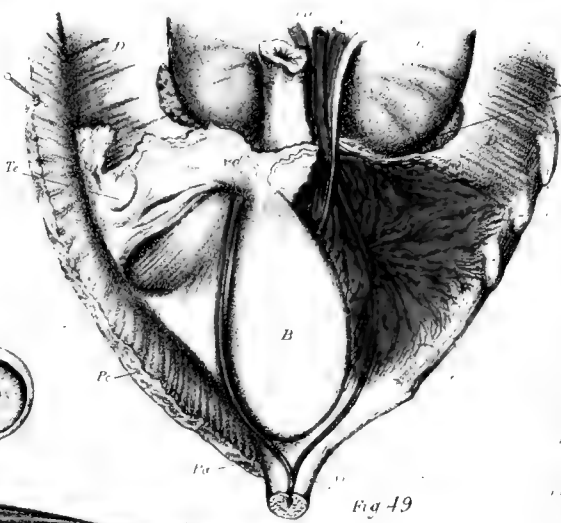


Fig 49

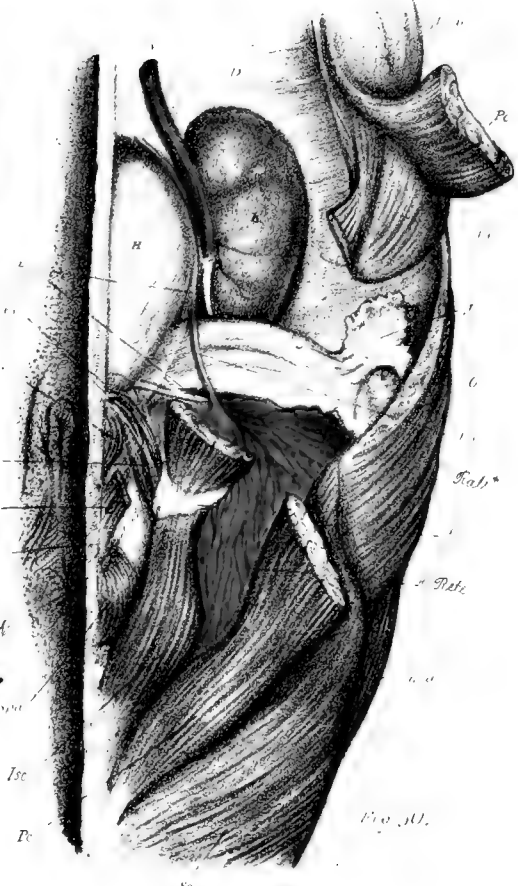
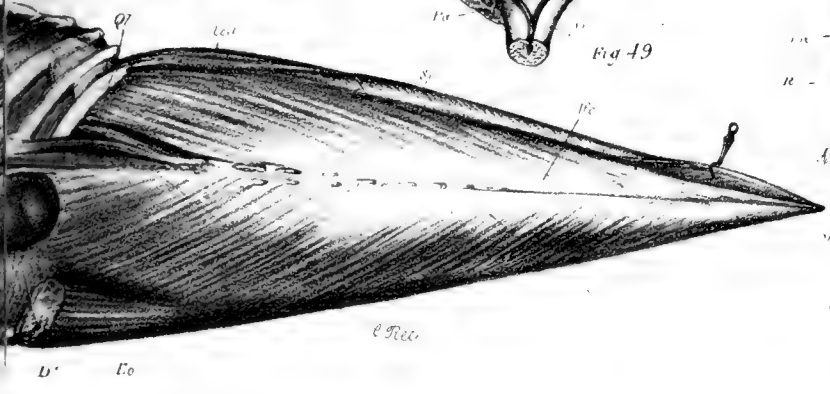


Fig 50

Fig 43





VI. *On the recent Ziphioid Whales, with a Description of the Skeleton of Berardius arnouxi.* By WILLIAM HENRY FLOWER, F.R.S., V.P.Z.S., Hunterian Professor of Comparative Anatomy, and Conservator of the Museum of the Royal College of Surgeons.

Read November 7th, 1871.

[PLATES XXVII., XXVIII., XXIX.]

THE interest which attaches itself to the remarkable division of the Cetacea which forms the subject of the present communication, is in some respects even greater than that which belongs to all the other members of the order.

The Ziphioid Whales form a very compact group, closely united together by the common possession of very definite structural characters, and as distinctly separated from all other groups by equally definite characters.

With the singular exception of *Hyperoodon rostratus* (the structure and habits of which species are as well known perhaps as those of any other Cetacean), no specimen of the group had ever come under the notice of any naturalist up to the commencement of the present century. Since that time, however, at irregular intervals, in various and most distant parts of the world, solitary individuals have been caught or stranded, now amounting to about thirty, which by some naturalists are referred to upwards of a dozen distinct species, and to very nearly as many genera. No case is recorded of more than one of these animals having been observed in one place at a time; and their habits are almost absolutely unknown. Their very presence in the ocean seems to pass unnoticed and unsuspected by voyagers, and even by those whose special occupation is the pursuit and capture of various better known and more abundant cetaceans, until one of the accidental occurrences just alluded to reveals the existence of forms of animal life of considerable magnitude (for they range between fifteen and thirty feet in length), and at least sufficiently numerous to maintain the continuity of the race.

This comparative rarity at the present epoch contrasts greatly with what once obtained on the earth, especially in the period of the deposition of the Crag formations, and leads to the belief that the existing Ziphioids are the survivors of an ancient family which once played a far more important part than now among the Cetacean inhabitants of the ocean, but which have been gradually replaced by other forms, and are themselves probably destined ere long to share the fate of their once numerous allies or progenitors.

These considerations are sufficient to lead to the endeavour to collect all available information with regard to them, and to put it in a convenient form for the guidance of those who may have opportunities to pursue their history further. Doubtless such

opportunities will become more and more frequent as the attention of naturalists in various parts of the world is directed to the importance of never omitting any chance of observing and, if possible, securing the remains of every specimen of the group that may come within his reach.

The Ziphioid¹ Cetaceans belong to the great primary division or suborder of the Odontocetes, or Toothed Whales. The following are their principal common characteristics, as far as they can be defined in the absence of sufficient knowledge of the structural characters of several forms:—

1. No functional teeth in the upper jaw.
2. Teeth of mandible quite rudimentary and concealed in the gum, with the exception of one, or occasionally two, pairs, which may be largely developed, and project like tusks from the mouth, especially in the male sex.
3. Bones of the cranium raised so as to form an elevated prominence or crest behind the nares.
4. Rostrum long and narrow.
5. Pterygoid bones very large and solid, produced backwards, meeting in the middle line, and not involuted but simply hollowed on the outer surface.
6. A distinct bone in the orbit, segmented from the posterior part of the malar, and probably the homologue of the lachrymal.
7. The tympano-periotic bone fixed to the cranium by a posterior, long, wedge-shaped (mastoid?) process lying in a groove between the exoccipital and the squamosal.
8. Number of vertebræ not exceeding 50; ribs not exceeding 10 pairs.
9. Transverse processes of arches of dorsal vertebræ ceasing abruptly near the end of the series, and replaced by processes on the body at a much lower level, and which are in a line (or serially homologous) with the lumbar transverse processes.
10. Spines of dorsal and lumbar vertebræ very long, transverse processes short, bodies of posterior lumbar and anterior caudal vertebræ much elongated.
11. Sternal ribs permanently cartilaginous.
12. Pectoral limbs small, with a rounded extremity. The five digits all moderately well developed.
13. A small subfalcate dorsal fin, situated considerably behind the middle of the back.
14. External respiratory aperture a single, transverse, median, subcrescentic opening.
15. A pair of longitudinal cutaneous furrows on the throat, nearly meeting in the middle line in front, and diverging posteriorly.

By the majority of the above characters, and all the more important ones, as Nos. 1,

¹ According to strict rules of priority, "Hyperoodontoid" would be the more correct term, as *Hyperoodon* was the first genus of the group distinctly characterized; but as the name is erroneous in its signification, and not hitherto used, I have thought it better to keep to the more generally adopted and less objectionable term of "Ziphioid" first applied by Gervais to the animals allied to the Cuvierian genus *Ziphius*. They constitute Eschricht's *Rhynchoceti*.

3, 5, 7, 9, 11, and 12, they differ from the typical Dolphins and agree with the Cachalots; and though they are separated from the latter by certain definite characters, as Nos. 2 and 6, and others of less importance, there is no doubt that the group of which *Physeter* is the type and that which includes *Ziphius* and its immediate allies are closely related, and should be considered subdivisions of one great division which excludes all the other Odontocetes. Perhaps it is most convenient to treat them as subfamilies of a common family *Physeteridæ*, taking its name from the earliest characterized genus *Physeter* (Linn.), and, according to the convenient nomenclature rules of the British Association Committee, to call one *Physeterinae* and the other *Ziphiinae*¹; though some zoologists may prefer to raise both to the rank of families.

Among the restricted Delphinidæ no genus is known which appears to form any true transition towards the Physeteridæ; but the strange and aberrant genera *Platanista*, *Inia*, and *Pontoporia*, which cannot be placed in either of the two principal families of the Odontocetes, and yet have scarcely sufficient common characters to constitute a group apart, do in some few respects fill up the otherwise wide intermediate space².

The excessively confused synonymy of the genera and species of the Ziphiinae, as thus defined, is a cause of great difficulty in writing about this group, and makes one almost hesitate to enter upon the subject, lest in endeavouring to clear up the confusion the perplexity should be inadvertently increased, either by adding new synonyms or by adopting and perpetuating ill-chosen and incorrect terms.

In a recent memoir on the group by Professor Owen³, the difficulty is disposed of in a very summary manner by uniting all the known forms, both living and extinct (with the exception of *Hyperoodon*), under the generic name of *Ziphius*. This proceeding at all events has the merit of running no risk of adding to the confusion of nomenclature which has been caused by hasty or ill-defined generic subdivisions, often founded on imperfect or fragmentary knowledge of the animal described. But, however great our admiration may be for this strong-handed resistance to the system of name-coining, which is fast rendering the study of zoology almost an impossibility, it must not lead us to overlook well-marked structural characteristics by which certain small groups of species are allied together and differentiated from others, whether we call them genera or by any other term. The question now is, can the genus *Ziphius*, as understood by Owen, be divided into any such groups?

¹ This is the arrangement adopted in the sketch of the classification of the Cetacea given in Trans. Zool. Soc. vol. vi. p. 113.

² In the attempt at a natural classification of the Cetacea just referred to, I had provisionally grouped these genera into a single family, between the Physeteridæ and the Delphinidæ; but the details of the anatomy of *Pontoporia*, first made known in the valuable monograph of Dr. Burmeister, published in the 'Anales del Museo Publico de Buenos Aires,' vol. i. pp. 389-442 (1869), show that this family can scarcely be retained, without at least considerable modification of the characters assigned to it. The only alternative seems to be to make of each of these three genera a distinct family.

³ "British Fossil Cetacea from the Red Crag," Palæontographical Society's vol. xxiii. (1870).

It must be premised that as far as is at present known, putting aside the peculiar rounded form of the head in *Hyperoodon*, the external characters of the various known Ziphiiinæ afford no grounds for generic subdivision. It is to the skeleton and the teeth that we must look in examining whether the group is truly homogeneous or not; and it is only very recently that complete skeletons of a sufficient number of individuals have been known, to attempt a comparison between them. The teeth have been relied upon almost entirely; and I agree with Professor Owen that the trifling differences in the situation of the developed teeth are not such as, unless accompanied by other more important and constant characters, are sufficient for generic distinction; but, at the same time, if such differences are constantly associated with others, they may be useful guides to classification.

HYPEROODON (Lacépède) appears to differ from all the other Ziphiiinæ in the characters of the cervical vertebræ, especially in their great antero-posterior compression, the constant ankylosis of all seven, and the absence of inferior transverse processes in the third, fourth, fifth, and sixth¹; it has also only nine pairs of ribs, and but forty-five vertebræ in all². In the more essential characters of the cranium it resembles one of the other sections to be spoken of presently (*Mesoplodon*), with the superaddition of the great maxillary crests; and in the dentition it resembles more nearly another section (*Ziphius*).

Having separated *Hyperoodon*, the remaining known members of the subfamily agree in having a comparatively well-developed cervical region, with certain of the posterior vertebræ (one, or usually more) permanently detached, and with distinct inferior transverse processes as far as the sixth, in having almost always ten pairs of ribs³ and at least forty-six vertebræ, usually forty-eight or forty-nine. There are, however, in the conformation of the skull and the form and situation of the teeth considerable differences, by which they may be divided into three distinct sections, which appear to me to be natural, and which are not, as far as is yet known, united by intermediate forms; so I think that they may well be considered generic, though of course this is a subject upon which the judgment of zoologists may differ. I can see no grounds at present for any further subdivision.

These sections may be characterized as follows—though the distinctive peculiarities are more readily appreciated by an inspection of a specimen than they can be expressed in words.

¹ The great differences between the cervical vertebræ of *Hyperoodon* and *Ziphius cavirostris* (erroneously called *Hyperoodon gervaisii*) were pointed out by Duvernoy (*Annales des Sciences Naturelles*, 1851, p. 24).

² The animal described by Cope, apparently without personal examination, as *Hyperoodon semijunctus* (*Proc. Acad. Nat. Sc. Philadelphia*, 1865, p. 280), and stated to be in the Charleston Museum, is evidently not a *Hyperoodon*, but most probably a true *Ziphius*. It was but between twelve and thirteen feet long, has the four posterior cervical vertebræ free, has ten pairs of ribs, and two more vertebræ than *Hyperoodon*.

³ The skeleton of *Ziphius cavirostris* at Jena has but nine pairs of ribs.

ZIPHIUS, Cuvier¹.

Skull with the præmaxillæ immediately in front and at the sides of the nares expanded, hollowed, and with elevated lateral margins, the posterior ends rising to the vertex and curving forwards, the right being considerably more developed than the left; the conjoined nasals forming a strongly pronounced asymmetrical eminence at the top of the cranium, projecting forwards over the nares, flat above, most prominent and rounded in the middle line in front, and separated by a notch on each side from the præmaxillæ. Anteorbital notch not distinct. Rostrum (seen from above) triangular, gradually tapering from the base to the apex, upper and outer edges of maxillæ at base of rostrum raised into low roughed tuberosities. Mesethmoid cartilage usually densely ossified, and coalescing with the surrounding bones of the rostrum.

A single conical tooth of moderate size on each side of the mandible, close to the anterior extremity, with its apex directed forwards and upwards.

The type of this genus is *Ziphius cavirostris*, Cuvier, founded on an imperfect skull picked up in 1804 on the Mediterranean coast of France, near Fos, Bouches-du-Rhône. and described and figured in the 'Ossemens Fossiles'², under the impression that it was that of an extinct species, a view which Gervais has clearly shown to have been erroneous. This is *Petrorhynchus mediterraneus* of Gray's Suppl. Cat. Seals and Whales in British Museum, 1871, p. 98.

A second specimen was taken on the coast of Corsica: its external characters are described and figured by Doumet in the 'Revue Zoologique,' v. 1842, pp. 207, 208; and its skeleton is preserved at Cette³.

A third specimen was stranded near Aresquiers, Hérault, South France, in 1850. The skull, which is preserved in the Paris Museum, is described by Gervais (Annales des Sciences Nat. 3^e sér. tome xiv. 1850). This is the *Hyperoodon gervaisii* of Duvernoy (Annales des Sc. Nat. 1851), *Ziphius gervaisii* of Fischer, and *Epiodon desmarestii* of Gray's Catalogue⁴.

A fourth is a skull in the Museum of Arcachon. It was found on the beach at Lanton, Gironde, West France, in 1864, and is very carefully described and figured by Fischer in the 'Nouvelles Archives du Muséum,' tome iii. 1867, p. 42, pl. 4⁵.

5. A complete skeleton of a very old animal in the Anatomical Museum of the University of Jena. This was obtained at Villa Franca in 1867, by Professor Haeckel, but has not yet been described.

¹ "J'appliquerai au genre dont elle [skull of *Z. cavirostris*] devient le premier type, le nom de *Ziphius*, employé par quelques auteurs du moyen âge (voyez Gesner, i. p. 209) pour un Cétacé qu'ils n'ont point déterminé."—CUVIER, *Ossemens Fossiles*.

² This skull is also figured in Van Beneden and Gervais's 'Ostéographie des Cétacés,' pl. 21. fig. 7.

³ Figured in Van Beneden and Gervais, *op. cit.* pl. 21. figs. 8, 9.

⁴ Figured in Van Beneden and Gervais, *op. cit.* pl. 21. figs. 1-6.

⁵ Figured in Van Beneden and Gervais, *op. cit.* pl. 21. fig. 6.

6. A skeleton in the Museum at Gottenburg. From Gullmarsfjärden, on the Swedish coast, north of Gottenburg, 1867 (*vide* Malm, "Hvaldjur i Sveriges Museer ar 1869." Kongl. Svenska Vetenskaps Akademiens Handlingar, Band 2. no. 2. 1871).

7. A skull in the Anatomical Museum, Edinburgh, obtained from Shetland, 1871.

8. A skeleton in the Museum at Pisa from the Mediterranean. Professor Gervais has informed me of this specimen, which has not been described.

9. In the Museum of the University of Louvain is a skull of an animal of this genus brought from the Cape of Good Hope, of which an excellent description has been published by Professor Van Beneden, under the name of *Ziphius indicus* (Mém. de l'Acad. Roy. de Belgique, coll. in-8vo, tome xvi. 1863¹).

10. A very similar skull in the British Museum, also from the Cape of Good Hope, has been described by Gray (Proc. Zool. Soc. 1865, p. 524) under the name of *Petro-rhynchus capensis*; and the same name is retained in the Suppl. Cat. Seals and Whales (1871), p. 98, although its specific identity with the last-named previously described specimen is admitted. It is further described by Owen (Crag Cetacea, Palæont. Soc. 1870, p. 7)².

11. A complete specimen of a young male, 3·95 metres long, was taken near Buenos Ayres in 1865, and is the subject of an elaborate memoir by Burmeister (Anales del Museo publico de Buenos Aires, vol. i. p. 312, 1869), accompanied by detailed figures of external characters, skeleton, and some of the viscera. The specimen was first named in a preliminary notice (Ann. & Mag. Nat. Hist. 1866, xvii. p. 94) *Ziphiorhynchus cryptodon*, but described subsequently as *Epiodon australis*.

Until more abundant materials are obtained, and especially a complete knowledge of the external characters or entire skeleton of several individuals, it is impossible to determine whether the differences that have been noticed in the above specimens are the results of age, sex, individual peculiarity, or whether they denote specific distinctions. For the present it may be advisable to admit *Z. cavirostris* (Nos. 1, 2, 3, 4, 5, 6, 7, and 8) and *Z. indicus* (Nos. 9 and 10) as species; but with reference to No. 11, it is not improbable that it is the young of one of the others. It should be remarked that Fischer, after a careful comparison, arrives at the conclusion that No. 3 is specifically distinct from *Z. cavirostris*, although not agreeing with Duvernoy's opinion that it should be placed in the genus *Hyperoodon*.

MESOPLONDON³, Gervais.

Præmaxillæ not greatly expanded and hollowed in front of the nares, rising suddenly

¹ Figured in Van Beneden and Gervais's 'Ostéographie des Cétacés,' pl. 21. figs. 11-13.

² Figured in Van Beneden and Gervais, *op. cit.* pl. 21. fig. 10.

³ There is much difficulty in determining the most appropriate name for this genus. The earliest known specimen was assigned by its discoverer Sowerby to *Physeter*, from which, however, it is clearly distinct. In the classification of the Dolphins furnished by De Blainville to Desmarest's article "Dauphin" in the 'Nouveau

on the sides of the nares to the vertex, where they are dilated laterally, the right one especially, the outer edges curving backwards, their anterior surface arching forwards above, overhanging the nares. Nasals lying, more or less sunken, in a hollow between the upper ends of the præmaxillæ; their anterior surface more or less concave, not projecting so far forward as the upper part of the præmaxillæ, and not separated on each side from those bones by a distinct notch. Anteorbital notch not very distinct. Rostrum long and narrow. No maxillary tuberosities. Mesethmoid generally ossified in its entire length, and coalescing with the surrounding bones.

A much compressed pointed tooth in each ramus of the mandible, variously situated, but generally at some distance behind the apex; its point directed upwards, and often somewhat backwards, occasionally developed to a great size (in the males?).

Dictionnaire d'Histoire Naturelle, 2nd edit. Paris, 1817, the subgenus *Heterodon* comprises eight species, of which five (*D. grænlandicus*, *chemnitzianus*, *edentatus*, *bidentatus*, and *butskode*) are synonyms of *Hyperoodon rostratus*, one (*D. epiodon*) an ill-described species from the Mediterranean, perhaps a true *Ziphius*, and two (*D. sowerbensis* and *D. densirostris*), undoubtedly belong to the section at present under consideration, being founded on the only specimens at that time known to naturalists. It is clear, therefore, that Blainville's *Heterodon* is equivalent to the present section, plus *Hyperoodon*; and the latter being removed, the name might very well have been retained for the remainder, if it had not been previously in use for a genus of snakes. *Heterodon* is employed in the same sense as by De Blainville for a subgenus in Desmarest's 'Mammalogie,' pt. 2. 1822, and as a genus in Lesson's 'Manuel de Mammalogie,' 1827. The specimen taken at Havre in 1825, apparently a female of Sowerby's Dolphin, supposed by its first describer, De Blainville, to be of the same species as the Dolphin described by Dale (now considered a *Hyperoodon*), was named by Cuvier *Delphinus micropterus*, and forms the type of the genus *Delphinorhynchus* of F. Cuvier's 'Histoire des Cétacés' (1836), being associated with several other Dolphins of very different structure and even belonging to different families. But *Delphinorhynchus* had been previously used by Blainville, in the article above cited, for a heterogeneous group of Dolphins, among which none of the present genus appears; so that it is perfectly inadmissible. The term *Diodon*, proposed by Lesson for the male, was already in general use for a genus of fish. *Aodon* (Lesson, Compl. de Buffon), changed to *Nodus* (Wagler, Syst. de Amph. 1830), likewise proposed for the female, being positively erroneous in signification, have never been generally received. Wagner (Schreber, Supplement, p. 352, 1846) constituted *Micropterus* as a subgenus of *Delphinus*, for the then known animals of the group, uniting them into a single species, but overlooking the fact that the name had already been given to more than one genus in the animal kingdom. Eschricht, however, adopted it in a generic sense (Nordische Wallthiere, p. 50, 1849), altering the spelling to *Micropteron*, in which form it has been used by Huxley (Proc. Geol. Soc. 1864, p. 388). In 1850 Gervais (Annales des Sciences Naturelles, 3^e sér. tom. xiv.) divided the group (as defined above), though, as appears to me, on very insufficient grounds, into two genera, which he named *Mesopiodon* and *Diopiodon*, Blainville's *Heterodon sowerbensis* being the type of the one, and his *H. densirostris* the type of the other. In the following year Duvernoy, in a memoir in the same journal, reunited them, bestowing the name of *Mesodiodon* on the whole group. Subsequently Fischer (Nouv. Archives du Muséum, iii. 1867, p. 67), not recognizing Gervais's divisions, adopted his name *Mesopiodon* for the entire genus, in which I have followed him. Owen, as above mentioned, includes this group, with all the rest of the subfamily, except *Hyperoodon*, in the Cuvierian genus *Ziphius* (Crag Cetacea, Palæont. Soc. vol. xxiii.), while Gray (Suppl. Cat. Seals and Whales in Brit. Mus. 1871) divides it into *Ziphius*, *Dolichodon*, *Neoziphius*, and *Diopiodon*, which, with *Berardius*, constitute the family Ziphiiidæ—the type of Cuvier's *Ziphius* being placed, under the name of *Petrorhynchus mediterraneus*, in a different family.

The specimens of animals referable to this genus preserved in museums are more numerous than those of *Ziphius*. They include:—

1. An imperfect skull in the University Museum, Oxford, from the animal (a male 16 ft. long) obtained on the coast of Elginshire, figured and described by Sowerby (Brit. Miscellany, p. 1, 1804) under the name of *Physeter bidens*, but to which the specific name of *sowerbiensis* or *sowerbyi* has since been generally attached. It is called *Delphinus (Heterodon) sowerbensis* by Blainville (Nouveau Diction. d'Histoire Naturelle, 2nd ed. tome ix. 1817, p. 177), and *D. sowerbyi* by Desmarest (Mammalogie, 1822, p. 521).

2. A skull in the Paris Museum, from a female specimen 15 feet long, stranded at Havre, September 9th, 1825, described by Blainville (Nouv. Bulletin Sciences, Soc. Philom. t. iv. 1825, p. 139) as the "Dauphin de Dale," by Cuvier (Règne Animal, 1829, t. i. p. 288) as *Delphinus micropterus*, by F. Cuvier (Hist. Nat. des Cétacés) as *Delphinorhynchus micropterus*, and afterwards by other authors under a variety of different names, but now generally considered to be specifically identical with the first mentioned¹.

3. A complete skeleton in the Brussels Museum from a young specimen stranded at Ostend, August 31st, 1835, described by Dumortier (Mém. Acad. Royal. Bruxelles, 1839, t. xii. tabb. 1-3) under the name of *Delphinorhynchus micropterus*. The skeleton subsequently described by Van Beneden as *Mesoplodon sowerbiensis* (Mém. Acad. Belgique, coll. in-8vo, t. xvi. 1863)².

4. A skull and part of skeleton in the Museum at Caen, from Sallenelles, Calvados, north of France, 1825; described by E. Deslongchamps (Bulletin de la Soc. Linn. de Normandie, tom. x. 1866) as *Mesoplodon sowerbyensis*³.

5. A mutilated skull in the Museum of the Irish Academy, Dublin, from an animal 15 feet long, stranded in 1864 in Brandon Bay, Kerry, Ireland (Andrews, Trans. Roy. Irish Academy, vol. xxiv. 1869, *Ziphius sowerbyi*).

6. The skull of another specimen from the same locality, a male, about 17 feet long, stranded May 31st, 1870 (Andrews, Proc. Roy. Irish Acad. ser. 2, vol. i. p. 49).

7. A mandible in the Museum at Christiania, from the Norway coast, figured and described by Van Beneden (Bulletin de l'Acad. Roy. de Belgique, t. xxii. 1866) as *Mesoplodon sowerbiensis*.

8. A skull in the University Museum, Edinburgh, of unknown origin. (I am indebted to Professor Turner for information of this specimen, which has not yet been described.)

9. A complete skeleton in the Gottenburg Museum, described by Malm (*loc. cit.*) under the name of *Micropteron bidens*. From the coast of Norway, 1869.

All the above appear to belong to one species.

10. A skull in the Museum at Caen, from an animal caught in the entrance of the

¹ Figured by Van Beneden and Gervais, *op. cit.* pl. 26. figs. 5-8.

² *Ibid.* pl. 22.

³ *Ibid.* pl. 26. figs. 1-4.

Channel about 1840. Described by Gervais as *D. europæus*, by E. Deslongchamps (*loc. cit.*) as *Dioplodon gervaisii*¹.

This appears to be at present a unique specimen.

11. In the British Museum is a skull received from the Cape of Good Hope, with remarkably developed teeth in the lower jaw, passing upwards and backwards, and finally curving inwards so as to meet over the rostrum. This has been named *Ziphius layardii* by Gray (P. Z. S. 1865, p. 358), and is figured and fully described by Owen (Crag Cetacea, p. 12, pl. 1). The condition of the teeth suggest an individual peculiarity; but Mr. E. Layard has in his possession a single tooth of another individual (also from South Africa) having an exactly similar conformation.

12. The Australian Museum at Sydney has lately obtained a skeleton of an animal of this group, stranded at Little Bay, about six miles from Sydney, which has not yet been described; but, judging from the photograph sent by Mr. Krefft, it is closely allied to, if not identical with the last. The teeth, however, are much less developed.

13. A skull in the Paris Museum, from the Seychelle Islands, has been figured and described by Duvernoy (Annales des Sciences Naturelles, 1851) under the name of *Mesodiodon densirostris*, being apparently identical with the rostrum, of unknown origin, described by De Blainville under that name (Nouv. Dict. d'Histoire Nat. 2nd edit. tome ix. 1817). It has also received the specific name of *seychellensis* from Dr. Gray².

14. A complete skeleton of an animal of the same species, obtained from Lord Howe's Island, is in the Australian Museum at Sydney. A brief description has been given of it by Krefft (P. Z. S. 1870, p. 426), and an outline figure in Ann. and Mag. Nat. Hist. vol. vi. 4th ser. 1870, p. 343.

The last two belong undoubtedly to a species distinct from any of the others, characterized by the peculiar form of the ramus of the lower jaw, and of the very massive tooth which it supports. It is to be hoped that further details of the structure of the skeleton, especially of the cervical vertebræ (which appear to be different from those of other members of the group), will be published before long.

15. In the Museum at Wellington, New Zealand, is a skull and some bones of an animal 9 feet 3 inches long, figured and partially described by Dr. Hector in the Trans. New-Zealand Institute, vol. ii. p. 27, and vol. iii. pls. 14 and 15. This has been named *Berardius hectori* by Gray (Ann. and Mag. Nat. Hist. August 1871). The conformation of the skull shows that it is a member of the present group; but the single compressed tooth in the lower jaw is situated further forwards than in any other known species, thus completing, with *densirostris*, *sowerbyi*, *layardii*, and *europæus*, the series of different positions in the side of the ramus occupied by the developed tooth, and proving its little importance as a generic character.

16. In the Report of the Director of the Museum of Comparative Zoology at Cambridge, U. S. A., for the year 1869, among the additions made to the collection by

¹ Figured by Van Beneden and Gervais, *op. cit.* pl. 24.

² *Ibid.* pl. 25. figs. 2, 3.

donation, a skull of "*Mesoplodon sowerbyensis*" is mentioned as presented by Stephen C. Martin, but without any further details.

BERARDIUS, Duvernoy.

Upper ends of the præmaxillæ nearly symmetrical, moderately elevated, very slightly expanded, and not curved forwards over the nares. Nasals broad, massive, and rounded, of nearly equal size, forming the vertex of the skull, flattened in front, most prominent in the middle line. Anteorbital notch distinct. Rostrum long and narrow. Mesethmoid only partially ossified. Small rugous eminences on the outer edge of the upper surface of the maxillæ at base of rostrum.

Two moderate-sized, compressed, pointed teeth on each side of the symphysis of the mandible, with their apices directed forwards, the anterior being the larger of the two, and directed forwards¹.

*History of Berardius arnouxii*².

The genus *Berardius* was founded by Duvernoy³ upon a skull received at the Museum of Paris in 1846, having been obtained from an animal stranded in Akaroa Harbour, Banks Peninsula, New Zealand. The following brief description of the animal, and the circumstances attending its capture, was supplied by M. Arnoux, surgeon to the corvette 'Rhin,' commanded by Captain Bérard, by whom the skull was presented to the Museum.

"Cet animal vint échouer, sur la côte, dans le port d'Akaroa. . . . Des habitants anglais, voisins de ce lieu, le tuèrent à coups de lance. . . . Ils en retirèrent trois barils de graisse. La corvette 'le Rhin' rentra dans le port d'Akaroa trois ou quatre jours après cet événement. . . . Je m'empressai d'aller voir les restes de cet animal, et je m'emparai de la tête et d'un aileron. . . . L'animal vivant avait 32 pieds anglais de longueur totale; il était pourvu d'une nageoire dorsale assez étendue précédée d'une bosse assez considérable. Sa couleur était entièrement noire, sauf une partie grisâtre claire vers les organes génitaux: c'était un mâle."

No portion of the animal except the skull was brought to the Museum. Duvernoy's description of this is accompanied by a figure of the upper surface of the cranium, of the mandible, and a side view of one of the teeth⁴.

¹ In the specimen in the Wellington Museum the second tooth does not seem to be developed. See *Trans. New-Zealand Institute*, vol. iii. pls. 13 & 14, p. 129. This, together with the circumstances mentioned with respect to the teeth of different species of *Mesoplodon*, shows that the diagnoses of the genera of Ziphioids from the teeth alone, relied upon by some authors, as Fischer, are insufficient.

² Spelt *arnouxii* by Duvernoy, *arnouxii* and *arnouxii* by other authors.

³ "Mémoire sur les caractères ostéologiques des genres nouveaux ou des espèces nouvelles de Cétacés vivants ou fossiles." (*Annales des Sciences Naturelles*, 3^e série, Zoologie, tome xv. 1851, pp. 1-71.)

⁴ *Loc. cit.* pl. 1.

In the great work on the osteology of the Cetacea in the course of publication by Van Beneden and Gervais, figures on a larger scale are given of several views of the same skull (pl. 23), but the description has not yet appeared.

Until the arrival of the subject of the present communication the Paris skull was the only portion of *Berardius* contained in any European museum. The length of the cranium is 55 inches.

2. The next indication of the existence of *Berardius* is thus recorded by Mr. F. J. Knox:—

“In January 1862, a male specimen was embayed in the Porirua harbour, and was captured by Mr. London, of which I was only able to make a rude sketch and take a few of the measurements.”

The following are the dimensions given:—

| | ft. | in. |
|--|-----|-----|
| “Total length | 27 | 0 |
| Greatest circumference | 14 | 0 |
| Tail, from tip to tip | 7 | 0 |
| Head.—Length of basal surface | 4 | 4 |
| Height | 2 | 2 |
| Breadth across occiput | 2 | 0 |
| Length of lower jaw | 3 | 10 |
| Length of pectoral extremity, free | 3 | 0 |

“Produce of fine sperm oil, about 240 gallons; spermaceti, a considerable quantity in the upper surface of the face”¹.

Except a statement that in the recent state no vestige of teeth could be discovered, no further description and no preparations were obtained from this specimen, which can only be conjectured to be a *Berardius* from its locality and size. The extremely slight sketch (pl. xiii. fig. 1) of the outline of this animal shows only the characters common to the Ziphioid Whales, except that the pectoral fin is unusually long and pointed. This, however, corresponds neither with Mr. Knox’s measurements nor with the form of the manus of the present skeleton².

3. No animal of the species was again observed until the subject which afforded the skeleton to be described in the present memoir was stranded, of which event the following account was given by Dr. Julius Haast, F.R.S., the eminent geologist and energetic curator of the Museum at Christchurch, Canterbury. As our knowledge of this rare animal is so scanty, I think it desirable to reproduce Dr. Haast’s notice entire:—

¹ Transactions and Proceedings of the New-Zealand Institute, 1870, vol. iii. p. 126.

² It may be noticed that further doubt is thrown on the accuracy of this sketch by its being attributed in the letterpress to two quite different animals, viz. the 27-feet long *Berardius*, taken in 1862 in Porirua Harbour (p. 126), and the 9-feet long *Mesoplodon*, taken in 1866 in Titai Bay (p. 125).

“*Preliminary Notice of a Ziphioid Whale, probably Berardius arnuxii, stranded on the 16th of December, 1868, on the Sea-beach, near New Brighton, Canterbury, New Zealand.* By JULIUS HAAST, Ph.D., F.R.S.

“Towards the latter part of December, last year, it was stated that a whale had been stranded on the sea-beach, near the mouth of the Avon. Unfortunately the notice reached me too late to enable me to see the body in its fresh state; and when I went to the sea-beach the blubber had been cut off nearly a week, and the animal was already in such an advanced state of putrefaction that the external appearance was greatly destroyed. Before entering into a description of its affinities and peculiarities, I may be allowed to offer a few observations on its capture.

“Mr. William Walker, a fisherman, living near the mouth of the Avon, one mile and a half below New Brighton, observed, on the 16th of December, early in the morning, that a huge animal was in the surf, making the most strenuous efforts to return to deeper water. The fisherman had only a large sheath-knife with him, with which he stabbed it several times, making it bleed very freely. Each time when the surf reached it, it threw out a large quantity of water and sand from its blowers, like a fountain; at the same time it moved its tail with such vehemence that it threw its captor several times when he came too near it. Seeing that he could not manage the large animal by himself, he returned home to fetch a rope, a larger knife, and assistance. After having, with some trouble, placed the rope round the tail, and fastened it securely to the stump of a tree on the beach, he inflicted with the large knife some deep wounds, from which the blood ran copiously; but the animal, notwithstanding this great loss of blood, still lived for fourteen hours. The fisherman also put a large stick several times into its mouth, which, to use his own words, made the whale ‘bellow like a bull.’

“A very interesting fact may be deduced from the observations of Mrs. Walker, who accompanied her husband on the second trip. She told her husband that each time he put the stick into the whale’s mouth, she could see several large teeth in front of its lower jaw, which, however, were not observed by any body else, and the existence of which was only revealed when the skull was cleaned, when, in front of the lower jaw, two large triangular and movable teeth on each side became exposed. It thus seems that the Ziphioid Whales, when defending themselves from their enemies, or attacking their prey, have the power to protrude these four teeth at will. Such an hypothesis gains still more in probability when we consider the nature of the principal food of the animal, which, judging from the contents of its stomach, seems to consist almost exclusively of the common Sea-Spider, or *Octopus*—a cephalopod which, as in the northern hemisphere, does not seem to be very numerous along the coast. In the stomach of the whale in question there was about half a bushel of the horny beaks of this cephalopod, which were nearly all of the same size. It would be rather difficult for any whale to obtain possession of such an agile animal as the *Octopus*, had not nature furnished the former with the means of taking good hold of it. It is interesting that the allied genera *Ziphius* and *Hyperoodon*, of the northern hemisphere, feed also on similar species of cuttlefish, as I learn from a paper of Dr. J. E. Gray, of the British Museum (Proc. Zool. Soc. 1868, p. 422). Also the Sperm Whales are said to feed almost exclusively on the same vivacious animal, which, by its agility and organization, is so well adapted to make great havoc amongst the smaller inhabitants of the sea. And, as Dr. Gray justly observes, it proves, at the same time, that these cephalopods, although apparently of rare occurrence, must in many localities be very numerous, as it would otherwise be impossible to understand how they could furnish those huge whales with sufficient food.

“When I proceeded to the beach the animal was still lying in the surf, partly covered with sand, but still intact. I measured its length exactly, and found it to be 30 feet 6 inches from the tip of the nose to the end of the lobes of the tail. The colour of the whole animal was of a deep velvety black, with the exception of the lower portion of the belly, which had a greyish colour. The tail was 6 feet 6 inches broad, and had the usual two falcate lobes. The pectoral fins were situated near the neck, a little above the middle of the body, and were 17 inches broad and 19 inches long. They had a triangular form; and one of them was buried in the sand when I saw the animal first. The dorsal fin was unfortunately destroyed when I first saw the whale, so that I cannot describe its form and position from my own observations; but Mr. Walker told me that it was small, had the usual falcate form, and was situated not far from the tail.

"I may here observe that, from the form of the skull and some other characteristics, it appears evident that this whale is the *Berardius arnuxii* of Duvernoy, of which a specimen was caught in 1846, in Akaroa harbour, the skull of which, of the length of four feet, is at present in the Imperial Museum in Paris. The animal to which it belonged is described as having been 32 feet long, and possessing a large dorsal fin, with a large boss or hump in front of it. As putrefaction and the cutting off of the blubber had greatly changed the outlines of the animal, I could not observe whether it possessed the larger boss in front. Mr. Walker did not speak of it when he gave me a description of the animal as it appeared when captured. However, as the figure of the skull, as given by Duvernoy in the 'Annales des Sciences Naturelles,' and copied into Dr. Gray's British-Museum 'Catalogue of Seals and Whales,' is identical with that of our own specimen, I do not hesitate to state that both belong to the same species. It also seems to me that this whale is very local, probably inhabiting only the coast of New Zealand, and perhaps the regions south of it, because, as far as I can find, it has never been observed elsewhere. It has without doubt not been met with on the coasts of Australia (or it would not have passed unnoticed), as, amongst others, the energetic director of the Australian Museum, Gerard Krefft, F.L.S., has not observed it. I may here state that the form of the skull is very peculiar, reminding one strongly of that of a dolphin.

"There seems to be nothing known of this peculiar whale, except its external appearance and its skull; and it is therefore a matter of congratulation to us that we shall be able to supply all the details of its osteological characteristics, which are peculiar in many respects.

"The specimen in our possession was evidently a young animal, because all the disk-like epiphyses of the vertebræ are still detached. The same is the case with the epiphyses of the limb-bones, which are not yet united with them; also the sutures of the cranium are not yet obliterated. The beginning of coalescence is, however, to be observed in the seven cervical vertebræ, of which the first three are already ankylosed, the first two completely, and the second and third only partially, as the neural arches and transverse processes are not yet united into one bone. In the allied *Hyperoodon* all the cervical vertebræ coalesce; and it is therefore possible that when *Berardius* is in an adult state the same will take place. The *Ziphius* has six cervical vertebræ separate; and it will therefore be necessary to examine very carefully into the character of the uncoalesced vertebræ of our skeleton before giving a decided opinion upon the subject. It possesses ten dorsal vertebræ, in common with *Ziphius sowerbiensis*; the Hyperoodont Whales have nine, and the Dolphins thirteen to fifteen. I have not yet been able to count and examine the lumbar and caudal vertebræ, as the animal was in such a state of putrefaction that, after cleaning the bones as well as possible and leaving often a great portion of the vertebral column together, we put them at once to macerate. We obtained only one of the small pelvic bones, the other having probably been washed away by the surf; it might, however, owing to its diminutive size and sticking loosely in the flesh, easily have been overlooked. As soon as the bones are clean, so that I can examine them, I shall offer a few more observations upon the osteology of this remarkable animal, for the complete skeleton of which the Canterbury Museum is indebted to the members of the Philosophical Institute, without whose pecuniary assistance I should have been unable to secure it for the Provincial collections."—*Proc. Phil. Institute of Canterbury, New Zealand, May 5, 1869*; also *Annals and Magazine of Nat. History, October 1870*, p. 348.

It is much to be regretted that no mention is made in this account of the sex of the animal, especially as some of the allied forms are supposed to present considerable sexual differences.

4. In January, 1870, a large Ziphioid Whale was stranded in Worsers Bay, near the entrance to Port Nicholson, and was captured. Its dimensions are thus given by Mr. Knox:—

| | ft. | in. |
|---|-----|-----|
| Total length | 27 | 0 |
| From beak to nostrils | 3 | 6 |
| From nostrils to occipital foramen | 1 | 6 |
| Total length [of head?] over vertex | 5 | 0 |
| Head.—Tip of beak to occipital foramen, basal surface | 4 | 0 |
| Greatest height | 2 | 0 |
| Length of lower jaw | 3 | 10 |
| Length of symphysis | 1 | 0 |
| Breadth between condyles | 1 | 10 |
| Breadth at symphysis | 0 | 6 |

The skull, the cervical vertebræ, scapula, and imperfect pectoral limb of this animal are preserved in the Museum at Wellington, and have been figured on a reduced scale in the Transactions of the New-Zealand Institute, vol. iii. Although there was but a single tooth on each side of the lower jaw, near the apex, the skull in form and size so closely resembles that in the Paris Museum, that it is difficult to believe that they are not specifically identical.

Though no complete description of the portions of this animal which were preserved has yet been published, the following paragraph relating to it by Dr. James Hector, F.R.S., is important:—"The preparation of the nose (figures 4 *a* & 4 *b*) shows that, notwithstanding this is a full-sized animal, the tooth is still sheathed in the gum, being imbedded in a tough cartilaginous sac, which adheres loosely in the socket of the jaw, and is moved by a series of muscular bundles that elevate and depress it"¹.

The dimensions of the skull are thus given by the same naturalist:—

| | inches. |
|-----------------------------------|-------------------|
| Length of head | 59·5 ² |
| Length of nose | 31·0 |
| Length of dental groove | 15·0 |
| Length of lower jaw | 43·0 |
| Width of notch | 14·5 |
| Width at orbits | 24·5 |
| Width at blow-holes | 7·0 |
| Width at nose | 5·0 |
| Height of occiput | 19·5 ³ |

¹ Trans. New-Zealand Institute, 1870, vol. iii. p. 129.

² This is evidently a mistake, as it is far too large for the other dimensions. According to the figure it should be 47·5.

³ The smaller specimen, 9 feet 3 inches in length, which was described in the 2nd vol. of the Trans. N.-Z. Inst. (p. 27) under the name of *Berardius arnuxii*, and which has since been named by Dr. Gray *Berardius hectori* (Ann. & Mag. Nat. Hist. August 1871), belongs, as above mentioned, to a different section of the group.

Description of the Skeleton of Berardius arnouxii.

I must return to No. 3 of the above list, of which the skeleton has been lately placed among the fine series of Cetaceans in the Museum of the Royal College of Surgeons; which fortunate circumstance is due partly to the extremely liberal desire of Dr. Haast that it should be made as available as possible for scientific examination, comparison, and description, and partly to the generosity of Mr. Erasmus Wilson, F.R.S., a Member of the Council of the College, in providing the means of adding it to the collection without expense to the Institution.

The skeleton is complete, with the exception of one of the pelvic bones, and a few of the phalanges. Although it may have attained nearly to its full size, the condition of the bones shows that the animal was far from adult. The terminal epiphyses of the bodies of the vertebræ are separate throughout the thoracic, lumbar, and caudal regions, though united to the rest of the bone in the neck-vertebræ. The epiphyses of both ends of the radius, the upper end of the humerus, and lower end of the ulna are free, but that of the lower end of the humerus has partially coalesced with the shaft.

The length of the skeleton as now mounted is 29 feet in a straight line from the tip of the lower jaw to the end of the tail; but, notwithstanding the careful indications kindly furnished by Dr. Haast, it is possible that the allowance made for the intervertebral substance is not quite exact.

Viewing the skeleton as a whole (see Pl. XXVII.), the most striking feature is the small size of the head, compared with the great length of the vertebral column, and the massiveness of the individual vertebræ, especially of the lumbar and anterior caudal regions. It presents a remarkable contrast to *Physeter* in this respect, though agreeing generally with the other Ziphiinæ.

Skull.—The cranium agrees so closely in form with the type specimen in the Paris Museum, described and figured by Duvernoy, and subsequently by Gervais, that a detailed description of its external characters will not be required. That specimen, however, is one inch longer than the present one, and probably belongs to a fully adult individual. The most prominent parts of the pterygoid bones are broken off, which alters the contour of the lower margin in the figure; and the petro-tympanic bones are wanting. The present specimen is quite perfect; and as a longitudinal median vertical section has been made through it, I am enabled to give for the first time this highly characteristic view (Pl. XXVIII. fig. 7).

As compared with the other Ziphioids, the most remarkable features of the skull are the almost perfect bilateral symmetry of the upper surface and the comparative simplicity of the posterior ends of the præmaxillæ, which do not curve forwards to overhang the superior narial apertures as in the other members of the group.

The vertex is formed by the massive nasals (*Na*), prominent and rounded in the middle line in front and above, and behind these by a small, but elevated, portion of the united frontals (*Fr*), which at this spot, instead of being solid, are composed of several

distinct irregular and freely moveable wedge-shaped pieces of bone of the nature of the so-called "Wormian bones."

The mesethmoid (*ME*) forms a strong ridge between the narrow nostrils, rising to a level with the præmaxillæ; its ossification becomes irregular and nodular anteriorly, and extends as far forwards as 2 inches in front of the base of the rostrum (*i. e.* a line drawn between the deepest part of the two anteorbital notches, and which is supposed to mark off the rostrum from the cranium proper). In the Paris specimen the ossification extends somewhat further, doubtless in consequence of the superior age of the individual; but it is not likely that it ever attains to the remarkable extent and solidity characteristic of some species of Ziphiiinæ.

As in *Hyperoodon* and other allied forms (but not in *Physeter*) the bone which lies in ordinary Dolphins beneath the anterior part of the orbital plate of the frontal, in contact with the maxilla in front, the frontal behind, and the palatine on the inner side, is divided by a distinct suture into two parts. The anterior part gives origin to the slender zygomatic arch, and undoubtedly corresponds to the malar of ordinary mammals; while the posterior part appears to represent the lachrymal, as pointed out by F. Cuvier¹, Eschricht², Van Beneden³, and others, though Duvernoy considered it a prolongation of the orbito-sphenoid.

There are several differences in detail in the form and arrangement of these bones between *Berardius* and *Hyperoodon*, one of the most important being that the orbit of the former is considerably smaller than that of the latter, which, together with the inferior size of the optic foramen, would indicate a smaller organ of vision.

The zygoma, like that of *Hyperoodon*, is broader and flatter, especially at its anterior extremity, than in the ordinary Dolphins.

A most important and characteristic region of the base of the skull in the Cetacea, as in other Mammals, is that surrounding the organ of hearing. Here *Berardius* agrees with the other Ziphiioids in showing affinity to *Physeter*⁴ rather than to the true Dolphins, both in the form of the tympanic bulla, and in the greater fixedness by which it is attached to the skull. This is chiefly effected by a large irregular wedge-shaped process (Pl. XXIX. figs. 1 & 2, *m*), which passes backwards and outwards from the hinder edge of the portion of the tympanic which articulates with the periotic, and lodges in a groove between the exoccipital and squamosal, reaching the external border of the skull. This process so closely occupies the position of the "mastoid" in ordinary Mammals, that it has very naturally received that name: but its exact homology must be cleared up by a study of its development; for it differs from

¹ Histoire Naturelle des Cétacés (1836), p. 76, pl. 7, *l*.

² Untersuchungen über die nordischen Wallthiere (1849) p. 44.

³ Mém. sur une nouvelle espèce de *Ziphius*, Mém. de l'Acad. Royale de Belgique, coll. in-8vo, tome xvi. 1863, p. 14.

⁴ And more remotely to the Whalebone Whales, as pointed out by Eschricht.

the ordinary mastoid in being united to the tympanic instead of the periotic. To the anterior and inner side the tympano-periotic is supported by a long slender process of the squamosal, with which it comes into closer contact than in the true Dolphins¹.

The tympano-periotic bones are slightly larger than those of *Hyperoodon* (Pl. XXIX. fig. 6), but have much the same general form, with certain differences in detail, of which the most important are:—in the tympanic the anterior (Eustachian) end (*e*) is more prolonged, pointed, and spout-like; the groove between the posterior lobes is deeper; the posterior articular surface (*a*) for the periotic is larger and smoother; the periotic is more elongated, the notch between its anterior (*a.l*) and middle lobe (*m.l*) is wider, the anterior lobe is more prolonged and pointed in front, and the orifice of the meatus auditorius internus (*i.a.m*) is rather smaller.

It is important to note that in every one of these points of difference, *Hyperoodon* approaches nearer than *Berardius* to *Physeter*—a confirmation of the great taxonomic value of the characters of this region of the skull.

On comparing the median section of the skull (Pl. XXVIII. fig. 7) with that of *Hyperoodon*, the main difference is the smaller degree of elevation and of antero-posterior compression in the great supracranial crest, and the greater extent, both in vertical and antero-posterior direction, of the bony mass formed by the coalescence of the presphenoid, mesethmoid, and frontals which lies in front of the cerebral cavity, separating it from the nasal passages. In these, as in so many other respects, *Hyperoodon* approaches much nearer to the Cachalot than does *Berardius*.

The hinder edge of the vomer, which is prolonged beneath the presphenoid and basi-sphenoid, is much less massive in *Berardius* than in *Hyperoodon*; but, generally speaking, the conformation of the cranium and the relations of the bones to each other as seen in this view are strikingly similar².

The basioccipital and the basisphenoid have completely coalesced; but the fissure between the latter and the presphenoid is open to the extent of more than a quarter of an inch. The floor of the cranial cavity is less curved from before backwards than in *Hyperoodon*, and therefore much less than in *Physeter*; and the commencement of the spinal canal is not directed upwards to the same extent. The pituitary fossa is very indistinct; but at some distance behind it there is a broad and deep groove on the upper surface of the basioccipital.

The cerebral cavity presents much the same general form and size as in *Hyperoodon* and the allied species, being high, very broad, and flattened from before backwards. Its greatest breadth is $11\frac{1}{2}$ inches, its greatest vertical height 7 inches, its length 8 inches. The posterior upper part has a strong median projection, or osseous *falx*

¹ See the description of this region in *Hyperoodon* by Eschricht (*op. cit.* p. 45), and in *Ziphius indicus* by Van Beneden.

² The comparison was made with the skull of a *Hyperoodon* of corresponding age in the Museum of the College of Surgeons; it is figured in *Trans. Zool. Soc.* vol. vi. pl. 56. fig. 3.

cerebri, which, in the figure, conceals the real height of the lateral parts of the cavity. A well-marked ridge, more conspicuous than in *Hyperoodon*, commencing on the orbito-sphenoid below, and extending upwards on the frontal almost to the vertex, divides the anterior from the posterior cerebral fossa. The cerebellar fossa is relatively larger than in *Hyperoodon*, and is separated from the posterior cerebral fossa by a strong ridge. There is no olfactory fossa.

The periotic bone is excluded from the cerebral cavity by a distance of $3\frac{1}{2}$ inches.

The foramina which pierce the base of the cranium, as seen from within, are:—

1. A very small hole, $\frac{1}{4}$ inch from the middle line, and 3 inches in front of the suture between the presphenoid and basisphenoid, and passing through the posterior lateral expansion of the mesethmoid which corresponds to the cribriform plate of other mammals, to the nasal passage, may be an olfactory foramen. A similar foramen has been noticed in *Ziphius* by Fischer, and exists on a larger scale in *Physeter*¹.

2. The optic foramen is a rather small oval fissure (0.4 inch by 0.3 inch) perforating the orbito-sphenoid, near its hinder border, and soon joining the great orbital or sphenoidal fissure. It is less than half the size of the corresponding opening in *Hyperoodon*.

3. Immediately behind the sharp ridge formed by the hinder edge of the orbito-sphenoid is the large funnel-shaped opening, compressed from side to side (about 1 inch by $\frac{1}{2}$ inch in diameter at the narrowest part), corresponding to the sphenoidal or orbital fissure together with the foramen rotundum, as it transmits the nerves to the orbit, as well as the middle division of the fifth nerve.

4. The foramen ovale, for the third division of the fifth, forms a distinct perforation through the alisphenoid, about 0.3 inch in diameter. It is connected with the last by a shallow groove.

5. Behind the orbito-sphenoid is a large infundibuliform depression, divided at the bottom into an anterior smaller circular aperture (0.3 inch in diameter) and a posterior larger oval opening (1 inch by 0.4 inch). The former is for the seventh nerve, which it conducts to the meatus auditorius internus on the periotic; the latter for the various nerves commonly known as the eighth pair; this is further divided near its termination on the surface by a narrow bony septum.

6. Immediately behind the last, in the cerebellar fossa, and $1\frac{3}{4}$ inch from the middle line, is the small condylar foramen (0.3 inch by 0.2 inch in width) for the hypoglossal nerve. After a course of about four inches through the bone, it opens into a groove in the hinder surface of the skull between the basioccipital and the exoccipital.

7. In the basisphenoid, 1 inch from the middle line, opposite the prominence in front of the sella turcica (*tuberculum sellæ*) is the longitudinal narrow oval aperture (0.4 inch by 0.2 inch) for the carotid artery. This canal opens externally in the pterygoid close to its posterior border.

¹ See "Osteology of the Sperm Whale (*Physeter macrocephalus*)," Trans. Zool. Soc. vol. vi. p. 316.

In general arrangement these foramina correspond very closely with those of *Hyperoodon*. In the Sperm-Whale the greater massiveness of the cranial walls, compared with the brain-cavity, and the consequent greater distance that has to be traversed by the nerve-canals, causes some alteration in the condition of the foramina, several (as in the case of that for the seventh and eighth nerves) more completely coalescing into a single aperture, at least at their cerebral ends, than in the smaller-headed Ziphioids.

Dimensions of the Skull.

| | inches. |
|---|---------|
| Extreme length of cranium | 54 |
| Length of rostrum (from the apex of the præmaxillæ to the middle of a line drawn between the anteorbital notches) | 36·2 |
| Anterior end of vomer to anterior end of præmaxillæ | 13·6 |
| From middle of hinder edge of palate (formed by pterygoid bones) to end of præmaxillæ | 43·2 |
| Greatest height of skull, from top of nasals to lower border of pterygoids | 21 |
| Greatest breadth, across postorbital processes of frontals | 27 |
| Breadth across zygomatic processes of squamosals | 26·4 |
| Breadth between outer borders of suprafrontal processes of maxillæ | 24·6 |
| Breadth of occipital condyles | 7·5 |
| Breadth of foramen magnum | 2·4 |
| Height of foramen magnum | 2·5 |
| Breadth of exoccipitals | 20·5 |
| Breadth of base of rostrum (between bottom of anteorbital notches) | 15·7 |
| Breadth of rostrum at middle | 6 |
| Nasal bones, antero-posterior length | 5·2 |
| Nasal bones, greatest breadth of the two | 4 |
| Anterior nares, greatest width of the two | 2·9 |
| Breadth between outer borders of præmaxillæ opposite nares | 6·6 |
| Breadth between outer borders of præmaxillæ at their widest part, in front of the nares | 8·2 |
| Breadth between outer borders of præmaxillæ at middle of rostrum | 3·6 |
| Mandible.—Length of ramus | 49 |
| Length of symphysis | 12·2 |
| Vertical height of ramus at coronoid process | 8·3 |
| Apex of mandible projecting beyond apex of rostrum | 2·7 |

The rami of the mandible are not ankylosed at the symphysis. They are more massive in form and of a denser substance than in *Hyperoodon*, especially near the symphysis, corresponding with the greater development of the teeth. A slight irregular groove, with numerous minute vascular canals opening into it, extends along the

upper margin from the apex for two thirds the length of the ramus, to opposite the entrance of the wide infundibuliform dental canal on the inner side. Just before its posterior termination this groove becomes wider and deeper than elsewhere; behind it the superior edge of the ramus rises into a sharp elevated crest, terminating behind in the feebly marked coronoid process.

At the anterior extremity of the ramus the groove dilates into a large, oval, narrow, alveolar cavity, 2·7 inches long, 1 inch wide and 2 inches deep. Two and a half inches behind this is another, smaller alveolus 1·8 long, 0·6 inch wide in front and very narrow behind. The floors of both these cavities slope backwards and upwards; and their openings are directed forwards.

Teeth.—Each of the above-mentioned alveolar depressions contains a tooth, which very nearly fills the socket, and projects but slightly above the level of the upper surface of the ramus of the jaw.

The anterior tooth of the left side, although loose in its alveolus, cannot be removed from it as long as the bone is intact. The right tooth, however, was extracted without much difficulty (see Pl. XXIX. fig. 7). It is compressed laterally to the form of a nearly equilateral triangle, with a base, an apex, and an anterior and a posterior margin. The base is 2·8 inches long, the anterior margin 2·8 inches, the posterior margin 3·2 inches, the height from the middle of the base to the apex 3 inches, the greatest thickness between the lateral surfaces 0·8 inch. The pulp-cavity is completely closed below, the base being rounded and rugose. The inner surface is concave, the outer one slightly convex in both directions. Both surfaces are marked with irregular shallow furrows and ridges running in a longitudinal direction, or rather radiating from apex to base. The apex itself is conical, with a deep linear longitudinal groove on the middle of its inner side; it appears to be formed of dentine, without any enamel covering, and projects for a distance of 0·3 inch from the mass of cementum which covers the greater part of the tooth. The extremity is somewhat polished, but presents no distinct signs of wear.

The left tooth, as far as can be seen without removing it from the alveolus, exactly resembles the right. The apex projects scarcely one inch above the level of the alveolar border; so that before the gum was removed very little, if any, of the tooth could have been exposed.

The second tooth (Pl. XXIX. fig. 8) fits very well into, and nearly fills its alveolus; but, owing to the form of its root, it is readily removed. It also is compressed and triangular, but narrower from before backwards than the other. Its base is closed; and its apex is formed, as in the other, of a small cone of dentine, emerging out of an enveloping mass of cement; the anterior margin is thicker, more rounded and curved than the posterior. The whole tooth lies very obliquely in its alveolus; so that the posterior margin is nearly horizontal, and the apex projects forwards. Such a very small portion is raised above the level of the alveolus, that we might naturally infer

that in life the tooth was entirely concealed¹. The height of the right tooth from the middle of the base to the apex is 1·8 inch, the length of the base is 1·1 inch, the length of the anterior margin is 1·5 inch, of the posterior margin 2 inches, the greatest thickness 0·6 inch. The left tooth is slightly larger than the right.

A longitudinal section in the antero-posterior direction having been made through these teeth, their structure was seen to be very similar to that of *Mesoplodon sowerbyi*, as described by Mr. E. Ray Lankester². In the larger anterior tooth the only remains of the pulp-cavity is a small irregular vacuity (p), an inch below the apex of the tooth, and consequently more than an inch and a half from the base. The true dentine (d) is limited to the portion of the tooth above this spot, the large bulk of the tooth below being composed of very coarse-looking osteo-dentine with numerous wavy fissures and channels, having a general longitudinal direction; immediately around the pulp-cavity a tissue (g) having a botryoidal or globular arrangement forms a transition from the last-named structure to the true dentine. There is no enamel. The surface of the tooth, except at the apex and base, is covered with a layer of cement (c), which nowhere exceeds $\frac{1}{10}$ inch in thickness. The constituent elements of the smaller tooth are arranged in a precisely similar manner.

Hyoid bones.—The basihyal and the thyro-hyals are not yet united (Pl. XXVIII. fig. 9). The former is more elongated transversely than in *Hyperoodon*, being 5·8 inches in width, and 2·7 inches in antero-posterior length at the middle. The posterior border is straight; the anterior border excavated in the middle, and with a roughened prominence near each end for the attachment of the anterior cornua.

The thyro-hyals are each 9 inches long, and 2·5 inches in greatest diameter. Their under surface is flattened. They are less wide in proportion to their length than in *Hyperoodon*, and thus, as in so many other details of the skeleton, they show that *Berardius* recedes further from *Physeter* than does that genus³, and consequently approaches nearer to the ordinary Dolphins.

The stylo-hyals are 14 inches long, and 2·9 inches in greatest thickness, slightly curved, and with three distinct surfaces bounded by three longitudinal ridges, the broadest and flattest surface being in the concave side of the bone. Towards what appears to be the upper end there is a neck-like constriction, surmounted by an expanded and obliquely truncated head.

Vertebral Column.—The numbers of the vertebræ are:—cervical 7, thoracic 10,

¹ See the remarkable observations upon the teeth of the animal when alive, recorded by Dr. Haast (p. 214), and the mention of "muscular bundles" by which they are moved by Dr. Hector (p. 216), which accord so little with any thing hitherto known in mammalian anatomy, that further observations on this subject are extremely desirable.

² Transactions of the Royal Microscopical Society, new series, vol. xv. 1867, p. 55.

³ The breadth and flatness of the thyro-hyals is eminently characteristic of both the genera of *Physeterinae*, *Physeter* and *Kogia*; and the affinity of the *Ziphiinae* to them is in this respect only slightly marked, though most so in *Hyperoodon*.

lumbar 12, caudal 19; total 48. This appears to be very nearly the usual number in *Ziphius* and *Mesoplodon*, and to exceed that of *Hyperoodon* by 3.

Though generally resembling that of the three allied genera, the column differs from *Mesoplodon sowerbyi* (Van Beneden and Gervais, pl. 22) chiefly in the spines of the anterior dorsal region being smaller, more pointed, and more recumbent—also in all the other spines sloping more backwards, and being smaller in proportion to the body, both in height and width from before backwards; thus in a middle lumbar vertebra, the antero-posterior diameter of the spine in Sowerby's Dolphin is about two thirds the length of the body, while in *Berardius* it is little more than one third. *M. densirostris* and another as yet undetermined species in the Sydney Museum agree generally with *M. sowerbyi* in these respects, judging from photographs of their skeletons sent by Mr. Krefft. *Ziphius australis* appears in Burmeister's figure to be rather intermediate between *Mesoplodon* and *Berardius* in the form of the spines of the vertebræ. In *Hyperoodon* the spines are as long as in *Mesoplodon* and as slender as in *Berardius*.

Cervical Vertebræ.—The vertebræ of the neck (Pl. XXVIII.), especially those of the posterior part of the region, are better developed than in most Dolphins, and, indeed (except for the coalescence of the first three), bear a considerable resemblance to those of the Beluga. Among the Ziphiiinæ, as far as is yet known, *Mesoplodon* and *Ziphius* both approach *Berardius* in the structure of this important region, while, as will be seen, *Hyperoodon* offers the greatest possible contrast.

The entire length of the bodies of the seven cervical vertebræ, when placed in contact, is 10 inches. The atlas, axis, and the third vertebra are united firmly by their bodies; and the first two are also united by the laminæ of the neural arches, but the axis and the third only by that portion of the arch corresponding to the zygapophyses, the upper part being free. All the remaining vertebræ are separate throughout. The free ends of their bodies show traces of the epiphyses by which they have been completed; and their surfaces appear so completely formed or finished, as it were, that it does not appear probable that much, if any, further union would have taken place had the animal attained a greater age.

In *Hyperoodon* not only is the whole length of the cervical region scarcely more than half that of *Berardius*, but the bodies of all seven vertebræ are firmly united together, and the spines of all, except the seventh, join to form a single elevated conical mass; the vertebræ, except the first two and the last, are evidently extremely compressed, almost rudimentary in fact. In *Ziphius australis*, according to Burmeister, the first, second, and third are united, and also the fourth and fifth to each other, though not to the third, and the sixth and seventh are free. In the specimen of *Ziphius cavirostris*, from Corsica, briefly described in Fischer's memoir, the six anterior vertebræ are stated to be united and the seventh free. In Sowerby's *Mesoplodon* at Brussels the first two only are united, and all the others free. In *M. densirostris*, according to Krefft¹, "the

¹ P. Z. S. 1870, p. 426.

first three cervical vertebræ are anchylosed, the next one is more or less free, and the remaining three are anchylosed again." In another specimen of the same genus lately added to the Sydney Museum, the first, second, and third are said to be united and the remainder all free (Kreffft, MS.).

The articular surfaces on the atlas for the occiput (fig. 2) are considerably smaller than in *Hyperoodon*, and do not coalesce at their inferior margins. Above the upper end of each there is a deep groove for the suboccipital nerve, instead of a foramen as in *Hyperoodon*.

The coalesced spines of the first and second vertebræ are but moderately developed, and slope backwards, overhanging the short pointed spine of the third (see fig. 1). The transverse process of the atlas is very little developed, and placed low on the sides of the bone; it does not unite at its extremity with that of the axis as in *Hyperoodon*. The inferior surface of the conjoined bodies of the first three vertebræ has a backward projecting compressed tubercle, wanting in *Hyperoodon*, and probably representing that so well developed in the Narwhal and Beluga.

The axis has two very short transverse processes on each side, compressed from before backwards, both placed on the side of the body, the lower one corresponding serially with the transverse process of the atlas, and being of about the same length.

The third has two distinct transverse processes on each side, further apart than those of the second, the upper one arising from the upper part of the body and root of the arch; the lower one is longer and narrower, and directed downwards and backwards.

Each of the three following vertebræ (figs. 3, 4, and 5) have two transverse processes, the upper ones (*diapophyses*) arising from the pedicle of the arch, rather slender, conical, and inclined downwards, in the sixth also somewhat forwards; they increase in size from the fourth to the sixth. The lower processes (*parapophyses*) arise from the inferior outer angle of the body, are thick and massive; that of the fourth vertebra is most compressed and longest, while that of the sixth, though scarcely extending laterally beyond the body of the vertebra, is greatly developed downwards, forwards, and inwards (passing beneath the body of the antecedent vertebra), being, in fact, little more than a great development of the inner basal tubercle of the others, and answering to the "inferior lamella" of the transverse process of the corresponding vertebra of the Carnivora, Ungulata, &c.¹

The seventh vertebra (fig. 6) has only the upper transverse process from the arch, the inferior projecting edge of the well-marked articular surface for the head of the first rib taking the place of the inferior process.

The bodies of all these vertebræ are broader than they are high. The arches of the fourth and fifth are incomplete in the middle line above for a space of more than half an inch. The arches of the sixth and seventh are complete, and incline backwards, but without any distinct spinous process.

¹ See 'Introduction to the Osteology of Mammalia,' p. 22, 1870.

The neural arches thus differ greatly from those of *Hyperoodon*, which has one tall conical upright spine springing from the conjoined arches of the six anterior vertebræ, and a second slender but equally elevated and vertical spine, belonging to the seventh vertebra alone. On the other hand they resemble generally those of *Ziphius* and *Mesoplodon*, as far as their condition in these genera is at present known; for the incompleteness of the upper part of the arch exists in the fourth and fifth vertebræ in *Ziphius australis*, and in the third, fourth, and fifth in *Mesoplodon sowerbyi*. Perhaps even more strikingly does the presence of well-developed inferior transverse processes to the third, fourth, fifth, and sixth cervical vertebræ show the affinity of *Berardius* to these two genera and its dissimilarity to *Hyperoodon*.

Dimensions of the Cervical Vertebræ.

| | inches. |
|---|---------|
| Antero-posterior length of bodies of all seven, lower surface | 10 |
| Length of body of united first, second, and third | 3·6 |
| Length of body of fourth | 1·4 |
| Length of body of fifth | 1·4 |
| Length of body of sixth | 1·5 |
| Length of body of seventh | 1·8 |
| Height from top of spine to lower edge of body of second | 10·7 |
| Height from top of spine to lower edge of body of seventh | 8·5 |
| Breadth between outer borders of articular surfaces of atlas | 8·7 |
| Height of articular surfaces of atlas | 5·8 |
| Breadth between tips of transverse processes of atlas | 11·5 |
| Height of neural canal in arch of atlas | 2·9 |
| Greatest breadth of neural canal in arch of atlas | 3·3 |
| Height of neural canal in arch of seventh | 3·3 |
| Greatest breadth of neural canal in arch of seventh | 3·6 |
| Breadth of body of seventh | 5·2 |
| Height of body of seventh | 4·2 |
| Breadth between tips of transverse processes of seventh | 9·5 |

Thoracic Vertebræ.—The bodies of the twelve thoracic vertebræ increase gradually in length (see table on p. 228, and Pl. XXVIII. fig. 1). The inferior surface of those at the commencement of this region is broad, flat, and somewhat rough; posteriorly they gradually acquire a median keel.

The spines are moderately high, compressed, sloping much backwards; that of the first is very little developed, and pointed; though tapering in the anterior vertebræ, they gradually become more obtuse and truncated at the extremity as they approach the posterior end of the series.

The zygapophyses are unusually well developed, continuing on the contiguous anterior

and posterior edges of the arch until between the eighth and ninth dorsal vertebræ inclusive, but not developed between the ninth and tenth.

Metapophyses first appear as distinct tubercles on the transverse processes of the third, and gradually increase in size and become more compressed, pointing forwards and slightly upwards.

Articular surfaces for the heads of the ribs are developed only on the hinder edges of the bodies, without any corresponding surface on the anterior edge of the next vertebra, so that the head of the rib appears not to articulate directly with the body of the same vertebra to which the tubercle is attached, but only to the one in front of it. In the first vertebra this surface is entirely on the side of the body, in the second at the junction of the body and the arch, from the third to the seventh at the root of the pedicle of the arch; on and after the eighth it is absent altogether, and the rib is attached only to the transverse process.

The transverse processes, in a line with the upper transverse processes (*diapophyses*) of the cervical region, are short and thick, with large rounded articular extremities for the tubercles of the ribs. In the seventh vertebra this process is small, and in the eighth reduced to a mere low longitudinal ridge on the outside of the metapophysis, which has here acquired a considerable size. In the ninth vertebra a large and massive process springs from the upper part of the side of the body near the anterior edge, in a situation corresponding to which no trace of a process exists on any of the vertebræ in front. It has a large articular surface at its extremity, looking somewhat backwards, for the ninth rib. The tenth vertebra bears a corresponding process, but rather longer, more depressed, wider from before backwards, situated rather lower on the side of the body, and not quite so near its anterior edge. Its articular surface (for the tenth rib), also directed obliquely backwards, is not so large as that of the ninth. This process corresponds serially with the transverse processes of the lumbar vertebræ.

Berardius thus conforms to the type of the *Physeteridæ* in the transverse processes of the dorsal vertebræ not gradually sinking from the arch to the body, as in the true Dolphins, but disappearing near the end of the series, and being replaced by a new process; but it differs from *Physeter*, and exactly agrees with *Mesoplodon*¹, in not having both upper and lower processes developed simultaneously on several of the vertebræ. *Hyperoodon* approaches nearer to *Physeter* in this characteristic feature, as its seventh thoracic vertebra has distinct upper and lower transverse processes, which in some specimens completely unite at their extremities, so as to form a ring, to the outer edge of which the rib is attached.

The twelve *lumbar vertebræ* are very much alike. Their bodies increase in size towards the hinder end of the series, where they are remarkably elongated. Below

¹ In the skeleton of Sowerby's *Mesoplodon* in the Brussels Museum, the upper process continues as far as the seventh vertebra, and the lower process commences abruptly on the eighth.

the transverse processes they are compressed or pinched in, as it were, at the middle of each side; and the inferior surface has a well-marked median keel.

The arches arise nearer the anterior than the posterior end of the bodies. The spines are long, compressed, of nearly equal antero-posterior breadth from base to apex, the edges being approximately parallel, and roundly truncated above; they slope backwards forming an angle of 45° with the long axis of the body. The anterior end of the arch, below the spine, develops a conspicuous, broad, flattened metapophysis, the lower edge of which carries another tubercle. The metapophyses remain at the same level throughout the series, instead of gradually rising on the sides of the arch in the posterior lumbar and caudal vertebræ, as in *Physeter* and *Orca*.

The *caudal vertebræ*, reckoning from the first which bears a chevron bone at its hinder border, are nineteen in number.

The first resembles those of the lumbar region; but it is distinguished from them by wanting the median keel on the inferior surface, and by the pair of articular facets on its hinder edge for the first chevron bone. Its spine is also shorter and considerably broader than in the last lumbar vertebra.

The bodies gradually shorten, though retaining their vertical height as far as the ninth; the tenth is much compressed; the eleventh is small, being the "transitional vertebra." The series of depressed vertebræ, or those of the tail proper, begins at the twelfth; but they are less flattened and less transversely extended than in the true Dolphins.

The under surfaces of the bodies are deeply channelled in the middle line, and have strongly marked tuberosities at each corner for the attachment of the chevron bones; the anterior and posterior tuberosities of each side become united in the seventh and succeeding vertebræ, enclosing a foramen which gradually diminishes in size.

The spines gradually decrease to the tenth, after which they are no longer developed. The transverse processes also gradually diminish, and cease to be apparent after the eighth. The last vertebra is a small depressed triangular nodule.

*Antero-posterior length of the Bodies of the Thoracic, Lumbar,
and Caudal Vertebræ.*

| | | | |
|-------------------------------------|-------------------------------|--------------------------------|-----------------------------------|
| Thoracic: first inches. 2·3 | Lumbar: second .. inches. 7·0 | Lumbar: twelfth .. inches. 9·8 | Caudal: tenth inches. 5·6 |
| second .. 2·7 | third 7·1 | Caudal: first 9·7 | eleventh 4·1 |
| third 3·5 | fourth 7·3 | second 9·5 | twelfth 3·5 |
| fourth .. 4·0 | fifth 7·9 | third 9·0 | thirteenth . . . 3·1 |
| fifth 4·3 | sixth 8·1 | fourth 8·5 | fourteenth . . . 2·9 |
| sixth 4·6 | seventh .. 8·7 | fifth 8·1 | fifteenth .. 2·7 |
| seventh .. 5·0 | eighth .. 9·1 | sixth 7·8 | sixteenth .. 2·2 |
| eighth .. 5·5 | ninth 9·3 | seventh .. 7·5 | seventeenth 1·8 |
| ninth 6·0 | tenth 9·7 | eighth 7·1 | eighteenth.. 1·5 |
| tenth 6·2 | eleventh.. 9·8 | ninth 6·6 | nineteenth.. 0·9 |
| Lumbar: first inches. 6·4 | | | |

As noticed by Van Beneden¹ in *Mesoplodon sowerbyi*, the bases of the transverse processes of the hinder lumbar and caudal vertebræ are not perforated by vertical vascular canals as in most Dolphins, but only the bodies of the posterior caudal vertebræ (beginning at the tenth) have such perforations.

There are nine chevron bones. The first consists of two pieces, not united in the middle line. The fourth is the largest. Their principal characteristic is that their spines are not particularly elongated downwards, but are large from before backwards.

The Ribs.—There are ten pairs of ribs, tolerably stout, especially thickening at their lower ends, though somewhat contracted rather above the middle.

The first is short and broad, articulating above by a well-developed tubercle with the transverse process of the first thoracic vertebra, and by a short capitular process with the body of the seventh cervical. It has a strongly pronounced angle.

The second to the sixth gradually increase in length, and diminish in thickness; afterwards they gradually become shorter. As far as the seventh inclusive, they have all distinct tubercles articulating with the transverse processes, and well-developed capitular process articulating with the hinder edge of the body or root of the arch of the vertebra in front. After the fourth the angle becomes obscure and is lost in the general convexity of the upper surface of the bone. In the eighth rib the tubercle is rudimentary, and does not reach the much diminished upper transverse process of the vertebra; the head articulates with the hinder edge of the base of the pedicle of the seventh vertebra, and on the right side only it has a small irregular articulation (not found in any other case) with the anterior edge of the pedicle of the arch of the eighth vertebra.

The ninth rib wants the whole of that portion representing the head, neck, and tubercle of the ribs in front, and has a truncated upper extremity, articulating to the end of the large transverse process of the ninth thoracic vertebra. The tenth rib is similarly articulated with the corresponding process of the tenth vertebra, and is nearly as well developed as the one in front of it.

The greatest length of each rib, in a straight line, is—

| | inches. | | inches. | | inches. |
|--------------|---------|---------------|---------|--------------|---------|
| First | 18 | Fifth | 39 | Eighth | 38 |
| Second | 26 | Sixth | 39 | Ninth | 32 |
| Third | 32½ | Seventh | 38½ | Tenth | 29 |
| Fourth | 37 | | | | |

As in *Physeter*, *Hyperoodon*, and the other known Ziphioids, there are no ossified sternal ribs.

The Sternum.—The sternum (Pl. XXVII. fig. 3) is remarkably long and narrow. It

¹ *Loc. cit.* p. 42.

resembles generally the form of the same part in *Ziphius* and *Mesoplodon*, but is proportionally longer than in *Hyperoodon*, and still more than in *Physeter*. The inferior surface is slightly convex from before backwards, and also from side to side.

It consists of five distinct segments, not connected together by bone. The anterior segment is the largest, and has a shallow fossa in the middle line in front; the posterior segment ends in a pair of narrow xiphoid processes, of which the right is slightly larger than the left.

As in the other Ziphioid Cetaceans, development is less complete along the middle line of the sternum than at the sides; not only are there median notches at each extremity, but there are three large median fenestræ, one between the first and second segments, one between the second and third, and one between the third and fourth segments. The edges of these fenestræ are bevelled and smooth; so that it does not appear that ossification would have advanced further in this direction if the animal had lived to be older.

Each side of the sternum shows six rough articular facets for sternal ribs:—the first near the anterior end of the first segment, at its broadest part; the second at the junction of the first and second segments; the third at the junction of the second and third segments; the fourth at the junction of the third and fourth segments; the fifth near the hinder end of the fourth segment; the sixth on the side of the fifth segment, near its anterior end.

The entire length of the sternum in a straight line is 45 inches. The greatest breadth of the first segment is 12·8 inches, of the second segment 10·9 inches, of the third 10 inches, of the fourth 9 inches, of the fifth 8·8 inches.

Pectoral Limb.—The pectoral limb, as in all other members of the group to which *Berardius* belongs, is small in proportion to the size of the animal.

The scapula bears a considerable resemblance to that of *Hyperoodon*; it is less narrow and elongated than in *Physeter*, and more regularly triangular, and less fan-shaped than in the ordinary Dolphins. The external surface is smooth and slightly concave, with one vertical ridge near the hinder border. The acromion is large and flat, curving regularly inwards, and somewhat upwards towards the extremity. The coracoid is rather longer, and more slender and rounded than the acromion. The glenoid fossa is irregularly oval, the outer edge more convex than the inner, and the anterior extremity more pointed than the posterior.

The humerus and bones of the forearm are elongated, slender, and simple in character; the latter more resemble the corresponding bones of a *Balænoptera* than of one of the Delphinidæ.

The humerus has a rounded head and single tuberosity, formed by a large and still free epiphysis. The lower epiphysis includes little more than the articular surface, and is united to the shaft, though the line of separation is distinct in many points. The radial border of the bone presents, near the middle of its length, a low rounded

protuberance, representing the deltoid ridge, with a shallow groove below it. Rather higher than this, just below the commencement of the expansion for the head, on the outer surface of the bone, is a roughened shallow depression. The articular surface for the ulna encroaches for a space of $1\frac{1}{2}$ inch on the corresponding margin of the humerus.

The radius is a simple narrow flattened bone of almost equal breadth throughout.

The ulna has more pronounced characters, having a very well-developed, broad, and flattened olecranon, with a strongly marked groove in the middle of the outer side of its upper border, apparently for the passage of a tendon, and which I have not observed in any other Cetacean. The bone is considerably contracted in its upper third, and expands moderately towards its lower extremity.

Both radius and ulna have well-marked epiphyses at either extremity, including the whole of the articular surfaces: that of the upper end of the ulna is united to the shaft; but the other three are still separate.

The carpus (Pl. XXVIII. fig. 10) presents some unusual features in the mode of union of its several elements with each other. All the bones which are met with in *Hyperoodon* and the other Ziphioids appear to be present and well ossified. There is thus one bone more (viz. the magnum) than in the ordinary Dolphins and in the Sperm-Whale.

The scaphoid (*s*) and the lunar (*l*) have almost completely united, though a groove shows their original limits. The cuneiform (*c*), which is the largest bone of the carpus, is united at its outer edge with the unciform (*u*); and a long bone to the distal side of which the second and third metacarpals are articulated, represents the magnum (*m*) and the trapezoid (*td*) coalesced as in the skeleton of *Mesoplodon sowerbyi* at Brussels. The bone, of the distal row, most to the radial side might well be considered the trapezium; but it represents the bone which, in other Cetacea, has been considered, with good grounds, to be the first metacarpal. Excluding this, the number of carpal bones are reduced by ankylosis to four. The arrangement on the two sides is precisely similar.

The second and third digits are of nearly equal length, the fourth (*IV*) not much shorter; the fifth (*V*) is well developed and stands considerably apart from the others; the first (*I*) is very small and adpressed. The phalanges were artificially articulated before they came under my observation; and some of the smaller terminal ones are probably missing; but the numbers present are, including the metacarpals, in the first digit 2, in the second 5, in the third 4, in the fourth 4, in the fifth 3.

Dimensions of the Bones of the Right Pectoral Limb.

| | |
|--|---------|
| | inches. |
| Scapula.—Height from middle of superior border to middle of external margin of glenoid fossa | 14 |
| Length of anterior border, from anterior superior angle to anterior margin of glenoid fossa | 15 |

| | inches. |
|--|---------|
| Scapula.—Length of posterior border from posterior superior angle to posterior margin of glenoid fossa | 12 |
| Breadth from anterior to posterior superior angle | 19·8 |
| Length of acromion | 6 |
| Vertical height of acromion at the narrowest part (near its root) | 2·8 |
| Vertical height at the broadest part (near its end) | 4·1 |
| Length of coracoid process | 6·5 |
| Length of glenoid fossa | 4·5 |
| Breadth of glenoid fossa | 3·3 |
| Humerus.—Length | 10·8 |
| Breadth at lower end | 4·3 |
| Radius.—Extreme length | 11·6 |
| Breadth at upper end | 3·3 |
| Breadth at middle | 3·1 |
| Breadth at lower end | 3·3 |
| Ulna.—Extreme length, including olecranon | 12·7 |
| Breadth at upper part, including olecranon | 5·6 |
| Breadth at narrowest part | 2 |
| Breadth at lower end | 3·1 |
| Manus.—Length, allowing for loss of terminal digits, about | 16 |
| Length of first metacarpal | 1·5 |
| Length of second metacarpal | 3·8 |
| Length of third metacarpal | 4·5 |
| Length of fourth metacarpal | 3·5 |
| Length of fifth metacarpal | 3·2 |

Pelvic Bones.—The one pelvic bone sent with the skeleton is very light and spongy in texture, and is apparently not completely ossified at the extremities. Its length is 5·8 inches, and its greatest thickness 0·9 inch; it is thus small in relation to the general size of the skeleton, and would indicate that the animal was a female, if the same sexual proportions obtain in *Berardius* as in many other Cetaceans. It is of very simple form, subcylindrical, a little compressed, and with a slight bend at one third of the length from one end, causing a low obtuse angular prominence on one edge. The characters and dimensions of the bone would probably have been somewhat different if the age of the animal had been more advanced.

Conclusion.—The special osteological characteristics of *Berardius* will be more fully appreciated when our knowledge of the skeletons of the other Ziphioids, especially of the genera *Mesoplodon* and *Ziphius*, is more perfect. We can hardly go wrong, however, in affirming that, as far as the structure of the skeleton is concerned, *Berardius* is a peculiar form of the group, and that it occupies one end of the series of which *Hyperoodon* forms the other, the remaining Ziphioids being in a certain

sense middle forms, and that *Berardius* is, on the whole, the least modified or specialized form, and approaches, therefore, nearer to the true Dolphins, while *Hyperoodon* is the most specialized, being modified in the direction of the Physeterinæ or Sperm-Whales.

The principal points still to be ascertained with reference to the skeleton of *Berardius* are:—1. Whether in the perfectly adult animal any further ankylosis of the cervical vertebræ takes place. 2. What is the number of the phalanges of a perfectly complete skeleton. 3. The form and size of the pelvic bones in the adult of both sexes. 4. Whether there is any difference in the development or form of the teeth in the two sexes. 5. Whether there are any rudimentary, non-alveolar teeth concealed in the gum of either the upper or the lower jaw.

Any one who may be fortunate enough to see the animal in a recent state should observe whether the cutaneous furrows on the throat, noticed in all other Ziphioids hitherto examined, are present; and it need scarcely be added that all observations on the visceral anatomy as well as any facts bearing upon the geographical distribution or habits of this rare and interesting Cetacean will be of great value in elucidating its history and determining its true place in the natural system.

DESCRIPTION OF THE PLATES.

PLATE XXVII.

- Fig. 1. Side view of the skeleton of *Berardius arnouxi*.
 Fig. 2. The skull and vertebral column of the same, seen from above.
 Fig. 3. The sternum, seen from below.

All one sixteenth of the natural size.

PLATE XXVIII.

- Fig. 1. Side view of the cervical, dorsal, and two anterior lumbar vertebræ. The lines from the Roman numerals below the figure point to the surfaces for the attachment of the ribs.
 Fig. 2. Anterior surface of the atlas.
 Fig. 3. Anterior surface of the fourth cervical vertebra.
 Fig. 4. Anterior surface of the fifth cervical vertebra.
 Fig. 5. Anterior surface of the sixth cervical vertebra.
 Fig. 6. Anterior surface of the seventh cervical vertebra.
 Fig. 7. Vertical median section of the skull.

Mx, maxilla; *PMx*, præmaxilla; *Vo*, vomer; *ME*, mesethmoid, united with the frontal above and the presphenoid below; *Na*, nasal; *Fr*, a number of loose wedge-shaped

fragments of bone, apparently dismemberments of the frontal; *SO*, supraoccipital; *BO*, basioccipital; *BS*, basisphenoid; *PS*, presphenoid; *Pt*, pterygoid.

Fig. 8. Inner surface of the right ramus of the lower jaw.

Fig. 9. Hyoid bones. *BH*, basihyoid; *TH*, thyro-hyoid.

Fig. 10. Dorsal surface of the left manus, some of the terminal phalanges missing.

R, radius; *U*, ulna; *s*, scaphoid; *l*, lunar; *c*, cuneiform; *td*, trapezoid; *m*, magnum; *u*, unciform; *I* to *V*, the five digits.

All one sixth of the natural size.

PLATE XXIX.

Fig. 1. United right periotic and tympanic bones of *Berardius arnouxi*, outer surface.

Fig. 2. The same bones, under surface.

Fig. 3. The periotic bone, upper surface.

Fig. 4. The periotic bone, under surface.

Fig. 5. The tympanic bone, upper surface.

Fig. 6. The united periotic and tympanic bones of *Hyperoodon rostratus*, outer surface.

From a specimen in the Museum of the University of Cambridge.

Letters to all the above figures:—*per*, periotic; *ty*, tympanic; *a*, principal or posterior articular surface between these bones; *a'*, broken surface where the two bones had been united; *e.a.m*, external auditory meatus, closed in life by the membrana tympani; *e.p.l*, external posterior lobe of the tympanic; *i.p.l*, internal posterior lobe of the tympanic; *e*, groove for the Eustachian tube; *m*, posterior bony process corresponding in its relations with the mastoid of other mammals, but united with the tympanic; *i.a.m*, internal auditory meatus; *a.f*, aqueduct of Fallopius; *f.o*, fenestra ovalis; *f.r*, fenestra rotunda; *a.l*, anterior lobe of the periotic; *m.l*, its middle lobe; *p.l*, its posterior lobe.

Fig. 7. Median vertical antero-posterior section of the anterior tooth of the right side.

c, cementum; *d*, dentine; *g*, globular dentine; *p*, remains of pulp-cavity.

Fig. 8. Corresponding section of the posterior tooth of the same side.

All of the natural size.

Faint handwritten text at the top of the page.



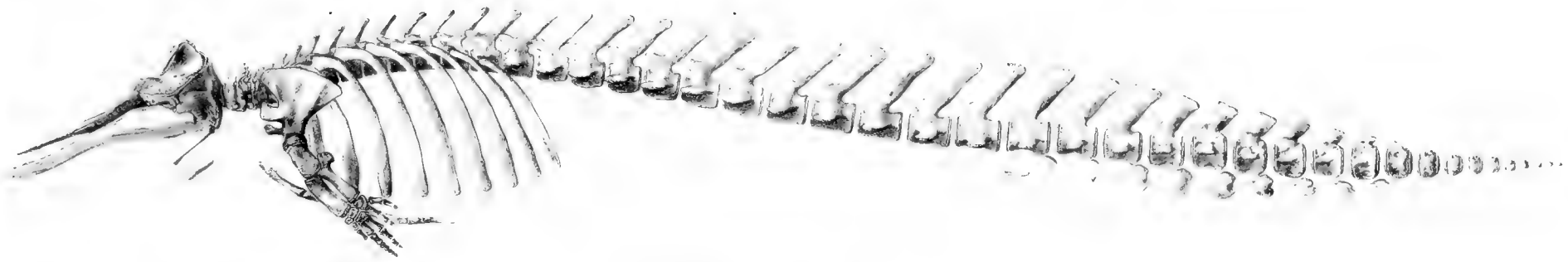






Fig. 2.



Fig. 3.

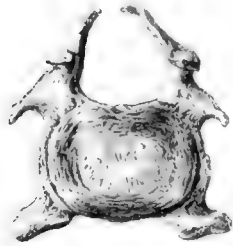


Fig. 4.

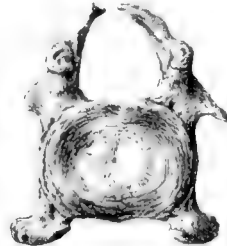


Fig.

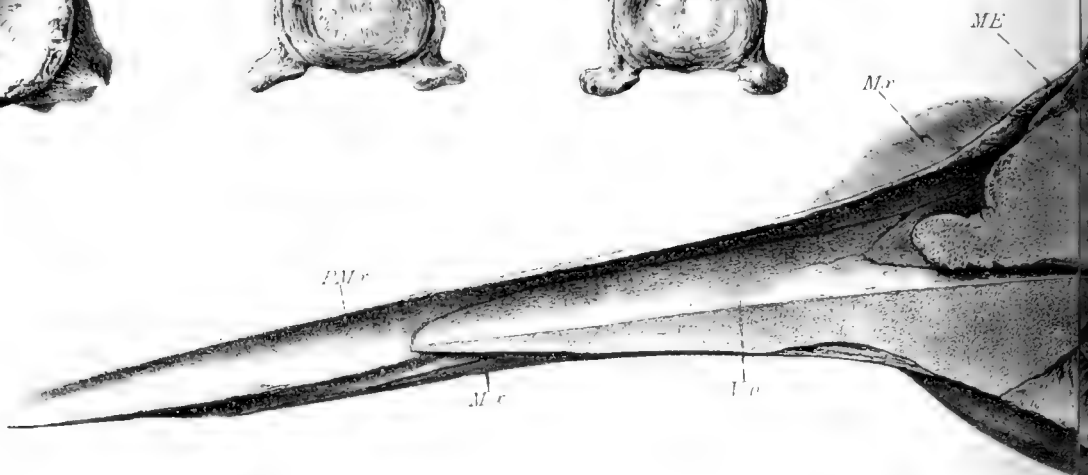


Fig. 8.



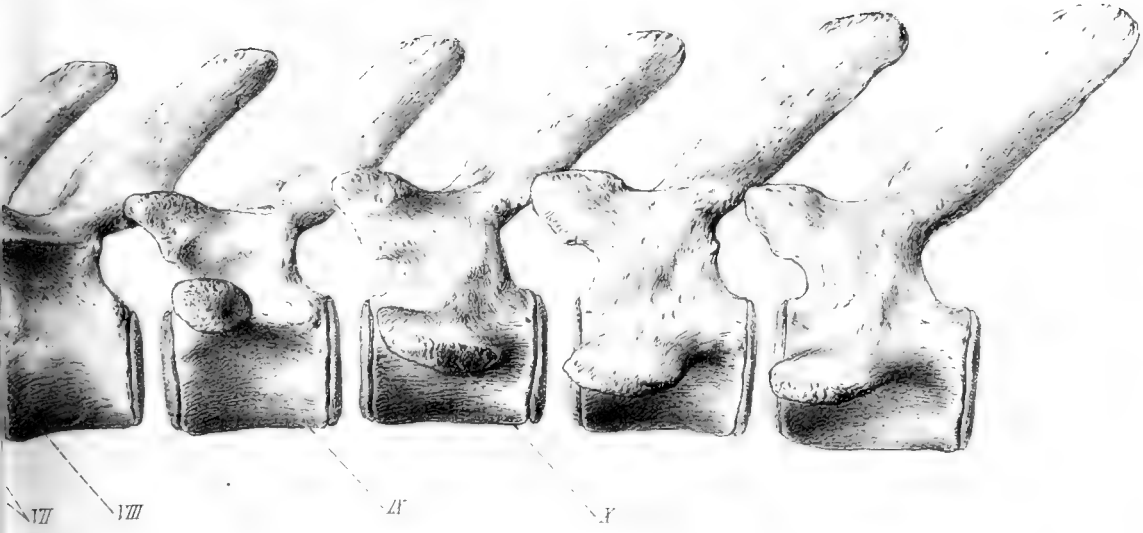


Fig 5

Fig 6

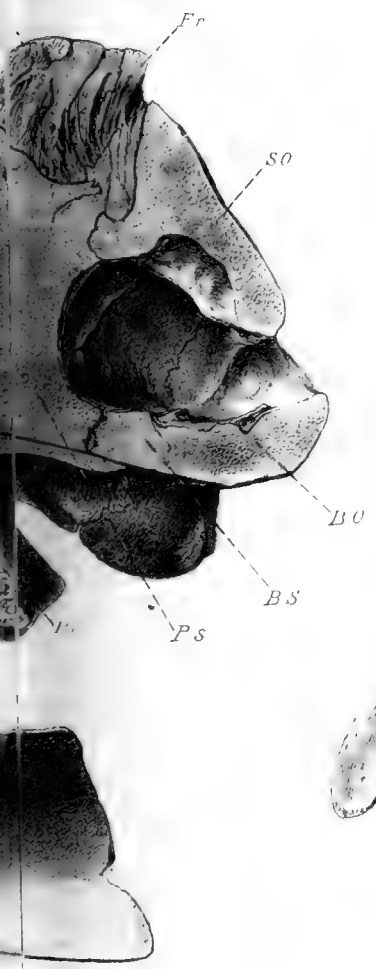
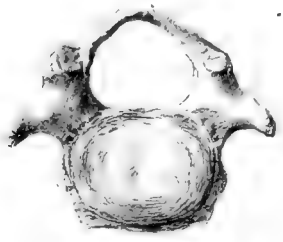
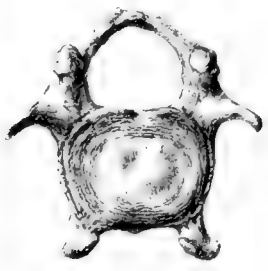


Fig 9

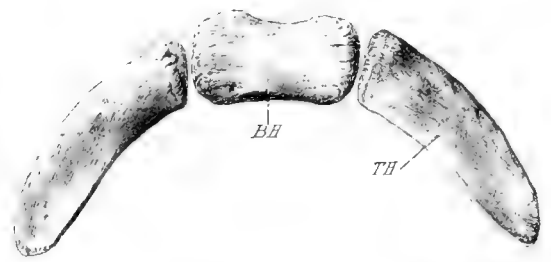


Fig 10

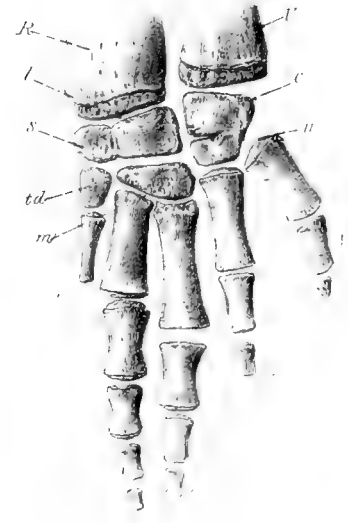




Fig. 1.



Fig. 4.



Fig. 5.



Fig. 2.

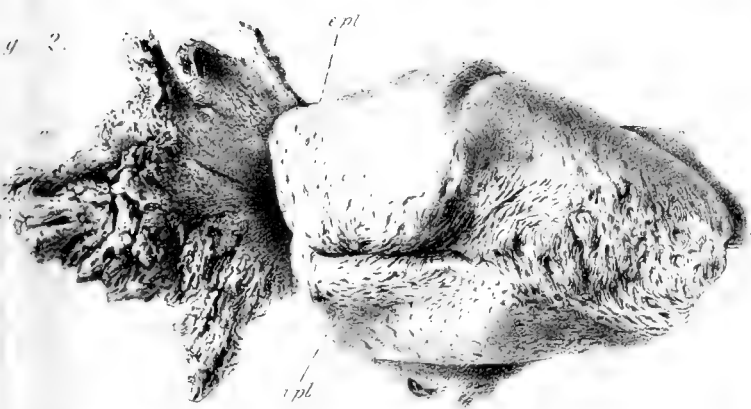


Fig. 3.



Fig. 6.



Fig. 7.



Figs. 1, 2, 3, 4, 5, 7 & 8. BERARDIUS Fig. 6. HYPEROODON



VII. *On the Organization of the Caving Whale, Globiocephalus¹ melas.*

By DR. JAMES MURIE, F.L.S., F.G.S., &c.

Read June 27th, 1867.

[PLATES XXX. to XXXVIII.]

I. GENERAL OBSERVATIONS AND HISTORY OF SPECIMEN.

THE labours of the majority of recent investigators on the Cetacea have mainly been devoted to the skeleton and external characters. These structures form the basis of a truer system of classification which has been engrafted on the previously existing knowledge of the order. Thus, although it is to the skeleton we may look for the safest guide in distinguishing generic and, it may be, specific differences, yet a study of the anatomy of the soft textures and organs, if not yielding such valuable results as regards classification, may still tend to the useful in science, and therefore be commendable.

Hitherto only a few monographs, confined to a full description of a single species, have appeared. Those of Professors Sandifort², W. Vrolik³, Eschricht and Reinhardt⁴ are among the best examples worth citing. But little of a connected nature has been published upon the soft anatomy of *Globiocephalus*⁵, and this so poorly figured that the present attempt to supply the hiatus, it is hoped, will prove an acceptable addition to the literature of the subject⁶.

¹ *Globiocephalus*, and not *Globiocephalus*, has recently been advocated by Professor Flower, T. Z. S. viii. p. 20. Etymologically neither is strictly appropriate; that I follow is known best; usage justifies preference.

² "Bijdragen . . . Walvissen," in N. Verh. d. 1. Kl. Nederl. Inst. 1831 (5 plates).

³ "*Hyperoodon*," in Nat. Verh. Maatsch. Haarlem, 1849 (15 plates).

⁴ "On the Greenland Right Whale," Ray Soc. 1866, from the Danish Trans. 1861.

⁵ *Vide* Dr. Jackson, Dissection of the *Phocæna globiceps*, Bost. Journ. of Nat. Hist. vol. v. p. 160; Gulliver, *Delphinus melas*, P. Z. S. 1853, p. 63; and Dr. Williams, *G. chinensis*?, Gray, Chinese Repository, vol. vi. (1838) p. 411.

⁶ Five years have now elapsed since the present communication was written and read. The above remark, therefore, necessarily applies to that date; for in the interval numerous strictly anatomical papers and monographs, both on the present species and other Cetaceans, have been published. Witness Dr. Macalister "On some points in the Anatomy of *Globiocephalus vineval*," P. Z. S. 1867, p. 477; Professor Turner, "A Contribution to the Anatomy of the Pilot Whale," Rep. Brit. Assoc. 1867, p. 104 (also in Journ. of Anat. and Physiol. Nov. 1867, p. 66, and Nov. 1868, p. 117); M. Fischer, "On *Grampus griseus*," Ann. d. Sci. Nat. 1867, p. 363; Dr. Burmeister, "Anatomy of *Pontoporia blainvillii*," P. Z. S. 1867, p. 484, previously published in the Anales d. Mus. Pub. d. Buenos Aires, tom. i. p. 389, pls. 25-27, also ejusd. Descrip. &c. of *Epiodon australe*, p. 312, pls. 15-20; Drs. Carte & Macalister, "On the Anatomy of *Balenoptera rostrata*," Philos. Trans. 1868, p. 201;

The animal which furnished the material for the present Memoir was one out of above twenty Whales which were killed in the Frith of Forth in the latter end of April 1867. A long and graphic account of the scene of capture appeared in the Edinburgh newspapers at the time, of which the subjoined is the substance:—A “school” of Whales, estimated between 150 and 200 in number, had been seen by the fishermen for a fortnight or so, cruising up and down the Frith. Nearing Prestonpans one day, a boat’s crew went in pursuit and managed to strike one of the largest of the Whales; the struggles to rid itself of the weapon were violent, and the boat at times was in peril. As the animal occasionally rose to the surface it uttered sounds and spouted; its companions meanwhile remained near. Unable to extricate itself from the gear attached to the flesh-imbedded instrument, the Whale darted up the Frith, dragging the boat along with it. Exhausted from the wound and fruitless efforts to escape, after passing Newhaven and the Chain Pier, it suddenly darted into the bay on the east side of Granton Harbour, the “school” of Whales following. Numbers of boats now joined in the pursuit. The Whales thus driven, pressed shorewards into the shallows. A deadly fight ensued; the boatmen endeavouring to harpoon them, while other individuals, armed with picks, spades, &c., waded into the water hither and thither and courageously hacked all within their reach. Artillerymen and volunteers showed their prowess in firing mortal shots. During this encounter a Newhaven crew harpooned one animal, which struck out to sea, followed by such of its fellows as could escape. Hauling the boat and its crew of twelve men behind it nearly as far as Inchkeith, the wounded Whale at last succumbed, and the fishermen secured their well-earned prize. The largest Whale killed measured 26 feet long and 11 feet in circumference; another was 21 feet in length, a third 16 feet long and 9 feet in girth; numerous smaller ones varied in size, the least being between 6 and 7 feet long.

Hr. Malm, “Anatomy of *B. carolinæ*,” *Cefvers. Vet. Ak. Förhandl.* 1868, p. 95; Professor Turner, “An Account of the Great Finner Whale, *Balenoptera sibballii*,” *Trans. Roy. Soc. Edinb.* 1870, p. 197; Professor Van Beneden, “Mémoire sur une Balénoptère capturée dans l’Escault en 1869,” *Mém. Acad. Belg.* xxxviii, 1871; Mr. Perrin, “Notes on the Anatomy of *B. rostrata*,” *P. Z. S.* 1870, p. 805; Professor Struthers, “On *Balenoptera musculus*,” *Journ. of Anat.* 1871, p. 107; J. Murie, *Grampus rissoanus*, *Journ. of Anat.* 1870, *Lagenorhynchus albirostris*, *J. Linn. Soc.* 1870; Professor Gervais, “Remarques sur l’Anat. d. Cétacés,” *Nouv. Archives du Muséum*, 1871, p. 65.

Oddly enough though it may sound, I have to some extent anticipated myself in the order of publication—a circumstance for which I am not responsible. Remodelling a paper is at all times awkward, but doubly so in the present instance, on account of my illustrations having long ago been drawn on stone. I have preferred, therefore, to preserve the original form with abbreviations and emendations in some parts, interpolations and footnotes &c. in others, so as to include recent writings. It would both be unpleasant and unfair for me to pass over in silence the observations of others having the advantage of priority of publication. I must crave leniency if some of my data appear behindhand or irregular in character, inasmuch as to waive all notice of them while giving illustrations would seem as if I were abstracting from the labours of others rather than producing original research on my own part. My plates, however, I am bound to say, will bear testimony to my having examined for myself, and quite independently of what has since been produced by others.

The above account corroborates what has often been told regarding the habits of the Pilot Whale. Their gregarious nature, constancy in following their leader, and manner of bellowing when injured, are peculiarities which have secured them the not inappropriate names of "Deductor" and the "Caaing¹ Whale." Under the latter name Dr. Neil² relates much interesting matter concerning them; and Scoresby³, it seems, at a later date designated them by the former appellation. The latter author quotes an old history of the Faroe Islands, where the name "Grind Whale" is used, probably derived from the ancient Norsemen, as the present Swedish and Danish term is "Grindehval"⁴.

The numbers of these Whales killed in family lots at different periods is something astonishing, a "school" occasionally being decimated at one fell swoop. Authentic accounts show that as many as 40, 70, 92, 98, 150, 190, and 200 have been destroyed at one onslaught. Consult the authors mentioned in p. 241, and also the 'Naturalist's Library'⁵, where Scoresby's figure of the capture of 98 animals at Stornoway is copied.

Mr. Gerrard, jun., of London, learning of the Whale-capture near Edinburgh, proceeded to the spot and purchased seven for the sake of the skeletons. In cutting up one of these he found within it a fœtus⁶ some 3 feet long. This he preserved in spirits and forwarded to the British Museum, where it now forms part of the rapidly increasing national collection of Cetaceans. A female, about 11 feet long, certified by the railway company as being 1 ton weight, was also transmitted to London for the purpose of a plaster cast of its body, intact, being taken by Mr. Frank Buckland. The casting of the huge marine mammal was safely accomplished; and this is deposited in the Museum of Pisciculture at the Horticultural Gardens. I dissected the carcass of the last-mentioned female specimen, the description of which is embodied in the text. The bones, roughly cleansed, were afterwards transmitted to Professor Krauss, Director of the Museum at Stuttgart⁷.

¹ A word of Scottish derivation, signifying to drive; see Traill and Brown, P. Z. S. 1868, p. 555.

² Tour through some of the Islands of Orkney and Shetland, Edinb. 1806.

³ Arctic Regions (1820), i. p. 496.

⁴ "Synopsis of the Cetaceous Mammalia of Scandinavia," by Professor Lilljeborg, Ray Society, 1866, p. 238.

⁵ Vol. xxvi. p. 214, and fig.

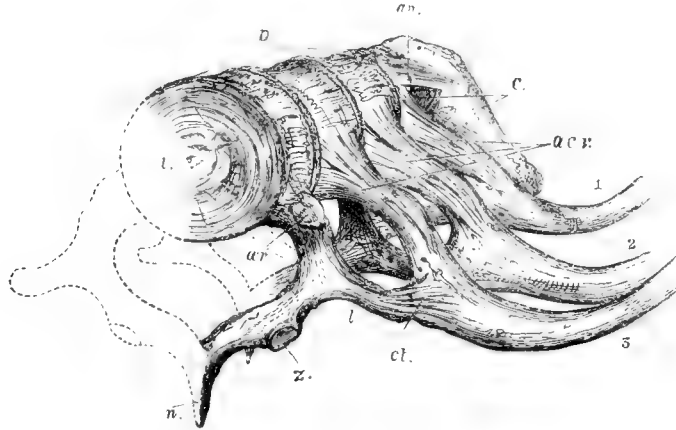
⁶ Gulliver gives the measurements of a fœtus in his notes of the Dundrum-Bay Cetacean herd (*l. c.*); and see Van Beneden's account of a fœtus *in utero* of the same species (Bull. Acad. Belg. tom. 7, 2nd ser., p. 439), and of another from *B. rostrata*; also Turner, in *B. sibbaldii* (*l. c.* p. 203), and *Orca gladiator* (T. R. S. Edinb. 1871, p. 467); likewise Dr. Meig's "Observations on the Reproductive Organs and on the Fœtus of the *Delphinus nesarnak*," Journ. Acad. N. S. Philad. vol. i. part 3, Aug. 1849, p. 267, pls. 35, 36.

⁷ During the autumn of 1867 I paid a visit to Stuttgart, and Professor Krauss then showed me the skeleton. Its partially macerated condition, however, forbade my doing more than making a memorandum concerning the skull. This agrees with the characters appertaining to the species, and in measurements nearly corresponds to No. 3 in the College of Surgeons, as given by Dr. Gray (Cat. Seals and Whales, 1866, p. 315). Extreme length 23½ inches; width 14¼ inches; length of palate 11½, and greatest diameter 7½ inches; mandible 18 inches long and 6 inches deep at coronoid process; narial aperture 4½ antero-posteriorly, and 3½ inches from side to side. Ribs 11—11, of these four are attached to the sternum and one to the ensiform cartilage; the remainder are

II. THE CAAING OR PILOT WHALE'S EXTERNAL CHARACTERS.

All observers more or less coincide in describing the colour of *Globiceps* as deep black (hence Traill's specific name *melas*¹), excepting a partial whitish streak on the

free. In their magnificent 'Ostéographie des Cétacés' (pls. 51 & 52), Gervais and Van Beneden figure the skeleton of this species, and skulls &c. of others of the genus. See also Gray and other authorities.



Inferior side and partially posterior aspect of the cervical and a few of the anterior dorsal vertebrae and segments of ribs of the Caaing Whale (*G. melas*), demonstrating ligamentous structures.

n, dorsal and c, cervical vertebrae; 1, 2, 3, the ribs in succession; an, anterior nuchal or forward termination of the anterior common ligament of spine; a.c.v., anterior costo-vertebral or stellate ligaments; ct, costo-transverse ligament; i, intervertebral cartilage; ar, articular surface or capitular facet; t, transverse process; z, zygapophysial facet; n, neural spine.

As more intimately related to the skeleton than to the myology, I have shifted to this place the illustration and few words I have to say regarding some of the ligaments. The woodcut is itself explanatory, and designed to show a dissection I made of the costal ligamentous unions. The anterior nuchal ligament, besides some longitudinal fibres, has more notably a strong oblique band, which passes from the body of the first dorsal to the united axis and atlas, lying upon the surface of the compressed posterior cervicals. This is partly a continuation of the anterior common ligament of the spine, but, moreover, may be representative of or include the so-called anterior atlanto-axial ligament of Man. Each rib is lashed to the vertebrae by a long, uncommonly strong, but yielding, anterior costo-vertebral or stellate ligament. This has only a partial trifid division, which is spread both on the ventral surface and side of the vertebral body, and on the adjoining intervertebral cartilage. It is likewise very firmly fastened over the head of the rib. Between the capitulum and vertebral facet is an intervening pad of cartilage. The costo-transverse ligament has its thickest set of fibres beneath; and the first rib has its due share of these. This articulation in all the ribs is simple in its nature. The dorsal intervertebral cartilages are dense; in the neck they are reduced to thin laminae; but the latter I was not at liberty to investigate with accuracy.

Professors Van Beneden, of Louvain, and Struthers, of Aberdeen, in their dissections of *Balaenoptera musculus* (memoirs already cited), have each briefly indicated some interesting points elucidating the cervico-dorsal, first rib, and sterno-costal articulations of that species.

¹ His original diagnosis runs:—"Corpore crasso, nigro: pinna dorsali una brevi: pinnis pectoralibus longis,

abdominal region. Some, however, attribute to this black colour a shining lustre, "like oiled silk," which G. Cuvier¹ defines as *gris noirâtre*. In the specimen dissected by me, the head, body fins, and tail were decidedly of a black hue. When the surface of the skin was moist it possessed an appearance which might be compared to the outer polish of fresh india-rubber; but as the integument dried it assumed more of a lamp-black or sooty tint. This variation in shade, there can be no doubt, was attributable to the reflection or partial absorption of the rays of light, according as the superficial layer of the cuticle was wet or dry. A similar alteration in depth of tint has been observed by Heddle² and myself³ as occurring in the genus *Physalus*. I have suggested, as a partial explanation of the phenomenon⁴, that the epidermis, readily separable into superimposed delicate layers, allows, under certain conditions, less or more of the subjacent pigment to predominate.

As remarked by the various writers, *Globiocephalus melas* (= *G. svineval*, Gray) is characterized by having a long posteriorly narrowed white stripe upon the abdomen. This commences at the hinder end of the throat, and widens in the pectoral region in a kind of heart-shaped or partially cruciform manner; thence it gradually narrows as it goes backwards on the abdomen, and finally terminates in a point a little in advance of the genital fissure. In these respects our specimen agreed. I had intended to have figured this abdominal view, as Baron Cuvier's illustration in the 'Annales'⁵ is rather deficient in clearness, but my chance was frustrated by my assistants partially flensing the belly during my temporary absence.

It is noteworthy that the dark colouring of the sides of the body shades by an intervening olive-green and grey tint into the yellowish rather than pure white of the abdomen. This assimilation of the extremes of colour by neutral or median tints, is the same which obtains, but with more mottling, in the Common Porpoise.

I believe Cetaceans, like other animals, vary within certain limits according to age and sex. The general outward conformation of this female might not inaptly be compared to a club with three outstretched falcate processes (dorsal and pectoral fins) abreast of its middle, and a semilunar transverse keel (the tail) at the narrow or handle end. This fancied resemblance to such an instrument is no mere stretch of the imagination, as the bird's-eye dorsal view (fig. 2) more especially certifies. In the lateral aspect of the body (fig. 1) the snout is seen to be very globose and prominent; hence Cuvier's term *Globiceps*. This protuberant swelling projects vertically nearly as far as the upper lip, a wide shallow sulcus, however, intervening.

The mandible and its dense labial covering are shorter than the premaxillary portion

angustis: rostro obtuso: maxilla superiore præclinante: dentibus acutis conoideis parum incurvatis" (Nicholson's Journal, 1809, xxii. p. 83).

¹ Ann. du Mus. d'Hist. Nat. t. xix. p. 3.

² P. Z. S. 1856, p. 193.

³ P. Z. S. 1865, p. 207.

⁴ See also a remark thereon by Professor Turner in *Balænoptera sibbaldii* (l. c. p. 203).

⁵ L. c. pl. 1. figs. 2 (♂) and 3 (♀).

of the cranium and its superincumbent nodosity. The under surface of the chin deepens towards the throat; and the contour from this point ventrally towards the tail is a nearly uniform, narrowing, sweeping line. The dorsal antero-posterior curve almost corresponds to the abdominal one, excepting where interrupted by the back-fin. Towards the caudal extremity the perpendicular depth is but moderate. Opposite the dorsal fin the body insensibly narrows, which narrowing steadily increases the nearer it approaches the root of the caudal fin, and becomes laterally compressed.

The subjoined measurements of our female give the relative total length in a straight line, and curvilinearly following the dorsal arch, in distances between various points. From these data it follows that the amount of arching of the back and projecting mass of the snout is longer by about one foot and a half than is the body taken in a horizontal parallel straight line.

| | ft. | in. |
|--|-----|-----|
| Length from the snout to the fork of the tail. | 10 | 10 |
| Distance from the projecting upper lip to the blow-hole, following curve | 1 | 11 |
| From the blow-hole to the anterior root of the dorsal fin | 2 | 9½ |
| Dorsal fin in length at its base | 1 | 9½ |
| Distance from the posterior root of dorsal fin to tail's root | 4 | 9 |
| Tail from root to fork | 1 | 0 |

The dorsal fin is a prominent feature in the profile outline of the animal. It is large, falcate-shaped, and very much laterally compressed near and at its upper free margin. The anterior upper smooth border forms the segment of a wide arch whose summit is perpendicular to the posterior attached root of the fin. Behind, it terminates in an almost hook-like manner. The posterior inferior border is deeply emarginate. This fin is situated in front of the middle of the body. Measured from the centre of the fin itself, the distance between it and the front of the truncated snout is six inches less than from the same point backwards to the root of the tail, while it is eighteen inches less when the measurement is carried to the fork of the tail-fin.

The dimensions of the dorsal fin are:—greatest length or that continuous with the upper curved border to the hooked tip, 2 feet 1½ inch; length of the base in a straight line, 1 foot 9½ inches; greatest vertical height, 8½ inches.

In relation to the body, the low-set position, and the peculiarly narrow, tapering, scythe-shape of the pectoral fins, in contrast with the blunt globose snout, render the Pilot Whale at once as remarkable as it is characteristic among the Cetacea. Each pectoral extremity or fin is thin and knife-like on the edges. The length, taken in a straight line, is 1 foot 10½ inches; but the measurement following the curve of the anterior border equals 2 feet 3½ inches, whereas the posterior border in its curve is only 1 foot 6½ inches. Their position is about the posterior third of the distance between the snout and the anterior end of the dorsal fin.

In shape the tail seems uncommonly like that of the Porpoise. It nevertheless

differs, inasmuch as the terminal free borders of the flukes are straighter or set more at a right angle to the long diameter of the spine, as Couch has observed. The tips of the flukes are also relatively more pointed than in the Porpoise. The median incision or fork is but of moderate depth; and in this specimen no overlapping of the adjoining borders occurred, as is occasionally found in *Phocæna communis*.

The measurement of the tail gave the subjoined results:—

| | ft. | in. |
|---|-----|-----|
| Distance from tip to tip of the flukes | 2 | 3 |
| The transverse diameter at middle of flange | 1 | 6 |
| The transverse diameter at the root | 0 | 3 |
| Length from the vertebral root to the fork | 1 | 0 |
| Length of the outer border of each fluke | 1 | 7 |
| Length of the inner or posterior border of the same | 1 | 2 |

If the accompanying illustrations be compared with those of Traill¹, the Cuviers², Scoresby³, Bell⁴, Jardine⁵, and Couch⁶, it will be seen that they do not quite correspond to one or other in outline or proportions. As the latter authority finds fault with the figures extant, and professes to correct previous delineations, I may be allowed to point out wherein his own as well as others differ from those views now given. To my mind, indeed, Mr. Couch's representation does not nearly so well convey an idea of the curious club-like, yet harmonious, symmetrical appearance of the Pilot Whale's body as do the very authors whom he quotes as having misrepresented it. In his specimen the dorsal fin is far too rounded at its posterior extremity, the pectoral fin too thick at its proximal half, and the caudal extremity of the body at the setting-on of the tail has too great vertical depth in proportion to the dimensions of the figure. What he remarks of Scoresby's and Bell's flexion of the tail forwards may be just, though not necessarily so. In but one point does he decidedly agree with my observations, namely the shape of the tail.

A pardonable error often fallen into in Cetacean illustrations is too great thickness of the body relative to its length. This happens on close inspection of the animal, which deceives as respects its vastness—considering that, as a whole, there is a certain symmetrical graceful proportion, *i. e.* thickness and breadth which decrease in an equivalent ratio rearwards. Such is my experience of the *coup d'œil* in various Whale genera I have seen in the flesh. In this respect Professor Traill's figure fails; moreover the dorsal fin is too much rounded, the pectorals proportionally in advance of their true position, and the eye rather high.

Of Baron Cuvier's side view of a male *Globiceps*, copied by his brother Frederick, I may note that the nasal prominence is less abrupt, and the distance betwixt this and the

¹ *Loc. cit.* ² *Annales*, as already quoted; also *De l'Hist. Nat. des Cétacés* (Paris, 1836), pl. 13. fig. 2.
³ *Op. cit.* pl. 13. fig. 1. ⁴ *British Quadrupeds*, p. 483.
 Naturalist's Library, *loc. cit.* p. 212. ⁶ *Ann. Nat. Hist.* vol. ix. (1842), pl. 6.

dorsal fin greater than in the present fig. 1. Moreover a faint depression is given to the occipital region, whereas in mine there is a gradual elevation at the same point. The depth of the root of the tail is exaggerated; and the pectorals spring quite from the abdomen. If his belly view be contrasted with the present dorsal one (fig. 2), it will be evident that the thoracic region is flatter than I have found it, the caudal root thicker, the terminal emargination wider, and the flukes antero-posteriorly narrower.

III. PARTS RELATED TO THE SENSES.

1. *The Eye and its surroundings.*—On first beholding a large Whale, among other things which impress strangeness of aspect to this marine mammal is the seemingly small organ of vision. The narrow elliptical aperture of which and dull-coloured eyeball (at least when the animal is dead and shored) give an odd and sly expression, contrasting unfavourably with those lustrous orbs of most Seals, or even with the wide optics, though lurid hue, of many great fish. John Hunter¹, always philosophical in his similes, supposed that their locomotion is not great on this account, and considered them as sea soarers compared with birds.

Situated a little higher than the angle of the mouth, from which its anterior canthus was 4 inches distant, the eye of *Globiceps*, as in all other Cetacea, appears extremely diminutive. The palpebral fissure, a narrow ellipse, and without eyelashes, has an extreme length of $1\frac{1}{2}$ inch. The two eyes are $29\frac{1}{2}$ inches apart, as measured following the arch of the head. The horizontal dark-coloured pupil is ellipsoidal, and $\frac{3}{4}$ of an inch in antero-posterior diameter.

When the tegument is removed, an external muscular sphincter is brought into view. This representative of orbicularis palpebrarum is only moderately developed, the fleshy fibres being intermingled with fatty tissue. Rapp² denies the existence of upper fibres in the Porpoise; but my observations both in small and large genera coincide with Stannius³ and Carte and Macalister as to their oval figure round the orbit.

In the *Globiocephalus* killed near Lewchew, the eye is mentioned as having a "sclerotic nearly osseous; iris dark, but not red or orange"⁴. In one of the specimens stranded at Dundrum Bay, Gulliver says that "around the eyeball was a firm bony plate in the sclerotic coat"⁵. In the present specimen the sclerotic certainly presented a dense fibrous texture, where thickest simulating cartilage in appearance, as in other Cete, but no true bone obtained.

2. *The Nasal Passages: Homology of the Sacs and adjunct Fleshy Structures.*—Dr. Francis Sibson⁶ has commented "on the Blow-hole of the Porpoise;" and (excepting, it may be, in the number of muscular layers) my observations on that animal corroborate

¹ "Observations on the Structure and Economy of Whales," Phil. Trans. 1785, vol. xvi. p. 335.

² Die Cetaceen zool.-anat. dargestellt, 1837, p. 92.

³ "Beschreibung der Muskeln des Tümmlers," Müll. Archiv f. Anat. 1849, p. 11.

⁴ Chinese Repository, l. c. p. 411.

⁵ L. c. p. 66.

⁶ Philos. Trans. 1848, p. 117.

his with regard to the structures. He looks upon the whole only in the light of a mechanical apparatus, and shows that the adjustments are such that "when the outer passage is closed, the posterior pouches can be distended and the anterior are emptied; and when the passage is open, the anterior pouches can be distended and the posterior are emptied." He believes the pouches serve to buoy up the head, and considers the spouting of the Whale to be sea-water regurgitated from the stomach.

Stannius¹ alludes to only a single muscle connected with the nasal sacs and spout-hole; this he calls the *nasalis*. He apparently disregarded the separation into layers of the muscular constituents surrounding the outer naris and its pouches. He describes, moreover, a *musculus cutaneus maxillæ superioris*—to wit, the long premaxillary muscle covered by the blubber (*N* of my plates); but as this is posteriorly interwoven with the buccinator, he includes it under the cheek-muscles.

With the exception of Hunter's² lucid physiological deductions as to the use of the nasal sacs, Von Baer's paper³ is by far the most philosophical description and piece of reasoning treating of this curious Cetacean apparatus. In it he notices the existence of a small single bone near the intermaxillaries, which Camper believed to be a process of the ethmoid, though other anatomists have overlooked it. Von Baer regards this little bone as a rudimentary inferior turbinate. There are cartilages present which he considers represent the blade of the ethmoid and not the vomer.

He goes on to say that Cuvier only takes notice of two nasal sacs, Camper and Ray thought there were three, while Blainville speaks of two pairs. He then gives a description of the sacs as they in reality exist in the Porpoise, and of the external layers of muscles. He states these may be divided into as many as six portions, which, however, he is inclined to regard as but one entire layer infolded upon itself. He pointedly observes, moreover, that they have a general resemblance to the nasal muscles of Man. There is, he thinks, no special sphincter to close the blow-hole, as the lips are thick and close together by their own elasticity. According to Blainville the sacs have three pairs of muscles acting upon them. Von Baer criticises Cuvier and others who say the muscles press upon the spout-hole to eject water therefrom, whereas he reasons upon his examination and known data to show that view is not tenable. From smell and inspiration of air having but a single passage, Von Baer believes the former is subdued.

He further discusses the number and position of the turbinal bones in various orders of animals, and shows that the anterior one in them has been taken for the upper one in Man, whereas he avers this is not the case. Gurlt, as he mentions, calls it the middle turbinal bone. Von Baer himself admits, however, that the turbinals are not specially organized parts—in other terms, are irregular in construction. He endeavours to show in different genera of Cete that the blow-hole influences the formation of the

¹ *L. c.* p. 4; and Rapp, p. 106.

² *L. c.* p. 335.

³ "Der Nase der Cetaceen," *Isis*, 1826, p. 811.

skull. The main facts, as he well exemplifies, are, that the turbinals alter from the horizontal to the vertical position, and occasionally in some animals are more than three in number. Moreover he upholds that the upper corrugated nasal sacs of the Whales are the homologues of the anterior or maxillary turbinate bones, in them a fibrous and not hard sclerous skeleton; and, again, the posterior sacs may possibly represent the inferior or ethmoidal turbinates. The outer opening he takes to be equivalent to the narial orifices of other animals with muscles attached; the cartilages in the Whales being absent.

Olfactory nerves obtain, but very diminished in size, indeed hair-like; but he is dubious as to their capacity in influencing smell, which he believes to be very much modified in the Cetaceans.

It seems to me that Sibson loses sight of the significance and homology of the parts in their ulterior specialization as a cranial floating organ—this, in my opinion, being as absurd a proposition as that, from the direction of the first stomach of the Rorqual, water swallowed in plenty (?) is thrown up therefrom. The otherwise correct Stannius must have but glanced at the fleshy narial layers. With Von Baer I agree, not only in surmising, but in recognizing individual nasal muscles, homologues of the occasionally diminutive series connected with the nose and upper lips in higher Mammals. I have little doubt also that odour, in a modified condition from land-breathers, is appreciable to the marine Cete, which notion Hunter had already promulgated. I am inclined to think the skull's development quite as much influences the position of the blow-hole than the reverse; but I differ most decidedly from Von Baer in not recognizing in the nasal sacs transformed turbinate bones.

In this female *Globiceps* the outer orifice of the blow-hole, or naso-respiratory opening (figs. 3 & 2), is situate upon the summit of the forehead, vertically rather behind the eye, and, as in *Delphinus*, a trifle to the side of the median line. It is distant rearwards 23 inches from the front of the labial prominence, and its outer angles each a foot from the eye. In the ordinary condition of the parts the lips of the aperture are closely approximated, leaving only a wide V-shaped transverse shallow sulcus, with slightly sinuous edges. This slit measures barely 2 inches from corner to corner, and its mid angle is directed backwards. When looked into by pressing forwards with the finger the front margin (as fig. 27, of *Lagenorhynchus* depicts), part of the anterior and lateral walls are seen to be thrown into innumerable fine striæ or black-pigmented cuticular wriggly but parallel rugæ, which radiate centrally and forwards. These, the loose surrounding membrane, and deep fatty tissues give great elasticity to the parts; which, furthermore, from two obliquely transverse cushions or backwardly resilient and smooth fibro-cartilaginous oblong bodies, naturally close the orifice while the muscles are relaxed.

At first intent I had described the spiracular cavity, and its sacs in detail, of our specimen. But as in my papers on Risso's *Grampus* and the White-beaked Bottlenose,

a careful survey of these structures has been instituted, it is unnecessary to pursue the subject here. I may add, though, that the sacs of *Globiceps* are three on either side, the so-called facial division of the naso-frontal being absent. All three genera, therefore, differ from *Phocæna* in division of the anterior or slipper-shaped premaxillary cavity.

The next structures whereby homology of parts can be traced are the cartilages. These, compared with the massive head, I may say, are very small, much interwoven with the fibrous and fatty tissues bordering the narial orifice, but nevertheless traceable. Shooting forwards from in front of and between the nasals as a narrow, short and diminutive wedge, is a little stump of cartilage, which I take to be the prevomerine ethmoidal or septal cartilage in a very rudimentary condition¹. On each side of the above, partly continuous and partly connected by fibrous material, is another, irregular-shaped but somewhat curvilinear and small fibro-cartilaginous isthmus, but which I could not satisfactorily follow out. From position they would accord with the upper lateral cartilages of land Mammalia. Lastly, forward from these and only connected by fibroid tissues (I speak only as far as my dissection permitted me to observe) are the two much larger and transversely oblique masses, visible in the upper opening of the nares, and which are composed of fibro-cartilage fatty substance and mucous membrane. As bearing relationship to the above mentioned, these bodies, to my reading, are homologous with the alar cartilages and their mucous membranous covering, either in whole or in part.

Now, if these fibro-cartilaginous masses collectively be rudiments of what I have said, even though I may have mistaken them individually, they afford a clue by which the muscular layers above can be understood aside from their office of dilators and compressors of the sacs and narial orifice. Furthermore the muscles and the cartilages furnish data expressive of what the nasal sacs are themselves. Von Baer builds up his homological theory of the Cetacean nasal sacs being the turbinate bones upon one gratuitous assumption, which if unsupported by other evidence than he has given, the whole structural pile of his reasoning falls baseless. I allude to the fact that he considers the thin fibrous induplicated membrane of certain of the rugose sacs an arrested condition of the osseous twisted laminae of the turbinals. In short, he takes for granted membrane replaces bone. As to this being the case, we have not a shadow of evidence. Indeed it is far more reasonable to suppose the ethmoidal turbinates aborted or entirely absent, than that they should be represented by or be transformed into a sacculate membrane of fibro-areolar consistence. It is undoubted that the Cetacea have singularly modified skulls. Some bones are very diminished in size, some wonderfully increased, and others jammed into most abnormal positions, or are unsymmetrical; but I think it yet lacks positive proof that a membrane completely replaces an entire cranial bone in the adult cranium.

Luckily for me, Von Baer compares the Porpoise's nasal sacs with those of a calf,

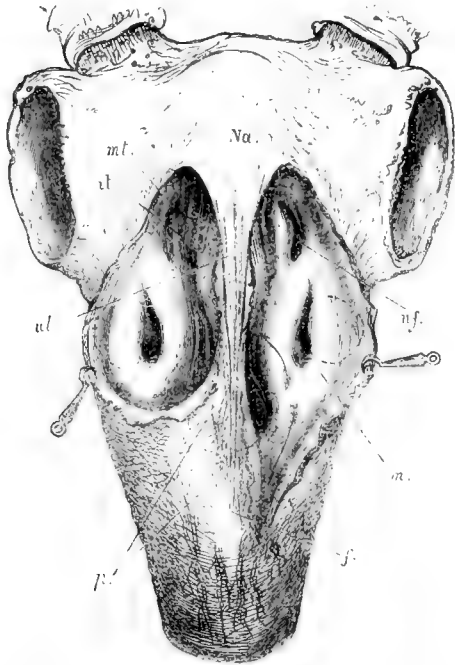
¹ As bearing on the subject, consult Dr. Cleland's well-reasoned paper "On the Relations of the Vomer, Ethmoid, and Intermaxillary Bones," *Philos. Trans.* 1863, p. 289, pls. 4 & 5.

among other forms; and Professor Huxley¹, who appears to support his views, instances the Tapir as having the ethmoidal turbinals posterior to the maxillary ones. Although the latter statement must be admitted, I will nevertheless confine myself to this animal, and more especially to a Ruminant, as excellent types, leading me to believe the Cetacean nasal sacs are not at all modified turbinals.

The Ruminant markedly possessing the shortest nasal bones, and therefore Whale- and Tapir-like in this respect, is the Saiga (*Saiga tartarica*). Moreover this Ruminant, like the Tapir, has a soft narial proboscis—shorter no doubt; but also as in that animal it has well-developed turbinal bones, the maxillary one of which, if not quite in advance of the ethmoidal, is at least nearly so. But both these animals have other nasal structures simulating closely, if not indeed the veritable homologues of, the Cetacean spiracular sinuses and their rudimentary nasal cartilages.

Adverting first to the Saiga², I have found on dissection its protruberant snout to

Fig. 2.



A partial upper view of the face of the male Saiga, with the nares opened on both sides, so as to display the parts which I deem homologous with the spiracular cavity and appendages of Whales.

Na., shortened nasal bones, from which runs forwards (*ul.c.*) the upper lateral cartilages comprising also the alar; a narrow fibrous cord (*f.*) is continued anteriorly into the soft patulous nares; *mt.* and *it.* denote respectively the middle and internal turbinals; arrows in contrary directions indicate the course of the main narial passage; *nf.*, sulcus corresponding to the naso-frontal canal of Cete; *m.*, inner orifice of the maxillary sinus or sac, the dots giving its entire outline; *p.*, palatal recess agreeing with Cetacean premaxillary sacs.

be made up of tegument, carneous substance, vessels, and nerves, lined with a delicate mucous membrane. The muscles can be identified with those smaller bands &c. which act on the nose-chamber and upper lip in other and higher Mammalian orders. The nasal cartilages are insignificant, and pass but a little beyond the short nasal bones; yet

¹ Hunterian Lectures, 1866, Reported in abstract, *Med. Times and Gazette*, p. 350, March 31 of that year.

² See *P. Z. S.* 1870, pp. 461, 478, figs. 5 & 8.

an upper lateral, alar, and rudiment of sesamoid are there. Quite within the narial passages on each side of the cavity, partially below but vertical with the alar cartilage, is a small globular bag which opens by a fissure into the nares. This sac, which I have named the maxillary sinus, is fibrous, smooth, yet glandular within, and contained sebaceous or ceruminous-like substance. Still higher on each side, and lying between the maxillary, turbinal, and lachrymal bones, and therefore nearer the nasals, is another semilunar depression or shallow sinus $\frac{1}{2}$ inch long, nearly vertical, though somewhat crescentic. A third and much better marked cavity exists on the floor of either moiety of the nares. This, a slipper-shaped fossa or sinus-like fold, is sunk forwards, or produces a well defined step about an inch long betwixt the deeper postnarial chamber and the more raised floor of the anterior segment of the interior nares. The two last-mentioned pairs of fossa are each smooth-surfaced and lined by a continuation of the moist mucous membrane. Anteriorly the nares are capacious, and under control of the flabby but muscular parietes.

Secondly, as regards the Tapir, the late Mr. H. N. Turner¹ has shown, and a dissection on my own part² verifies, that quite within the nose, in the semicircular notches outside the projecting nasal bones, are two long, smooth-lined sacs or naso-frontal maxillary sinuses. Each of these is somewhat *f*-shaped, the blind and bulbous posterior extremity being curved inwards, the anterior straighter end freely communicating with the interior nares. These elongate sinuses are mainly hollowed out of what Turner supposes to be the lateral nasal cartilages, continuous with the septal. He thinks alar cartilages are absent; in this I do not quite agree. The muscles of the proboscis are arranged after the usual type of the nasal group, with a special pair of long levators.

I refer the reader to my illustrations and account of the anterior cranial muscles of *Lagenorhynchus albirostris* and *Grampus rissoanus*, and the figures 63 to 67 of the present plates, in lieu of redescription. The latter has one layer less than the former, and the diminutive fascicles connected with the naso-facial canal are not so markedly differentiated.

As regards the action of the different layers in *Globiceps* &c., they are nearly identical in the several forms. The superior layer is a dilator of the blow-hole and compressor of the maxillary sac; the second sheet assists the first. The third set of fibres assimilates to the preceding in its use; but there is an additional mechanism of the parts induced by its upper anterior tendinous slip. This runs quite into the nasal blubber; and the fibres cross well over, so that, while creating tension of the fatty nodosity, a certain amount of backward pressure follows, and aid is lent to the elastic fibrous cushion which usually keeps the commissure of the nasal orifice closed. The small, short, and semicircular muscle connected with the posterior canal acts as a retractor and compressor to it. What I have termed premaxillary or naso-labialis, while less fleshy in *G. melas*

¹ P. Z. S. 1850, p. 103.

² *Rhinocærus sumatranus*, Journ. of Anat. & Phys. vol. vi. p. 138, and figs. 8 & 9, pl. x.

than in the old *Lagenorhynchus*, nevertheless offered more appearance of separation in the latter (*vide* figs. 63, 64, *Nl*). The combined action, however, agrees, *viz.* protraction and retraction of the lips of the blow-hole, according as the longer anterior or shorter fan-shaped vertical fibres contract, and also, coincidentally, compression or dilatation of the premaxillary sac.

A dilator naris, retractor *alæ* nasi (*seu* pyramidalis plus constrictor naris, = compressores naris), and depressor *alæ* nasi muscle, in superincumbent planes, besides a vomerine and alar fibro-cartilages, are described by Carte and Macalister as existing in *Balenoptera rostrata*¹. Whether they or I have interpreted the structures correctly future investigators must decide. But as regards the muscles I would note that the attachments and numbers of layers more truly belong to the entire facial set of land Mammals than are only restricted to the homologues of the nasal group.

3. *Skin and Subcutaneous Coverings*.—The skin over the entire head is very thin, hardly exceeding 0.1 of an inch; and the superficial film of cuticle has only a thickness of about $\frac{1}{100}$ of an inch. Beneath the skin proper, and corresponding to the subcutaneous tissue of other Mammals, is a dense fibro-elastic tissue, composed of innumerable reticulations of white glistening fibres, intermingled with fatty or oily material. Some of these fibres are stronger and more prominent than others, so that, as seen in vertical section (fig. 26), there appears to be an irregular meshwork of thickish and more delicate thread-like fibres laid together, warp-and-woof fashion. Some are directed longitudinally, others transversely, and others again entwine obliquely to the cord of the nasal prominence. Here and there between the fibres white puncta manifest themselves, these being nothing other than cross and tangential sections of the fibrillæ themselves.

The entire body, side of the head, and throat in *G. melas* has an envelope of pale yellow-coloured fat, similar in consistence to that found in the same situation in the Porpoise. This fat thins as it approaches the root of the tail, and upon the caudal expansion is lost in the strong fibrous substance of which that organ is composed.

On the body generally the fat has a depth of from 1 to 1½ inch. In some parts, for example the throat and the chest between the pectoral limbs, it is even more. Where the latter become free it diminishes; and quite on these appendages it is barely recognizable. Indeed, on the limbs strong fibrous, almost gristle-like substance takes its place; and this latter, towards the free extremity, becomes itself so reduced in quantity that at the point only a very thin layer of fibro-membrane intervenes between the upper and lower dark-coloured external tegument. Upon the back, in front of the dorsal fin, the fatty tissue is more interwoven with fibres, and finally, in the fin, resolves itself into dense, firm and elastic texture, truly more cartilage-like than fibrous.

Regarding the function of the semirigid dorsal fin in this and some of the allied genera we have not the remotest conception, unless balancing of the body in the watery element has something to do with it. But it does not seem a necessary

¹ See their chapter on its "External Nares," *l. c.* p. 238.

adjunct to the creature's correct equilibrium; for we find several widely different genera of the Cetacean order wanting this appendage. It is within the range of possibility it may be one of those organs the homologue of which we detect in forms removed; and to our appreciation of things, functionless, inasmuch as use to a direct purpose is indiscernible. We can, notwithstanding, descry in it, both structurally and positionally, a counterpart to the remarkable dorsal humps in some Bovidæ and Camelidæ, *e. g.* the Zebu and Dromedary, and thus recognize another of those links, besides compound stomachs &c., which entitle us to refer the Cetacea and Ruminantia to some ancient primordial intervening form.

The dimensions and shape of the dorsal fin have already been mentioned. Here it needs only be noted that, from being thin and laterally compressed above, it gradually thickens basally and slopes outwards, merging with the general curvature of the back. But this remark, it must be borne in mind, applies only to the fixed anterior moiety; for the posterior region, partly attached and partly, so to say, free, or where it becomes falcate in outline, alters, and is thicker above than below. (Consult the sections in Pl. XXXII. figs. 17 to 24 inclusive.)

The very distinctive character which the Deductor, like the Sperm-Whale, possesses in its prominent blunt muzzle or nasal protuberance, is chiefly caused by a vast deposit of a fatty, semioleaginous material. This is overlain exteriorly by the thin dermis, and beneath that by thick and dense fibrous tissue. The latter decreases inwards, from the fibres being wide-meshed and their permitting a sort of gristly-looking fat to be interspersed between them. Proceeding still deeper, the denseness of the fat diminishes gradually until it is succeeded by very soft blubber; and this, again becoming slightly firmer, commingles with the muscular fibres of the so-called premaxillary muscle. The main direction of the interwoven fibres among the blubber is transverse, so that when cut in that direction they appear as layered wavy lines of white glistening fibre, varying much in thickness.

The entire mass of the fat and blubber of the massive boss of the frontal region, looked at from above, has a somewhat blunt wedge- or even heart-shaped aspect, in this respect agreeing with the contour of the maxillo-premaxillary region. The apex, or tapering front of the blubber, is so interwoven with the strong fibrous tissue anteriorly, that near the tip of the beak (premaxillaries) it becomes lost or indistinguishable among the fibrillæ. It is arched from side to side above, and also somewhat convex antero-posteriorly. Inferiorly, as noted, it loses itself among the fibres of the premaxillary muscles; but as the right and left one of these have a deep sulcus between them, this is filled up by a median keel-like portion of the blubber, which latter has thus below a wide V-shape. The greatest length of this deposit of blubber and fat is about eleven inches, the greatest vertical depth six and a half inches.

4. *Auditory Appendages.*—No external auditory orifice was detected by me before removal of the skin. On this being cut off and the subjacent fatty tissue searched, a

minute point was noticed on a line nearly parallel with and posterior to the angle of the mouth, the eye being above and its postcanthus nearly equidistant between them. As further dissection was proceeded with, the external auditory canal or meatus became more apparent, and was found to be, as in other Cetacea, a cord-like tube as thick as a goose-quill. It was at first directed horizontally inwards, on a level with, but behind the articular condyle of the mandible. Slightly widening it quickly resumed its calibre, and by three several spiral turns, or winding S-ways, it reached the foramen and membranæ on the outer side of the inflated tympanic bulla, at this point being situate immediately above and in front of the cranial attachment of the stylo-hyal. The auditory tube, though in one sense free, was nevertheless retained in its position throughout by dense fibrous tissue and the other padding of the outer cranial wall; but at the upper ends of the spiral turns muscular fibres were fixed to it, of which more presently.

Among the many writers on Cetacean anatomy, Von Baer alone I find mentions the existence of rudimentary muscular fibres in the Porpoise, appertaining to the external auditory apparatus. In my dissection of this female Caaing Whale, and still better in the fleshy adult male White-beaked Bottlenose (*Lagenorhynchus albirostris*), I have been fortunate in discovering, not indeterminate fibres, but three well-developed muscular slips, attached to and acting upon the cartilaginous tube of the meatus. These might either represent the diminutive muscles of the helix and tragus of higher Mammals, or more probably, and as I take them to be, they are the homologues of the auricular muscles, in spite of the absence of an expanded pinna. Accordingly I have already named them as external muscles of the ear, viz. attollens, attrahens, and retrahens¹.

Concerning the action of these muscles, one would think their functional subservience to the organs of hearing would be very slight. They have no outer pinna to move; how or in what way therefore do they act? Judging from their position and attachments (*vid.* fig. 29), the partially conjoined attrahens and attollens evidently drag both forwards and upwards the outer portion of the auditory tube, particularly the wider horizontal segment. The retrahens, while elevating, or, it may be, very slightly tugging the tube backwards at its root, would also, at the same time, horizontally straighten it. These movements, though of the most constrained description, may serve a purpose in audition.

As a precautionary measure, in case of loss of the small ear-bones in transmission of the skull abroad, they were left attached; I had no opportunity, therefore, to examine thoroughly the organ of hearing. The gifted Hunter and others have already ably explained the auditory mechanico-physiological construction in Whales generally; I confine myself therefore to a few loose notes of the parts *in situ* (fig. 31).

The tympanic bulla, which in this inferior aspect has a long oval outline, with a capitulate pedicle (malleus?) about the middle of its outer margin, lies obliquely for-

¹ Linn. Soc. Journ. vol. xi. p. 152.

wards and inwards, in the space betwixt exo- and basi-occipital, squamosal, and pterygoid bones. At the inner extremity it is slung, as it were, by a fibro-cartilaginous attachment from what appears as a hamular process of the pterygoid. Below this, and anteriorly, is a broadish ligament which fastens it to the ali- and orbito-sphenoids. To the commencement of the Eustachian tube it is connected by strong fibrous tissue, such as composes the canal itself; but there is besides, somewhat rearwards and inwards, a padding of cartilage. Behind this is a great vascular plexus reaching to the condyloid foramen. Between these and the tympanic fibroid tissues obtain. Posteriorly, externally and at the narrow end of the bulla the broad strip of the stylo-hyal cartilage arises from the exoccipital, and here is so imbedded as to prevent the tympanic impinging upon the latter bone. The facial nerve escapes from the skull by a separate foramen immediately in front of the cartilage; and the auditory tube ends in the recess and tympanic membrane hard by. In the dried skull of this species the petrotympanic bones are all but quite loose; the fibro-cartilaginous parts, above described, therefore act as cushions around them. But, moreover, the vascular network and oily and fatty substances hereafter described supply a soft external casing supplementary to audition. The Eustachian canal, as it leaves the tympanic bulla, has considerable diameter, and retains it more or less uniform as it passes forwards towards the fauces. A tough membrane and rete mirabile lie superficial to it.

5. *The Tongue.*—This is a fleshy organ, dorsally covered by a thick corium or leathery-like envelope. It is perfectly smooth, and superficially flat, excepting at the root. There it exhibits numerous glandular papillæ and depressions, probably the representatives of papillæ fungiformes; other larger and much deeper furrows behind may be either circumvallate cavities or simply mucus-glands. The glosso-pharyngeal rugæ are narrow, linear, and longitudinal.

The tongue's length is $7\frac{1}{2}$ inches as it lies in the recumbent posture; posteriorly it is 4 inches across, narrowing regularly to the tip. About a couple of inches of the apex is free; and there is a considerable fold of loose membrane beneath, forming a distinctly marked frænum linguæ. This is flesh-coloured, with nearly black outer edges. The tongue, however, is apparently not capable of protrusion beyond the mouth. The sublingual membrane is thrown into crescentic folds only moderately raised; and these interdigitate the one with the other, whilst the frænum itself connects these by rather irregular, crenate, transverse plicæ.

I may as well at once refer to several of the fleshy masses of the submandibular region and composing the lingual organ itself. Among these the most conspicuous superficial layer, to wit, the mylo-hyoid, is of great breadth, moderate thickness, and coarse in fibre. The two muscles together spread out from the lower jaws to the hyoid, and have throughout transverse fibres. It acts as a compressor of the inframaxillar pouch in the Piked Whale¹. What may be the homologue of a digastric is a relatively

¹ Phil. Trans. 1868, p. 220.

enormous mass which has attachments to the skull behind the articulation to the stylohyal, and, partially covering the ramus of the mandible, is therein narrowly inserted at its fore part. This apparently agrees with the depressor maxillæ inferioris of Carte and Macalister.

Beneath the last is what I presume is the representative of stylo-glossus. This likewise is of a long wedge-shape. Posteriorly broad, it occupies nearly all the antero-inferior edge of the stylohyal, and advancing and narrowing is fixed by a tendon betwixt the side of the mandible and tongue. Essentially similar in other genera of Whales¹.

The hyo-glossus in *G. melas* I found partly double. Its smaller outer head arises from about the middle of the stylohyal; its larger broader head springs from the front border of the thyrohyal, deeper than and partly outside the genio-hyoid. The two bellies converge, run side by side, and amalgamate about the middle of the tongue, the fibres dipping into the substance of the latter. Stannius² says that in the Porpoise the united hyo-glossus and hyo-pharyngeus springs broadly from the anterior part of the body of the hyoid and from the fore border and upper surface of the lower corner. The first thicker portion goes to the tongue's root along with the stylo-glossus; the other proceeds outwards and upwards to the posterior or upper edge of pharynx. One origin, a round fleshy mass from the great cornu of the hyoid bone, is given to the hyo-glossus by Carte in *Balenoptera*.

The pair of strong genio-hyoidei, which lie parallel to each other, run straight from the basihyal forwards to the mandibular symphysis. The genio-hyo-glossi are an expanded sheet, whose bundles of fibres from the inferior median raphe run upwards, forwards, and outwards in sweeping lines, intermingling with the lingualis or intrinsic muscle of the tongue. Posteriorly the genio-hyo-glossi are fixed to the ceratohyals and partially to the basihyal rostrum.

IV. ORGANS SUBSERVIENT TO DEGLUTITION AND DIGESTION.

1. *Cavity of the Mouth, Dental Armature, and Pharynx.*—The absence of baleen in the cavity of the mouth of the Pilot Whale necessarily gives quite a different aspect to it, compared with the mouth of the Whalebone species. No view of the Toothed Whale's mouth has hitherto been published; that which I furnish (fig. 5) was drawn from the fresh specimen, and therefore ought to give a fair idea of the buccal cavity. The dimensions of the original were:—Distance from the tip of the mandible to the angle of the mouth $11\frac{1}{2}$ inches, and the widest stretch or depth of gape at symphysis $6\frac{1}{2}$ inches; the roof of the mouth antero-posteriorly is above 7 inches.

The soft palate, excepting behind, is of a sooty-black colour, dense or firm to the touch, fibrous in structure, and firmly adherent to the bone. There is a middle flat portion similar to the tongue in shape, or lanceolate; and this has a breadth behind of 3·7 inches, and narrows anteriorly to 0·5 inch. Running round on each side of this,

¹ Rapp, p. 132; Stannius, p. 8; and Carte & Macalister, p. 231.

² *L. c.* p. 8.

and between it and the gums, there is a smooth shallow gutter an inch broad. The anterior third of the mid palate is coriaceous, rough, and bestrewed with hardened, closely placed papillæ, which are arranged in irregular linear rows. In the median line, however, this rough patch is longitudinally bisected by a narrow shallow sulcus, which is lost behind in the smoother palate; but anteriorly it sinks deeply between the pre-maxillary bones, and there its edges are firmly adherent to the periosteum. Quite at the back of the palate, or faucial portion, there is a smooth whitish-coloured area narrowest forwards; and on either side of this are numerous openings of muciparous ducts.

The dental formula in this specimen may be expressed by $\frac{10-10}{11-12}$. The last left lower tooth was very small. The mandibular teeth increased in size from the first to the sixth, again decreasing in magnitude posteriorly; nearly the same ratio obtained in those of the upper jaw, where the teeth are less curved. I noted that the sixth tooth of the mandible, the largest in the series, had an elevation of 0.4 inch above the gum, and the final one of the same row but 0.15 inch. The superior maxillary teeth were set with tips recurved, and inwards and downwards; the mandibular series agreed as to postero-inward inclination. The length of the lower dental row was 6 and $6\frac{1}{2}$, and of the upper $5\frac{1}{4}$ and $5\frac{1}{2}$ inches respectively. The conical teeth were implanted in deep sockets, but nevertheless they possessed a certain amount of mobility when pressed laterally by the hand. This slight looseness, even in adolescence, may account for individuals, both young and old, losing them, as authorities record.

The mucous membrane of the gums is continuous with the palatine tissues, but is lighter coloured. It embraces the necks of the teeth circularly, and runs between each dental interspace as a longitudinal ridge. Outside the gums and teeth, or labially, the membrane returns to its dark colour, and intensifies as it approaches the jet-black surface of the skin of the body. The portion which corresponds to the upper lip slopes gradually downwards and outwards, so as to form an eave or firm overhanging arch. This is deepest behind at the angle of the mouth, and becomes by degrees less so, until anteriorly reaching what represents the frænum labii superioris, where it is but very slightly elevated above the palate. The maxillary labial border projects sufficiently to overlap and partially hide the mandibular one, when the mouth is closed.

The inner surface of the lower jaw shelves rather abruptly downwards. It is narrow and dark-coloured, towards the teeth inwardly smooth, from that rough as far back as the teeth go. The gingival membrane, like the maxillary arch, is light-hued and rises round the dental necks. So suddenly and perpendicularly does the outer smooth and jet-black mandibular surface rise, that there is no defined lower lip or ridge whatsoever.

There is no clearly marked dependent uvula¹; but the posterior pillars of the fauces prominently arch over the root of the tongue by the great thick palato-glossus. When the mouth is fully agape, the loose folds of the mucous membrane form lateral segments of arches, the middle or keystone dividing these by short, somewhat longitudinal,

¹ A condition likewise mentioned by Professor Macalister, P. Z. S. 1867, p. 478.

plications. As the different plicæ meet they give rise to unequal-sized trapezoidal elevations, many of which are perforated by glandular orifices, which doubtless secrete abundantly during the process of deglutition.

As Macalister has not failed to note, there are a pair of thick palato-glossi, whose transverse fibres line the roof of the mouth, in my specimen having a breadth of more than six inches. Some few of the anterior fibres continue to the frænnum linguæ; others posteriorly are lost among those of the palato-pharyngeus and constrictores. That the above can act as a sphincter isthmi faucium, "capable of occluding perfectly the aperture of the pharynx," I quite acquiesce in; but this is aided to a remarkable extent by the presence of a palato-pharyngeal muscle, likewise recorded by the above author¹, and well developed in my specimen.

By pharyngo-laryngeal valley, I mean the deep groove running round and within the sphincter which grasps the glottis (*vide* fig. 13). The inner wall of this sulcus is formed by a dipping inwards of folds of the postpharyngeal region. Its depth is irregular, half an inch at the sides, but shallowing in front and behind, where it is cranially attached.

The elongated glottis is firmly grasped by the so-called sphincter, the latter leaving only an elliptical aperture, whose fleshy rim is about half an inch thick when cut through. According as the outer walls are contracted or relaxed, so are the pair of gutters or lateral channels of the floor of the pharynx narrowed or otherwise. The lining membrane of this latter portion of the pharynx is smooth, or, at most, minutely puckered. The postnarial passages possess great numbers of mucous glands. Some of these project slightly; others are embedded in shallow cavities, varying from the size of a hemp-seed to twice that. Some are locular, and the whole give a punctated character to the membrane, contrasting with the smoother superficies of the pharyngeal floor.

The posterior narial passages, moreover, possess each a muscular layer, above chiefly composed of longitudinal fibres. These, as they descend or proceed backwards, increase in thickness, and the fleshy bundles assume an oblique and spiral direction, ultimately becoming circular as they merge into what is usually entitled the superior pharyngeal constrictor. Some of the fibres of this can be traced downwards and backwards to the surface and angle of the thyroid cartilage. Others, the enormously developed circular ones, constitute chiefly the posterior wall of the pharynx, where they meet from the opposite sides in strong, glistening tendinous fibres, covered by a narrowed portion of the inferior constrictor. The constrictor superior, besides, has attachments to the posterior border of the palate and to the internal pterygoid plates.

The constrictor medius is likewise very strong, broad, and fleshy; attachments, side and lower surface of the thyroid cartilage, and upper surface of the constrictores superioris et inferioris. The last-mentioned muscle is considerably thinner than the others. Its narrow upper point has been spoken of with the superior constrictor; its other attachments are the inner surface of the thyroid cartilage and descending process; the posterior fibres mingle with the circular layer of the œsophagus.

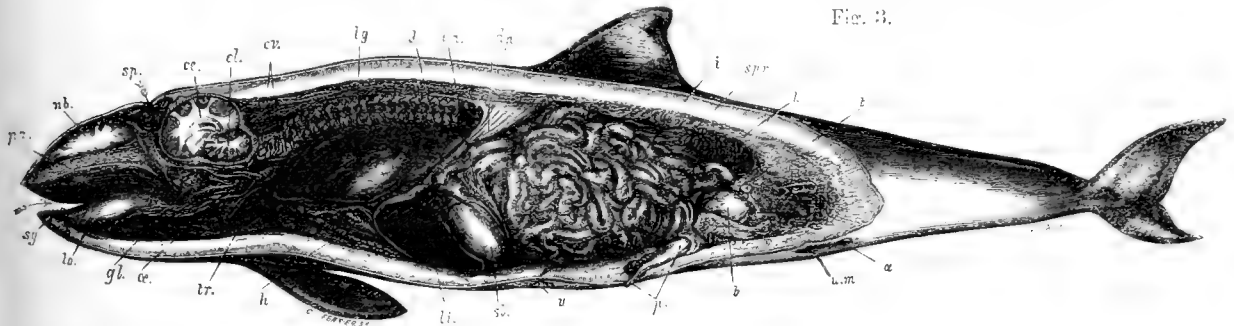
¹ See P. Z. S. 1867, p. 480.

The representative of stylo-pharyngeus arises from the stylohyal close to its cranial articulation, therefore with almost a squamous origin. It widens in its oblique or nearly transverse course as it approaches the pharyngeal constrictors, with which its fibres mingle.

A superior constrictor is said to be absent in the Piked Whale¹; and Macalister² regards the postmarial sphincter of *Globiceps* as a displaced representative of the levator palati muscle. From my examination of several Cetaceans I am convinced that the elevator and sphincter of the pharynx is but a modification of constrictor superior, though the distinctly longitudinal fibres may be worthy of a separate name; for I could make out, besides, a differentiated levator and tensor palati. The levator muscle covers the interspace of the pterygoid plates and the Eustachian enlargement; it is fleshy forwards on the palate, narrows posteriorly, and is fixed fibro-tendinously near the tympanic region (*vide* fig. 30, *Lagenorhynchus*). The circumflex or tensor palati is somewhat mingled with the last.

Stannius³ points out in *Phocæna* a thyreo-pharyngeus as coming from the inferior horn of the thyroid cartilage and going downwards to the pharynx. Possibly it may be equivalent to Carte and Macalister's kerato-pharyngeus⁴. If such a band exists in *Globiocephalus*, it is evidently part and parcel of the constrictor.

To illustrate a characteristic view seldom⁵ given of vertebrates, but one most useful



A longitudinal vertical section through the body of a male Porpoise (*P. communis*), slightly to the left of the median line, and with the viscera &c. retained nearly in their natural positions.

sy, mandibular symphysis; *to*, tongue; an arrow leads in the direction of the oral cavity; *pa*, palate; *nb*, nasal blubber; *sp*, spiracular cavity, exhibiting its upper corrugated pouches and the fleshy narial passage, continued by an arrow and dotted line; *gl*, glottis, thrust upwards through pharyngeal cavity; *æ*, œsophagus; *tr*, trachea; *cc*, cerebrum; *cl*, cerebellum; *cv*, cervical vertebræ; *lg*, lung; *h*, heart; *li*, liver; *st*, stomach; *d*, duodenum; *dp*, diaphragm; *om*, omentum; *i*, intestines; *k*, kidney; *spr*, suprarenal body; *t*, testicle; *a*, anus; *um*, uterus masculinus, a style has been passed through the smaller external orifice of the male mammary cleft, above and forwards, from which the rudimentary male uterine vesicle is situated; *b*, urinary bladder; *p*, penis, within its sheath; *u*, umbilicus.

¹ Phil. Trans. 1868, p. 245. ² P. Z. S. 1867, p. 479. ³ Müll. Archiv, 1849, p. 10. ⁴ Memoir, p. 235.

⁵ Vrolik has produced a side view of the viscera of *Hyperoodon*, *l. c.* pl. xii. fig. 41. In it the ribs are left in place, but in front the section of brain and mouth are not displayed; this remark applies to Burmeister's *Epidon*, pl. 16. fig. 4 (cited in footnote *anted*, p. 235). In Huxley's 'Lectures on the Elements of Comparative Anatomy,' 1864, and Rolleston's 'Forms of Animal Life,' 1870, there are some good diagrammatic generalized ideas of longitudinal sections; but they lack precise anatomical data.

to comprehend the interior organic relations, I introduce the woodcut, figure 3. *Ceteris paribus*, it may stand as a type of the Cetacean formation, and is essentially applicable to the preceding and succeeding sections.

2. *The Alimentary Canal.*—The œsophageal tube is throughout wide, dilating somewhat as it approaches the cardiac end. From the faucial aperture to where split by the upright, arytenoid, laryngeal pyramid it measures 8 inches, and thence to the stomach 23 inches. The mucous lining is of a pink hue, and plicated longitudinally. These folds widen and enlarge towards the ventral end; at the cardiac orifice, which is large, the ridges alter and merge gradually into the corrugate rugæ and white epithelial lining of the first gastric cavity. At about a foot's length from the stomach I observed a number of irregularly scattered, little, oval depressions, or openings of œsophageal glands. These (fig. 42, *gl*) are situated an inch or two apart, and occupy the ridges, but not the interspaces or sulci. A transverse section through the wall of the œsophagus (fig. 43) showed moderate outer circular, and inner longitudinal muscular coats, and a much greater lamina of fibro-arcolar tissue, or middle coat, capped by a thickish mucous layer.

Mr. Gulliver, in his notes on the Dundrum-Bay Whales (*Globiceps*), alludes to but two compartments of the stomach, as does Williams in the Chinese species¹. Dr. Jackson describes five separate cavities and a subsidiary one, besides a supplementary one connected with the first. Professor Turner assigns to the species five gastric compartments. My examination of this female leads to me think *G. melas* possesses but four true digestive cavities, that which has been taken for another being merely an enlarged parietal passage between the second and third compartments. In elucidation of this discrepancy of opinion, I render a full account of my dissection of the parts, the drawings of which are shown in figs. 32, 33.

The first gastric cavity (*I, I**) is by far the largest, and in several respects corresponds to the Ruminant Paunch. Its measurements were, 20 inches in extreme length, and 34 inches in widest circumference, at the cardiac end somewhere about 10 inches round, and much less than that at the opposite inferior tapering extremity. The cardiac orifice, not constricted, but a trifle narrower than the œsophagus, leads solely into this first chamber. The mucous plicæ at this point are slightly puckered together, but immediately below enlarge and form serpentine longitudinal folds with short interdigitating cross and oblique offshoots; both these diminish at the apical end of the cavity, which is comparatively smooth. Upon the left wall, 3 inches below the cardiac orifice, is a wide aperture leading into the second gastric chamber. As in the Ruminant's paunch, below the opening into the second cavity in *Globiceps*, there stretches obliquely across and downwards on the posterior wall of the first stomach a large and wide fold of

¹ Professor Huxley agrees with Dr. Brinton's description, that the stomach of the Porpoise consists of three cavities (Hunt. Lect., Lancet, 1866, p. 350, and Manual of A. V. A. p. 407)—an opinion at variance with John Hunter's statement (Æcon. of Whales) and Owen's (Art. CETACEA, Cyclop. of A. and P., and Anat. of Vert. vol. iii. p. 453).

membrane, or septal semidivision. This gives a median pouched character to the first chamber, and doubtless is what Jackson mistook in his inflated specimen for a supplementary cavity of a crescentic form opening largely into the first. The interior of the first stomach is of a white or opaline colour, lined with an epithelial layer of membrane $\frac{1}{20}$ of an inch in thickness; this ends abruptly and ring-like at the entrance into the second stomach. The muscular and serous coats are moderate layers.

The second chamber or true digestive cavity (*II*), as Jackson says, is a globose bag, and in our female, from upper to lower border, following the curve, measured 11 inches, and from left to right 8 inches. It lies partially in front and to the left side of the first chamber; and its upper posterior wall is adherent to the œsophagus by strong cellular tissue. Its inferior wall approximates both to the third and fourth chambers. The mucous rugæ of this second stomach give its great thickness. The folds are large free lappets, which radiate from the aperture of entrance towards its left wall, and in so doing wind in long, parallel, crooked lines, with innumerable subsidiary shorter diagonal intersecting plicæ connecting them. In these interdigitations they resemble the character obtained in the longer second stomach of the Porpoise. The mucous membrane of this second cavity in the Deductor, as in the latter Cetacean, is of a rich florid colour, and very vascular. The communicating aperture or passage leading from this the second to the third chamber is a constricted narrow tube or canal, 4? inches long, tunnelled between the walls of the second, fourth, and partly the third stomachs. It leaves the second stomach on its right inferior wall, an inch below the wide aperture which connects the first and second, and it enters the third stomach above and behind. There is no true sphincter at either end.

The third gastric chamber (*III*) is also subglobular when distended, and occupies the lower interspace between the second and fourth cavities. Its diameters or, rather, semi-circular dimensions are $3\frac{1}{2}$ inches longitudinally and 4 inches transversely. The walls are thin, and the internal mucous coat nearly smooth and devoid of rugæ, although it may be noted that to the left side, and below the aperture leading to the fourth cavity, there are faint traces of longitudinal plications. The round, smooth, ring-like orifice between the third and fourth stomachs, is a little over half an inch in diameter. It is an inch distant from the opening into the second and third; and its direction is nearly at right angles to it.

The fourth digestive chamber (*IV*) is in the main long and cylindrical. Its first portion, or left end, however, is rather wider, $2\frac{1}{2}$ inches deep from the orifice, and bulges, in a pouch-like manner, upward and towards the right wall of the second stomach; between which *cul-de-sac* and the second stomach the tunnelled canal spoken of as connecting the second and third chambers runs. This sac-like part, viewed externally, seems only a portion of the third stomach, but when opened is perfectly separate from it. The remainder of the chamber narrows as it proceeds to the pylorus. The total length of this compartment is 18 inches; following the curvature of the dilated first portion it is $3\frac{1}{2}$ inches in breadth, and the remainder is about $2\frac{1}{2}$ inches. Its walls are smooth, or

with only slight indications of longitudinal rugæ. The true pyloric orifice is ring-like and thickened, thus approaching a splincter in its formation, though I doubt if this designation can justly be applied to it. The diameter of the opening is fully half an inch.

Comparing my interpretation of the gastric chambers with the observations of the aforesaid writers, it does sound odd that Williams and Gulliver should limit the number to two. This anomaly, I think, receives explanation on the ground that they only consider the large dilated sacs as stomachal receptacles, the narrower chambers but as portion of the intestinal tube. Jackson's five or six gastric divisions are to me accounted for in this way. He describes (and in outline figures¹) the compound stomach in the inflated condition, consequently the partial septal membrane of the first chamber appeared to him as a crescentic supplementary cavity. What I name as the canal of junction between the second and third stomachs he avers is a distinct division. His subsidiary division, fifth or sixth as may be, is the dilated duodenal commencement. Turner² evidently takes the same view of the nature of the canal between the second and third stomachs as Jackson. Where we differ, then, is whether the burrowing passage between the vascular corrugated and large cavity *II* and the globular (*III*, fig. 32 in Plates) is entitled to be regarded as a true digestive division or not. I look upon it only as a communicating canal; because of its diminutive capacity³ and diameter; because it is not at all a free chamber, but, strictly speaking, like the end of the bile-duct, a tunnel burrowing its whole length betwixt the adjoining walls of *II* and *IV*; because of its smooth mucous membrane showing few or no traces of digestion taking place therein; because the other four chambers agree with what obtains in *Phocæna*, *Grampus*, and *Balænoptera*, and the two latter also offer an incipient structure of a similar kind, and corresponding in situation; and, lastly, because I regard certain of the so-called stomachs of some Cetaceans (*Hyperoodon* for example, with six or seven) as only canals between the true digestive chambers, as is shown above.

As is not uncommon in Whales, the duodenum of the "Deductor" commences by a dilatation $4\frac{1}{2}$ inches in transverse diameter, which, narrowing somewhat at 9 inches distance from the pylorus, is pierced slit-wise by the combined hepatic and pancreatic duct. This interval of gut has smooth-surfaced mucous membrane, and hence by some has been considered as a division of the stomach; but, as has been shown by others, the duct's entrance and want of constriction evinces its true nature. From this point onwards to the rectum there is no separation by valvular division, cæcal appendage, or sudden

¹ *Loc. cit.* pl. 15. fig. 2.

² Paper cited, p. 70, woodcut, fig. 2.

³ I had almost omitted reference to a second contribution of Professor Turner's ("Further Observations on the Stomach in the Cetacea," *Journ. of Anat.* 1869, p. 117), where he gives measurements of the several gastric compartments of the dried and inflated stomach of an adult *Globiocephalus* (?) and a fœtus, in support of his opinion of there being five, and not four, true digestive stomachs. The dried, distended condition of his adult specimen, as in Dr. Jackson's case, still causes me to doubt the soundness of his argument. With reference to his third compartment or stomach (my intercommunicating passage), he notes it was $6\frac{1}{2}$ inches long and from 1 to $3\frac{1}{2}$ inches in diameter in the adult; but the same chamber or canal in the fœtus was with difficulty recognizable.

change of calibre, into distinct small and large intestine, although the mucous membrane regionally changes its character. The total length of the gut is 97 feet 4 inches, or about nine times the length of the animal; but in Jackson's smaller male the proportions were as 8 to 1, and in Williams's 7 to 1. From this I infer that, as in other Mammalia, the intestine bears a relation to the age of the animal.

As to the intestinal diameter, the following tabular view expresses gradation of calibre at various points:—

| | inches. |
|---|---------|
| Diameter at dilate duodenal end | 4½ |
| Diameter about 2 feet from pylorus | 2½ |
| Diameter about 12 feet from pylorus | 2¼ |
| Diameter about 48 feet from pylorus | 1½ |
| Diameter about 90 feet from pylorus | 1 |
| Diameter about 1 foot from the anus | 2 |

I can offer testimony to the general correctness of Jackson's description of the intestinal tract, save his statement "no Peyer's nor other glands seen." On the contrary, the glands are a predominant feature throughout. But first as to the membranous folds, which attract attention by their peculiar disposition. In the lower part of what may represent the duodenum and the upper portion of the ileum, to about 6 or 7 feet from the pylorus, valvulæ conniventes, in great transverse flaps, are present, just as the above author has noted. These by degrees become smaller, but nevertheless continue uninterruptedly for 36 feet or thereabouts. The mucous folds then become reduced, and there begins a tendency towards development of partial longitudinal and oblique intersecting rugæ. The longitudinal plications thence are the most marked, and exist in pairs some little distance apart, running nearly parallel, but sinuous and continuously along the length of the gut. Short transverse folds unite these; and this condition obtains for 40 feet or more. Within about 3 feet or so of the anus the longitudinal parallel ridges have increased in volume and strength, whilst the short transverse and oblique rugæ have relatively diminished, leaving wider and deeper interspaces between them.

The intestinal glands of this zoophagous Cetacean are most interesting physiologically, in number, disposition, and as evidence of important functional activity carried on over an immense area. I counted in all some twenty-four Peyer's patches; and, although I made a careful search, it is possible others may have been overlooked. Visually I did not detect any representatives of Brunner's glands at the duodenal end of the intestine. The first agminate gland was situate ten feet from the pyloric orifice; and then, at less or greater distances, they were found for a great way on.

I shall record the general appearance of these Peyer's patches, which were twofold, and tabulate their lengths and distances apart. The first kind were those distributed amongst the large free valvulæ conniventes. These were ovate, and from two to three

times as long as they were broad, well defined, and raised prominently on the mucous membrane (*vide* fig. 44, *P.gl*). The second sort (fig. 45) were found further on in the intestine, and existed as elongate narrow strips, one half to three quarters of an inch broad, and placed between the parallel pairs of longitudinal folds.

| | | ft. | in. | Its length | inches. |
|--------------------|----------------------------|-----|-----|------------|---------|
| 1st Peyer's patch. | From pylorus | 10 | 0 | ..... | 4 |
| 2nd " | From preceding patch | 3 | 0 | ..... | 3 |
| 3rd " | " | 1 | 7 | ..... | 3 |
| 4th " | " | 4 | 10 | ..... | 3 |
| 5th " | " | 4 | 6 | ..... | 1½ |
| 6th " | " | 5 | 0 | ..... | 10 |
| 7th " | " | 5 | 4 | ..... | 10 |
| 8th " | " | 5 | 6 | ..... | 6 |
| 9th " | " | 5 | 0 | ..... | 7 |
| 10th " | " | 9 | 8 | ..... | 6 |
| 11th " | " | 3 | 0 | ..... | 6 |
| 12th " | " | 12 | 0 | ..... | 4 |
| 13th " | " | 6 | 0 | ..... | 7½ |
| 14th " | " | 1 | 0 | ..... | 6½ |
| 15th " | " | 1 | 7 | ..... | 2 |
| 16th " | " | 2 | 9 | ..... | 5 |
| 17th " | " | 1 | 0 | ..... | 4 |
| 18th " | " | 1 | 9 | ..... | 2 |
| 19th " | " | 0 | 7 | ..... | 5 |
| 20th " | " | 0 | 10 | ..... | 4 |
| 21st " | " | 1 | 6 | ..... | 10 |
| 22nd " | " | 0 | 8 | ..... | 3 |
| 23rd " | " | 0 | 3 | ..... | 1 |
| 24th " | " | 0 | 10 | ..... | 2½ |

The haste necessitated by the disagreeable stench which arose on the abdomen being opened did not allow of full detail or study of the relative position of the viscera being made; but the relation of parts was thus noted. The liver occupied the interspace between the diaphragm, the second and fourth stomachs, and the duodenal flexure. The omentum was thin and contained little fat, and only partially covered the intestines. Its visceral attachment was in a semicircular manner across the middle of the first gastric cavity, and slightly over the upper part of the spleen and lower anterior or ventral margin of the pancreas. From the first stomach on the left side it passed on to the lower curvature of the second, proceeding across to the right side along the lower margins of the third and fourth gastric divisions, thence to the duodenum and upper gut (dotted line, fig. 33). The second and third lay nearly across the cardiac end of the first stomach. The intestinal loops appeared to fill the remainder of the abdominal cavity, hiding all other parts, and even portions of the stomachs themselves.

3. *Glands accessory to Alimentation.*—By some¹ authorities the Cetacea are said to

¹ Cuvier, *Leçons*; Meckel, *Anat. Comp.* vol. viii, p. 375; Huxley, *Hunterian Lectures*, 1866, and *Manual A. V. A.* 1871, p. 394.

have no salivary glands; by others¹ that they are reduced to the most rudimental condition, while a third set of observers² evidently point to their presence as fairly developed. In my own researches among the group, notably the toothed section, I have satisfied myself that two of them obtain, and these not so feebly represented as I had been led to imagine. Their position and relations in *Globiocephalus*, *Grampus*, and *Lagenorhynchus* sufficiently agree for one description to serve. The parotid, firm and thick, is situated behind the auditory canal and the small fleshy slip connected therewith. It occupies, and somewhat deeply, the angle between the insertion of the sternomastoid and cephalo-humeral and the anterior nuchal continuations of the long dorsal muscles. Steno's duct, a fair-sized tube, passes forwards to the cheek. The submaxillary gland is flatter and thinner, but with a superficies almost as large as the parotid. It lies between, and partially overlaps, the neighbouring borders of the large muscle representing the digastric and the masseter, inferior to the auditory tube and in front of the cephalo-humeral muscle near its insertion. The facial artery and nerve either partially pierce or lie closely adherent and beneath the upper margin of the submaxillary gland. The cutaneous muscle covers both.

The liver (fig. 34), in simplicity, agrees with that of other Cete; but, as considered divisible into a right and left lobe, these were nearly of equal size, and not with a preponderant right, as Dr. Jackson³ found in his specimen, nor with a left enlargement, as the same author describes in the Sperm-Whale. With an average diameter of 18 inches, the organ is rather flat, smooth, and of medium thickness. There is no gall-bladder—as all observers record, excepting Williams⁴, who says in *G. chinensis* it is small.

The round ligament is of considerable thickness, and dips into the anterior median incision or umbilical fissure. I found its vessel all but closed; but in the younger Craigie's-Bridge specimen it was "pervious, opening freely into the vena portæ." The broad ligament has a nearly mesial line of attachment, and is strong. The coronary and the two lateral ligaments are fused together, and cover only the inferior edge of the right moiety of the gland.

The umbilical is the only well-marked fissure; that for the vena cava is broad and shallow; and a mere central indentation marks a transverse fissure where the hepatic and portal vessels enter. A single hepatic duct, half an inch in diameter, is joined by the united double and much narrower pancreatic duct, about two inches from the liver. Thence, three inches further on, it enters the serous coat of the duodenum and forms a dilated bile-reservoir; a narrow passage, five inches long, continues the duct within the intestinal wall; and it pierces the mucous coat nine inches distant from the pylorus. The expanded portion of the duct has alone narrow transverse rugæ within.

¹ Owen's *Anat. of Vertebrates*, vol. iii., submaxillary and sublinguals in a diffused form in Whalebone Whales but not present in others; Fré. Cuvier, *Cyclop. art. Cetacea*, p. 572; Eschricht, *Ueber die nordischen Wallthiere*, 1849, p. 108.

² Carte and Macalister, *Memoir*, pp. 222, 223.

³ *Loc. cit.* p. 163, and p. 144.

⁴ *Chinese Repository*, 1838, p. 412.

The softened condition of the pancreas prevented my making as satisfactory an examination as I could have wished. It measured $11\frac{1}{2}$ inches, had a breadth of between 4 and 5 inches, and weighed $8\frac{1}{4}$ ounces. It occupied chiefly the interspace between the right border of the first stomach and the duodenal loop, being covered in great part by the omentum and gut. Its excretory duct, as mentioned, joined the hepatic. Drs. Williams, Jackson, and Turner nearly agree as to the proportions of this organ, its breadth under half its length; their specimens were younger than the above.

Professor Turner's observations¹ on the lacteal vessels and mesenteric glands bear the stamp of accuracy. I am at one with him regarding Abernethy's² supposed great bags. These are undoubtedly the product of decomposition; for I satisfied myself, on studying several transverse sections in my specimen of *G. melas*, where considerable cavities existed, that these were solely due to disintegration of the interior tissue and not to be confounded with the lymphatic sinuses. I may further say, from long experience in such matters, that the mesenteric glands, next to the blood and brains, soonest spoil and internally decompose. The rectal cluster of glands mentioned by Turner are shown in my figure 73.

The spleen, &c., I shall notice in connexion with the blood-reservoirs.

V. RESPIRATION AND MACHINERY INVOLVED.

1. *Hyoidean and laryngeal Structures*.—The hyoidean arch (figs. 14, 15, & 16) consists of five separate elements, a single and two pairs of bones. The body, or more or less ankylosed thyro- and basihyals, is a broad and thickish crescentiform bone, whose widest diameter, from tip to tip, is $9\frac{1}{2}$ inches. From the anterior border there juts forwards a flat rostrum, basihyal, 1.7 inch wide, which terminally forks, and to the extremities of which the ceratohyals are affixed by a fibro-cartilaginous joint. The latter bones are each some 2 inches long, $\frac{8}{10}$ of an inch in diameter, subcylindrical, and very slightly curved. Another fibro-cartilaginous joint exists between the ceratohyal and the stylohyal bone; and these are bent at a sharp angle to each other. Individually the stylohyal osseous rods are stout, thickish at the middle third, or $1\frac{1}{2}$ inch in diameter at this point, and with a length of $8\frac{1}{2}$ inches.

The larynx has the common Cetacean formation of an elongate, nearly upright, and slightly effect. tubular epiglottis and arytenoid cartilages. The latter are rather higher than the former³, and with an emarginate lip front forwards. The former is a broader semilune, the aperture being relatively small, and in the ordinary contracted condition, widest transversely. The tube is narrowest in the middle, and basally wide. The body of the thyroid cartilage is somewhat flat and with large expanded alæ. These jut out

¹ Pilot Whale, *l. c.* p. 76.

² "Some particulars in the Anatomy of a Whale," *Phil. Trans.* 1796, vol. xvii. p. 673.

³ In the young specimen dissected at Boston, U. S., the arytenoid cartilages are mentioned as not rising quite so high as the epiglottis, *l. c.* p. 165.

broadly with an anterior protuberant blunt corner superior cornu. Posteriorly the wing sweeps backwards and inwards in a long limb, the inferior cornu, which terminally narrows and is fastened to the side and hinder margin of the cricoid cartilage. Between the inner edge of the posterior or inferior thyroidal cornu is a large oval space, partially occupied by the thyro-arytenoid and crico-arytenoideus lateralis muscles. The posterior surface of the cricoid has a considerable arched expanse, and is a trifle longer than the body of the thyroid cartilage. Behind, it is deeply incised or bifid, as Jackson specifies; in front, at the junction of the arytenoids, more abruptly transverse. Anteriorly the cricoid, like the thyroid cartilage, sends off a pair of cornua, but which proceed in an opposite direction, pass through the lateral thyroidal spaces, and, rounding the edges of the body of the thyroid cartilage, embrace the trachea in front. These cricoid limbs, or rods, well nigh meet in the middle line, and maintain a fair thickness throughout.

A strong crescentiform sheet of ligamentous membrane unites the thyroid body and thyrohyal bone. Another expanded sheet connects the latter, the basi-, cerato-, and stylohyals; both membranes have fleshy fascicles overlying them.

Besides the muscles, chiefly protractors, having attachment to the hyoidean apparatus, and which I have incidentally mentioned along with those of the tongue &c., the sterno-hyoidei and thyroidei are two most powerful agents influencing retraction. The former, broad throughout, widen as they are inserted into the basi- and thyrohyals. The latter are not nearly so voluminous, and more ribband-like in figure. Their origin, as Macalister¹ observes, is from the first costal cartilage as well as sternum; their insertion, side of thyroid cartilage. The sterno-thyroidei are wanting in *B. rostrata*², but are certainly present in several other forms of Cete.

The thyro-hyoidei broadly cover the under surface of the thyroid cartilage and the thyro-hyoidean membrane. Each crico-thyroideus, fleshy, and of considerable size, is attached to the inner border and anterior surface of the cricoid cartilage and lower border of the lateral horn; thence it reaches the inner border of the inferior thyroidean cornu.

Upon the back or deep surface of the cricoid and posterior root of the arytenoid cartilages a sheet of muscular fibres exists (fig. 13). From the devious direction of these, more than actual division, two muscles on each side may be noted, the posterior crico-arytenoid³ and lateral crico-arytenoid⁴. The former, probably the stronger and larger moiety, overlays the dorsum of the cricoid, and, directed outwards and forwards, is fixed to the root and posterior half of the arytenoid cartilage. The latter lies more to the side, and, besides covering the cricoid laterally, has a partial origin from the inner edge of the inferior thyroid cornu; its fibres converge upwards and forwards to the lateral root of the arytenoid in union with the former muscle. A well-defined,

¹ P. Z. S. 1867, p. 480.

² Trans. Roy. Soc. 1868, p. 219.

³ *Balenoptera*, l. c. p. 237.

⁴ Not mentioned by these authors *ibid.*, but both described by Stannius, 'Müll. Archiv,' 1849.

short, but strong thyro-arytenoideus¹ muscle lies in front and obliquely to the crico-arytenoideus lateralis; it passes upwards upon the post-lateral root of the upright arytenoid cartilage. The true arytenoidei², each appropriately named arytenoideus transversus by Stannius in the Porpoise, have a similar direction in *Globiceps*. The short but well-developed pair of muscles lie athwart and partially cover the anterior fibres of the posterior crico-arytenodei. In fact they bridge the hinder base of the adnate arytenoid cartilages, but do not run up its erect portion.

As in other Cetaceans, there is a pair of hyo-epiglottic muscles, which approach close to each other mesially in front. Each is powerful, and must considerably influence the movements of the glottis, as taking their fixed point from the hyoid bone. They are each of an elongate wedge-shape, point upwards, and externally have two faces, an anterior and a lateral. The broad basal origin is from the hyoidean arch, namely those parts representing cerato- and stylohyals—the whole upper surface of the former, and about one half of the adjoining inner margin of the latter. Converging from these points upwards, the muscle is fixed to the lower moiety of the erect and firm epiglottis, in front and partially to its side. Three additional muscles, viz. a superior and an inferior aryteno-epiglottideus, and an accessory aryteno-epiglottideus, are found in *Balaenoptera rostrata*³. The wider separation of the epiglottis and arytenoid cartilages, with intervening folds, may doubtless in this animal necessitate their presence for approximation of the walls of the glottis. Unless part of the hyo-epiglotticus, as above described, include these additional slips, they appear to be absent in several Cetacean genera.

As having continuity with the hyo-epiglotticus, I may here mention a small, but distinct muscle arising cranially from the neighbourhood of the auditory canal, and inserted halfway down the stylohyal, close to the posterior end of the hyo-epiglotticus. This doubtless answers to the occipito-hyoideus of Rapp⁴ and Stannius⁵ in the Porpoise, and stylo-keratic and squamo-styloid of Macalister⁶.

There is a fleshy sheet in the space intervening between the stylohyal, the cerato-, and the thyrohyal in *G. melas*, the interhyoideus. Macalister, in his short notice of *G. vineval*, names it hyo-keratic⁷, and suggests that it is probably a modified hyoglossus. This, to my reading, is equivalent to the stylohyoid of Stannius⁸. He describes it in *D. phocaena* as springing along the entire posterior borders of the two pieces of the anterior horns of the hyoid, but also receiving fascicles from the first piece itself. Its oblique fibres are fastened to the upper surface of the body of the hyoid, and partly to the posterior border of its hinder lower cornua. In short, it fills the interval of the hyoidean elements. The same appears to me to be what Carte and Macalister

¹ Carte and Macalister, *l. c.* p. 238; Stannius, *l. c.* p. 11.

² The A. proprius of Carte and Macalister.

³ *Op. cit.* p. 132.

⁴ In *G. vineval*, P. Z. S. 1867, p. 480; and Trans. Roy. Soc. 1868, p. 235.

⁵ *Ibid.*, marked *p* in woodcut, p. 478.

⁶ *Loc. cit.* pp. 237, 238.

⁷ *Loc. cit.* p. 7.

⁸ *Loc. cit.* p. 7; and Rapp, *l. c.* p. 132.

differentiate in *B. rostrata* as superficial hyo-keratic, deep hyo-keratic, and kerato-pharyngeus¹.

Under the title of occipito-thyroideus, Stannius² has called attention to a partially separate slip of muscle adjoining the preceding. He says that in the Porpoise it arises along and from the sharp borders of the exoccipital, and is inserted on the side of the thyroid cartilage and angle towards the epiglottis. In *Globiceps* there is a muscle corresponding to this, but partially with a thyrohyal attachment. Macalister³ designates it basio-thyro-hyoid, and believes it to be an expanded representative of the cephalo-pharyngeus of Theile.

2. *Tracheo-pulmonary parts*.—The short trachea bifurcates into short, right and left bronchi, about the top of the upper third of the pulmonary organs; and there is a tertiary bronchus to the right. In this respect *Globiceps* agrees with such Cetacea as have been dissected, save *Balaena mysticetus*.

The lungs, when taken out of the chest, were collapsed, and contained apparently but a very small amount of residual air. This gave them the reverse of a crepitant character, viz. a lax spongy kind of texture under pressure. Moreover their pleural covering is such a strong, tough, fibrous envelope, that they acquire marginally an almost leathery consistence. Having inflated the lungs, on their removal *en masse* with the heart (reproduced in the sketch, fig. 49), their shape and another most remarkable peculiarity were fully disclosed. Each lung is elongate and, strictly speaking, unilobed. But there is a small anterior or apical emargination or wide shallow cleft which tends to mark off an isthmus or indefinite tongue-shaped corner. This lobule, if one may so term it, passes sternally inwards, towards its fellow of the opposite side, at the root of the heart. The area enclosing the heart, great vessels at its root, and the pericardium, is necessarily large; but the basal surface of the lungs, or that fitting upon the diaphragm, is likewise relatively enormous. This diaphragmatic superficies is dome-shaped, and doubtless is chiefly intended to receive the capacious compound stomach when distended. At the superficial diaphragmatic end the two lungs are connected by a bridge of pleural membrane, which is also fastened to the diaphragm. I ascertained the length of the lungs to be, right 23, and the left 25 inches.

In the Chinese *Globiceps* it is stated "the lungs have two lobes on each side—the two central lobes are broad, flat, and thin, but as long as the lateral lobes, and both are well supplied with bronchia"⁴. A thoroughly cleft and compound lung is certainly an unusual condition in Cetacea; but I conjecture from Dr. Williams's allusion to the longitudinal nature of the lobes, that he but means the long, thinner, free approximate margins partially covering the heart &c.

The most interesting feature connected with the pulmonary parts of the Caaing Whale is the presence of a pair, or more, of large lymphatic glands most prominently

¹ *Loc. cit.* p. 235, and pl. 6. figs. 3 h, 18, and f.

² *Loc. cit.* p. 9.

³ Papers cited.

⁴ Repository already cited, p. 412.

and oddly situated. At first I thought these were unknown, but found they had been incidentally noticed by Hunter¹ and Gulliver², Williams³, and Jackson⁴. The two latter entirely misconceived their true nature, thinking them the product of diseased tuberculous deposits. That they are not of pathological origin I am certain, and, moreover, found them well developed at the same spot in Risso's *Grampus*. In the female under present consideration the bodies in question lie at the sterno-ventral corner of each lung, and upon the pleural bridge already spoken of (consult respectively figs. 49, 50, & 51). They appear as two raised, oval, or even somewhat reniform, glandular bodies, each about a couple of inches long and an inch or so in widest diameter, covered by opaque pleural membrane; yet the surface of the lungs themselves, but more especially their pectoral aspect, shows that they are overspread by a series of parallel sinuous veins and arteries. These converge to the glands at the pleural bridge, send a few twigs into their substance, but almost wholly pass over and underneath them to large vessels close by. The latter I shall take into consideration along with the circulatory organs. Regarding the structure of each glandular body, it is firm, as Gulliver says juicy, and texturally in all respects resembles a lymphatic. It is not, therefore, a blood-reservoir, as I was inclined to deem it; for I convinced myself by injecting the vessels hard by. It was then I became fully satisfied of Mr. Gulliver's mistake, who considered the linear pulmonary tracery to be lymphatic vessels running to the glands. There are many lymphatic vessels in the neighbourhood, it is true; but these are very secondary, compared with the blood-channels, in producing the radial pulmonary lines from the glands, so very obvious even on casual inspection. Besides the more prominent pair of glands, there are, particularly in *Grampus rissoanus*, some smaller deeper ones adjoining the larger.

VI. SANGUIFEROUS DISTRIBUTION.

1. *The Heart*.—This bulky organ agreed sufficiently with Dr. Williams and Jackson's notice of its exterior; and the cavities and valves so corresponded with those of other large Fin-Whales⁵, save in one most unusual circumstance, that I need only call attention to the latter.

This certainly very remarkable and abnormal structure was the existence, in the septal segment of the tricuspid valve, of an opening the shape and size of an ordinary bean. The said opening, moreover, I found was guarded by a valve similar in every respect to the ventral valve occurring in the auriculo-ventricular orifice of the left ventricle. In

¹ In *Delphinus tursio*, 'Essays and Observations,' vol. ii. p. 107.

² *L. c.* p. 65.

³ *L. c.* p. 412.

⁴ *L. c.* p. 164.

⁵ Several preparations of the cardiac valves of the Rorqual (*Physalus antiquorum* = *Balaenoptera musculus*, dissected by me in 1859, P. Z. S. 1865, p. 213) are preserved in the Hunterian Museum (nos. 927 B to BC). These have been fully described by my old colleague Dr. Pettigrew, and need no comment on my part. See his "Valves of the Vascular System of Vertebrata," Trans. Roy. Soc. Edinb. 1864; and Appendix, R. C. S. E. Museum Report, 1865.

other words, the valve consisted of two segments, the delicate free margins of the segments being supplied with numerous fine chordæ tendineæ attached to the rudimentary musculi papillares of the right ventricle. From this it follows that the supplementary mitral valve within the septal segment of the tricuspid (this valve within a valve) appears to be acted upon by the musculi papillares and by the blood, precisely in the same manner as the mitral and tricuspid valves themselves; *i. e.* it is opened during the diastole of the heart, and closed during its systole.

By reference to figures 52 & 53 a better conception of the position of the perforation and its relation to the tricuspid will be gathered than by entering into minutiae verbally. I may remark, however, that this ancillary valve, whatever its homological significance, appears to me to be to the valvular system of the heart, what the rete mirabile is to the vascular system generally. One may regard it as a tendency in nature to repeat herself, a something superadded without apparently any special end to be served. It may be imagined to weaken rather than strengthen the action of the tricuspid; on the other hand, it may be a kind of safety-valve¹. From its anatomical structure, its physiological influence can only be conjectured. The rarity of such an instance shows that it is not a necessity to Cetacean circulation.

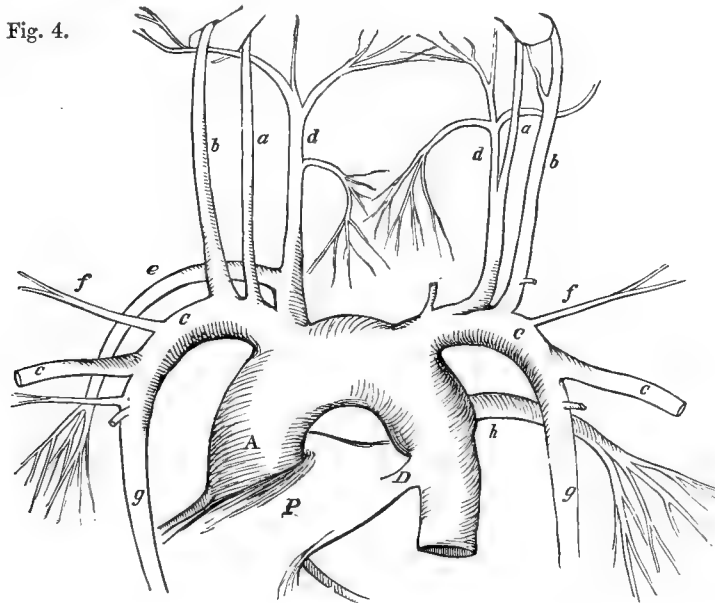


Fig. 4.

The arch and great arteries of the Pilot Whale, after Turner, from the Journ. of Anat. ii. p. 67.

A, aorta; P, pulmonary artery; D, ductus arteriosus; a, carotis cerebialis, the diminution in calibre of this artery in the course of its ascent is not sufficiently represented in the figure; b, carotis facialis; c, subclavia; d, cervico-occipalis; e, thoracica posterior dextra; f, transversalis colli; g, mamma interna; h, thoracica posterior sinistra.

¹ See a paper by T. King "On the Safety-valve Functions in the Right Ventricle of the Heart," Guy's Hosp. Reports, vol. ii.

2. *Vascular Channels and Reservoirs.*—My notes respecting the great vessels springing from the arch of the aorta were less complete than those of Professor Turner; I must be content, therefore, to abide by his description—adding that, in his specimen as in mine, three main trunks were given off from the arch (*vide* fig. 49).

Of the cranial vascular distribution, circumstances did not permit me to master it in detail. The more notable observations I could make were chiefly regarding a great plexus situated at the inferior base of the skull, and situated with a rete occupying the proximal infundibular cavity of the mandible. I subsequently had an opportunity of investigating the same in *Grampus* and *Lagenorhynchus*, where it likewise obtains¹.

The internal maxillary artery having passed deeply behind the lower jaw, and made a bend, sends forwards a long inferior dental artery. As this pursues its course it distributes ramuscles among the fatty matters and plexus presently to be mentioned. The mandibular cavity contains a mass of softish, marrow-like substance, held together by a network of fibrous tissue. Moreover the interstices are occupied with a maze of vascular channels partly composed of arterial and partly of venous capillaries, interwoven irregularly. Next the bone the tissue and vessels are firmly adherent to the periosteum. In some Cetaceans, *e. g.* the great *Balæna mysticetus* and *Balænoptera musculus*, as I have been myself a witness to, the cavity in question possesses a perfectly enormous amount of oily material. Even in smaller genera the quantity is by no means sparse; so that the tissues hereabouts as a whole and on section may be compared to blubber surcharged with blood-vessels. Further on, the internal maxillary gives off large muscular branches and others forming pterygo-maxillary divisions. These latter were not followed into the cranium. The inferior base of the skull, from the tympanic bone forwards to the maxillary, internally bounded by the levator or sphincter muscle of the postnares, presents one continuous rete mirabile. This spongy network of vessels lies upon a thick layer of fibroid tissue; and the vessels anastomose with the aforesaid mandibular rete, whilst they likewise appear to intercommunicate with another venous locular network behind and at the root of the Eustachian tube. The venous capillaries collect into a jugular channel, more or less connected with the rete of the neck.

The facial artery, vein, and nerve emerge from beneath the cephalo-humeral muscle and submaxillary gland below the auditory canal, thence traverse the face. Steno's duct bears them company. There is a vascular plexus behind the ear-tube, and above and overlapping the parotid gland.

The multitudinous divisions forming the great rete mirabile of the neck, limb, thorax, and spine bore correspondence to the arrangement of the zoophagous Cete, amply

¹ Of original observations on Cetacean circulation, after Tyson, Hunter, Meckel, Breschet, and Von Baer, all well known, those of Stannius commend notice ("Ueber den Verlauf der Arterien bei *Delphinus phocæna*," Müll. Arch. 1841, p. 379) as being simple, explicit, yet full of detail. For copious illustration, probably a trifle too diagrammatic, Barkow's plates stand unrivalled, 'Die Blutgefäße vorzüglich die Schlagadern der Säugethiere,' 1864, p. iv. Professor Turner's recent contributions are highly valuable.

discussed by preceding authorities. In fig. 54 I give an illustration, by a transverse section between two of the lumbar vertebræ, of the appearance of the cut vessels in their recent state. Two immense veins lie on either side of the spinal cord, the remainder of the space above and outside them being filled by a closely packed reticular mass of venous and arterial channels of diminished calibre. The nervous cord itself is small compared with the neural canal and vascular aggregation. The deep lumbar plexus extends outwards from the side of the vertebral body to the tip of the transverse process; and in the intervertebral spaces branches communicate with the spinal rete. A strong flat arch of fascia extends between the points mentioned, and it binds down the retia, whilst superficial to it is the immense inferior lumbo-caudal muscle.

The plexuses are essentially composed of arteries and veins, varying in proportion according to the situation. Besides the ordinary large and small vessels, there is a vast congeries of capillaries of uniform calibre. Of the latter a primary series runs in parallel lines, often straight, and frequently looped and contorted. Their diameter may be compared to the thickness of a hog's bristle. They anastomose freely, bridging and intercommunicating by acute forks, the divisions continuing parallel, either side by side, or twisted like a rope, or occasionally tangentially twirling away from each other. Besides the above capillary network, a subsidiary or secondary series springs from the first. These, even when injected, are only half the diameter of a human hair, and in their branches and ramifications diminish to a far finer tenuity. The secondary arise everywhere from the first series, and often run alongside and between them; so that one of the primary may have several of its satellites spun around it in its course. The finer ramifications, however, are by no means so regularly parallel, but split up into thousands of divisions, branching and divaricating in all manner of ways, forming an intercommunicating network, intertwined with the loops of the primary series. The venous radicals have an arrangement somewhat similar; and their primary capillaries lie in juxtaposition and are spread amongst the arterial series.

By Hunter and others it is said that in Cetacea the abdominal aorta does not send off any external iliacs. I have found the following condition obtain in this female *G. melas*. A little way beyond the inferior mesenteric artery and lumbar branches there arose laterally and at right angles from the aorta two short wide stems, common iliac arteries. Each of these was fully an inch long, and split into two divisions, or what may be termed anterior and posterior. The former or hypogastric artery proceeded forwards partly enwrapped by a fold of the uterine broad ligament. Abdominally to this it went to the apex of the urinary bladder, distributing branches thereabouts, and joining its fellow artery of the opposite side, ultimately constituting an umbilical artery, which cord was nearly impervious. The latter or posterior division of the short aortic stem, at two inches distance from the anterior one, bifurcated. One of these two branches, which I take to be an external iliac, almost immediately beyond its origin

split and sent rami to the parietes of the abdomen and genital parts. The second of the two branches, corresponding to the internal iliac, only proceeded for an inch and a half, when it separated into an artery and minor branches, apparently supplying the fleshy and other deep genito-urinary regions. The other artery of equal calibre I followed to beneath the os innominatum and interpelvic fascia; there it broke up into several diminutive channels: some of these were distributed to the pubo- and ilio-coccygeus muscle &c.; others, with a nerve, pierced the interpelvic fascia at the notch, just behind the anterior capitulum of the bone¹.

The vena cava inferior, after leaving the deep border of the liver and passing to the diaphragm, received thereon numerous phrenic tributaries. Among the large venous sinuses situated at the pleural bridge, there were many tortuous twigs, already alluded to. The series of these derived from the surface of the lungs advanced towards each pulmonary gland, and passing both above and beneath, joined the larger vessels. The great vein-channels at this part did not appear to have valves², but instead interiorly showed a compound character. Longitudinal septa existed and divided the vessel into compartments of unequal calibre. Moreover, here and there intercommunication took place between the larger passages by oblique twigs, which ramified within the septal walls. Thus a kind of retial sinus obtains, something like, but less complicated than that within the neural canal. An artery which I took for the superior phrenic branch of the internal mammary accompanied the phrenic nerve. This, besides dividing into branches, supplying the diaphragm, pleura, and adjoining parts, also yielded the offshoots which ramified superficially and deeply upon the lymphatic bodies, and then, as the arterial network, spread in long tortuous parallel radii over the surface of the lungs³.

As a vascular reservoir, I here insert remarks on the spleen. It lies upon the right side of the first stomach, below the left extremity of the pancreas, and just free from the omental attachment. It is said by others to be compound. In my specimen it is composed of three lobes, together somewhat quadriform and flattened, but each broader than long. It is moderately firm, and weighed $10\frac{1}{2}$ ounces. Altogether it is relatively small, $5\frac{1}{2}$ inches long by 4 inches broad.

In various parts of the body, but notably in the neck, are firm glands, many, doubtless, belonging to the lymphatic system, but some which seem rather to partake of the nature of blood-reservoirs. I examined several of these, but I did not inject them, so possibly may be mistaken as to their true relationship with the circulatory apparatus. In one delineated in figs. 40, 41, it is seen that the cervical vascular plexus is in close

¹ Consult Professor Struther's remarks, "Anat. of a Great Fin-Whale," Journ. of Anat. 1871, p. 110, pl. 8. fig. 3.

² Barkow, *op. cited*, pl. 16. fig. 3, shows that imperfect valves do exist in certain of the veins of *Balenoptera*.

³ "On a Supplementary System of Nutrient Arteries for the Lungs," Brit. & For. Med. Chir. Review, January 1865. In this paper Professor Turner demonstrates a vascular arrangement in the human body in many ways according with the above. *Vide* also Dr. Chiene, "Obliteration of Cœliac and Mesent. Arteries," Journ. of Anat. 1869, p. 65.

connexion with it exteriorly, and even more so than is shown in the drawing; for a great part has been cleared away to bring out the shape of the gland. Many of the vessels also penetrate the glandular substance, and ramify therein. The centre, somewhat fibrous in texture, is more solid than the cortex; the latter locular, and in section uncommonly like the open mouths of the surrounding rete mirabile. The very great blood-supply which these glands receive, makes one suspect their function to be subservient to the extraordinary sanguineous distribution; yet, on the other hand, their constitution, *ceteris paribus*, agrees with a magnified lymphatic gland. The loculi, often the size of a pin's head, evidently correspond with the so-called lymphatic sinuses; but they are diminutive as compared with the cavities of disintegration met with by me in the mesenteric glands.

Some novel and important observations of Professor Turner on a large moniliform tube in the mesentery of *B. sibbaldii*¹, make me see likeness in it to the above-mentioned glands. Both, taken in conjunction with the superficial pulmonary glands, would seem to support Turner's views of their being diffusers of the arterial stream. This theory, however, I am not inclined to adopt. I recognize in them intimate association with the absorbents, kinds of lymphatic hearts in their way; and moreover I apprehend they bear a relationship to the so-called coccygeal gland of human anatomy. It is quite conceivable, and, indeed, I think probable, that the vascular and absorbent systems of the Cetacea are in far closer connexion than has hitherto been supposed. Such a view is credible, and supported by those who maintain that there is a direct interchange of material between the lymph- and blood-channels within the ordinary lymphatic glands².

Fig. 5.

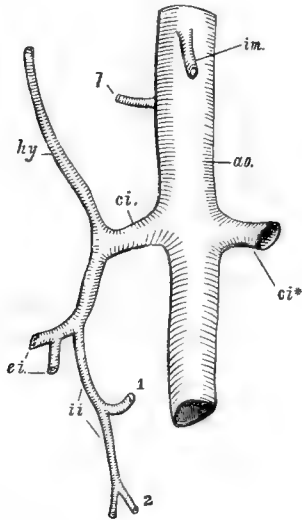


Diagram illustrating division of the iliac arteries of the female *G. melas*.

aa., abdominal aorta; *im.*, inferior mesenteric; *l.*, lateral lumbar branch; *ci, ci**, common iliac trunk; *hy*, hypogastric; *ei*, external iliac division; *ii*, internal iliac a n (1, 2) branches.

¹ *Loc. cit.* p. 231.

² Hunter, always alert in physiological inferences, preserved a most interesting specimen, no. 862, *Cat. Mus.* :

VII. THE NERVOUS CENTRE.

I can only offer a disjointed fragment concerning the brain, which in the present instance was scooped out piecemeal through the foramen magnum. The portions thus rudely extracted comprised almost, if not quite, the entire encephalon; but this was softened and decomposed. It weighed altogether $5\frac{1}{4}$ lbs. avoirdupois. If the body weighed a ton, or thereabouts, as estimated by the railway officials during transport of the creature, then the brain would approximately be something like $\frac{1}{400}$ of the weight of the body.

Portions of the cerebrum, somewhat more intact than others, showed that, as in the Porpoise, the brain of the Pilot Whale is highly convoluted, and that likewise there is a very considerable superficial thickness and amount of grey matter covering the white substance. The tentorium is composed of a strong fibrous texture.

An accurate and detailed account of the brain of a large Cetacean is a great desideratum, but one which as yet is not easy to be provided. I look forward, therefore, with interest to Professor Turner's promised contribution in this untrodden field.

VIII. FLESHY MOTOR AGENTS OF BODY AND LIMBS.

When I made my dissection, and had the accompanying plates lithographed, illustrations of the kind (*i. e.* showing the whole body and in layers) were unknown to me. Indeed, in this respect I believe they will still stand ground as original views. The literature on Cetacean myology has since received considerable accessions, especially as regards limb-flexors and extensors. Several authorities thereon have already been quoted in my preliminary note, *anteâ*, p. 235.

1. *Muscles acting chiefly on the Pectoral Limb.*—The superficial layer, that which represents the panniculus carnosus of land Mammals, is distributed over nearly the whole surface of the body, but leaves the tail free. What corresponds to Cuvier's thoracico-fascien, or may be equivalent to platysma myoides, covers the throat from the angle of the mouth back to the pectoralis major. According to the part of the body so are the fibres of the entire panniculus differently directed; and they taper posteriorly upon the side vertically above the genital outlet. A great expanse seems to act upon the pectoral extremity, both superficially and deeply through an axillary portion (Cuvier's dermo-humérien) joining the latissimus dorsi. A semirotating motion, therefore, is imparted to the limbs. The great expanse of this muscle and the accessory offshoot to the fore limb present little deviation among the Whale tribe.

the description runs:—"A portion of a plexus of absorbent vessels from the head of a Spermaceti-Whale (*Physeter macrocephalus*, Linn.), filled with spermaceti, which was by their action in process of removal. This most valuable preparation affords a strong argument in favour of the doctrine that the waste and superfluous parts are removed by the absorbents, and not by the veins." On the contrary, consult Professor Wharton Jones's "Caudal Lymphatic of the Eel," *Phil. Trans.* 1868, p. 675; where he demonstrates the phenomena attending the propulsion of the lymph from the caudal heart into the caudal vein &c.

What constitutes the pectoralis major in Cetaceans is a moot point. Cuvier, in his *Leçons*¹, says, "Dans les mammifères qui n'ont point de clavicules parfaites, même dans le dauphin, il y a une première portion sternale qui va perpendiculairement à la ligne âpre, et qui forme avec la portion correspondante de l'autre côté, ce que l'on a appelé le muscle commun aux deux bras; c'est lui qui produit l'entre-croisement des jambes de devant." It is evidently this same portion which Meckel², with whom Rapp³ coincides, refers to as an elongated strong triangle, partially continuous with the panniculus, and inserted broadly into the humerus as far as the antibrachial aponeurosis. Stannius⁴, however, views it differently, regarding this only as a thoracic portion of the panniculus; and the true pectoralis major he specially points out to be what Rapp⁵ and, possibly, Meckel have considered the pectoralis minor. There may be some good grounds for the conclusion which Stannius has arrived at, that the deeper portion is pectoralis major and not pectoralis minor, if it is allowed, there are two layers of the former, which to some extent obtains in Ruminants and Rodents. On the other hand, the superficial layer ought certainly not to be confounded with the thoracic portions of the panniculus; for neither in the direction of its fibres, at nearly right angles to this last, nor homologically traced in other Mammals, does it positively belong to it.

For these reasons I shall therefore describe the pectoralis major in the Pilot Whale as a somewhat broad and rather triangularly shaped muscle, arising upon the superficies of the thorax from opposite the fourth to the first rib, meeting its fellow in the median line over the sternum⁶. Its fibres are directed outwards and slightly forwards, and are inserted by strong aponeurotic tendon into the breadth of the distal end of the humerus. The fibres of the panniculus, as already mentioned, intermingle with those of its posterior border, while anteriorly the representative of the platysma is similarly related. The description of pectoralis major in *B. rostrata*⁷ pretty closely agrees with the above; and in other Cetaceans examined by myself little difference obtained.

If the pectoralis minor is not, as hinted at, a deep layer of the pectoralis major, then I may assume that in *Globiceps* it has an origin from the ventral surface and median line of the thorax over the sternal cartilage of the fourth rib. Only of moderate breadth, but long, it is inserted into the strong fascia at the inner posterior root of the flipper. A muscle equivalent to the above existed in *L. albifrons*, but was attached as far as the sixth costal cartilage. In the Porpoise, Stannius⁸ notes the pectoralis minor as short and fleshy, springing from the anterior border of the sternum, behind the

¹ *D'Anat. Comp.* 2nd ed. (1835), vol. i. p. 393.

² *Op. cit.* p. 269.

⁴ "Muskeln des Tümmers," *l. c.* p. 16.

⁶ Fréd. Cuvier speaks of it as the "musculus communis," *Cyclop. of Anat. & Phys.* vol. i. p. 571.

⁷ Carte and Macalister, p. 218.

⁸ *L. c.* p. 14 (Rapp, 89).

³ "Die Cetaceen," p. 90.

⁵ *Op. cit.* p. 89.

sterno-thyroid and close to the costo-humeralis, with an attachment to the coracoid process. Said to be absent in *Balænoptera rostrata* (*l. c.* p. 218).

Rapp¹ names a costo-humeralis in *Phocæna*. This is short, fleshy, and passes from the posterior border of the first rib-cartilage to the inner side of the humeral tubercle. It goes under the insertion of the scalenus anticus, where it mingles with fibres of the pectoralis minor. I did not observe this in *Globiocephalus*, though I have recorded its presence in *Lagenorhynchus*.

Cephalo-humeral² roundish and strong-bellied. Origin, paramastoid along with the sterno-mastoid; directed backwards and downwards parallel with the sterno-mastoid for part of its course, it is inserted by a strong tendon into the anterior surface of the head of the humerus.

I recognize a diminutive levator anguli scapulæ³, with fascial attachments to the transverse process of the atlas, the neck generally, and to the anterior angle of the shoulder-blade. It differs but triflingly in other Cete, though occasionally relatively stronger.

A monogastric omo-hyoid obtains in *Balænoptera*, which if differentiated in other genera has been overlooked by me.

Though wanting a clavicle, yet I consider there is a homologue of a levator claviculæ in *G. melas*. This I found broad, flat, and chiefly composed of tendinous fibres, which radiately arise upon the supra- and infrascapular muscles, and, rather more muscularly, are inserted into the transverse process of the atlas. It lies between the parotid gland and the transversalis cervicis muscle (*vide* fig. 63, *L.cl.*).

There is but a single rhomboideus, as obtains in the Dolphin⁴, *Lagenorhynchus*⁵, and *B. rostrata*⁶. Stannius⁷ mentions two, rhomboideus superior and rhomboideus inferior, in the Porpoise; but Meckel's⁸, Flower's⁹, and my own observations on *Phocæna* agree in its being single. I noted in *G. rissoanus*¹⁰ a rhomboideus capitis, or what, indeed, might be a trapezius.

The serratus magnus has an attachment to the altoid transverse process, covers the side of the neck, and broadening posteriorly is fixed to the scapula. A narrow portion, moreover, digitally descends to the second and third ribs close to the cartilages; a broader costal and more aponeurotic portion is fixed to the ribs and intercostal spaces,

¹ *L. c.* p. 99, and Stannius, *l. c.* p. 16; also well shown in Flower's drawings (*infra*) of *P. communis*, besides a pectoralis minor.

² The humero-mastoideus of Fréd. Cuvier (*Cyclop. of Anat. & Physiol.* vol. i. p. 571, fig. 256), the occipito-humeralis of Stannius (*l. c.* p. 15), and masto-humeral of Carte and Macalister (*l. c.* p. 219).

³ Rapp, p. 88; Stannius, p. 13.

⁴ Cuvier, *Leçons*, vol. i. p. 375.

⁵ *Linn. Soc. Journ.* vol. xi. p. 152.

⁶ Carte and Macalister, *Phil. Trans.* 1868, p. 224.

⁷ Muller's *Archiv*, 1849, p. 13.

⁸ *Anat. Comp.* vi. p. 240.

⁹ Unpublished dissection, drawings of which were kindly lent me.

¹⁰ *Journ. of Anat.* 1870, p. 134.

from the fourth backwards. Rapp¹ and Stannius² note a serratus anticus major in the Porpoise.

The costal origin of the short, narrow, and thin latissimus dorsi in *Globiceps* is from the seventh, sixth, and fifth ribs and spaces, about their middle; and the insertion is on the inner side of the neck of the humerus by thick fleshy fibres. In the Piked Whale³ it appears to come by aponeurotic expansion from the dorsal and some of the lumbar spines. According to Stannius⁴, its costal attachment in the Porpoise is sixth to fourth ribs. I have noted in the same animal eighth to sixth; in the White-beaked Bottlenose⁵, twelfth to sixth.

The deltoid presents no feature of importance differing from that of Whales generally. Its scapular attachment might be mistaken for a supraspinatus, owing to the altered relation of the fleshy parts by absence of spine. According to my observation (*vide* fig. 70) the subscapularis covers the entire inner surface of the scapula with a capitular humeral insertion. Macalister's⁶ younger specimen showed eight tendinous intersections, *B. rostrata*⁷ differing in this respect. We agree as to the capsule of the shoulder not being pierced by its tendon, and an absence of bursa. The supraspinatus in *G. melas* and *L. albirostris* answers the description of it in *Phocæna* and *Balænoptera* as given by several authors. The infraspinatus fills the shallow scapular concavity behind the deltoid, its fibres running in an acute angle to those of the latter.

In *Globiceps*, Risso's Grampus, and the White-beaked Bottlenose, I have found but a single teres = teres major and teres minor. In one instance I met with duplicity of these muscles in the Porpoise, though Meckel's⁸, Rapp's⁹, Stannius's¹⁰, and Flower's dissections of this animal show it to be more commonly single. Fréd. Cuvier's figure¹¹ of the shoulder-muscles of the Dolphin demonstrates a teres major and minor. But the former is evidently the infraspinatus, the latter the teres major, and his infraspinatus a portion of the deltoid. Macalister¹² avers of the young *Globiocephalus*, "there was no sign of a teres minor or teres major, which are present in Dolphins." A teres major is recorded in the Piked Whale.

The diminutive triceps has two heads of origin:—one, a narrow slip, from the neck and dorsal surface of the scapular over the teres, and which mingles with the panniculus; the other, more tendinous, from the head of the humerus. In the same species (*G. melas*) Macalister¹³ met with only intersecting threads of fibrous tissue devoid of muscularity; but he and Carte¹⁴ mention a tricipital division as obtaining in *Balænoptera*. Decidedly a triceps is present, but single, in *Phocæna*, *Grampus*, and *Lagenorhynchus*.

There is in *Globiceps* a single, well-developed and fleshy coraco-brachialis, which

¹ Cetaceen, pp. 88, 89.

² *L. c.* p. 13.

³ *L. c.* p. 224.

⁴ *L. c.* p. 16.

⁵ *L. c.* p. 151.

⁶ P. Z. S. 1867, p. 481.

⁷ Phil. Trans. 1868, p. 226.

⁸ *Op. cit.* pp. 278 & 262.

⁹ *Op. cit.* p. 90.

¹⁰ *Loc. cit.* p. 14.

¹¹ Cyclop. of Anat. & Physiol. vol. i. p. 571, fig. 256.

¹² P. Z. S. 1867, p. 481.

¹³ P. Z. S. 1867, p. 481.

¹⁴ Trans. Roy. Soc. 1868, p. 227.

Macalister suggests is the short variety of Wood¹. In my specimen it arose from the coracoid process, passed downwards, overlapping partially the supraspinatus and subscapularis insertion. Strengthening the capsular ligament of the shoulder-joint, it is fixed into the inner process of the humerus.

The remainder of the forearm and manus, on both its surfaces, was clad with glistening, flat, tendinous material, as delineated in figs. 63 & 70. This divided below, supplying the several digits. I did not detect muscular fasciculi proximally, though it is possible these may have existed. Certainly in this specimen, as in Macalister's, distinct flexors and extensors of the limb were wanting, unless indeed the aponeurotic-like fasciculi represented them. In *B. rostrata*² and *B. musculus*³ five competent observers record them. In these two Whalebone species an extensor communis, a flexor carpi radialis, a flexor ulnaris, a palmaris longus, a flexor sublimis, and a flexor profundus digitorum are severally mentioned.

2. *Muscles acting on the Trunk and Tail*.—Although there is considerable difficulty in pointing out the lines of demarcation of the several muscles composing the erector spinæ, I shall nevertheless treat them seriatim.

Lying upon the tips of the transverse processes of the dorsal vertebræ, and covering the heads of the ribs, the sacro-lumbalis has muscular attachments to all the former, and tendino-fleshy slips to the whole of the latter. Continued posterior to the ribs, it ends pointedly at the side of the lumbo-caudal region, in a line with the genital fissure. The anterior continuation of the sacro-lumbalis has been termed cervicalis ascendens, or descendens in other Mammals. Here in the Caaing Whale a part of the former sufficiently merits the latter appellation. It is the more fleshy of the two. It has attachments to the transverse processes of the more or less coalesced cervical vertebræ, and specially to the atlas; moreover it proceeds with the nuchal continuation of the longissimus dorsi to the cranium, and is fastened partly by tendon to the upper part of the paramastoid.

Longissimus dorsi and spinalis dorsi are most intimately bound up together in the dorsal region, forming a long but enormous fleshy mass, interwoven spinally and costally with tendinous fascia. That which may be considered equivalent to a transversalis cervicis commences by a short, strong tendon at the paramastoid. Immediately becoming fleshy and thick, it ascends posteriorly on the side of the neck to the anterior dorsal region, and is lost in the combined longissimus and spinalis dorsi. Where the body posteriorly begins to narrow, a division of the two latter is perceptible. Hereabouts a superficial tendon passes obliquely upwards and backwards from the outer longissimus to the inner spinalis. A little way behind, another bridge of two oblique tendons similarly crosses, and immediately posterior to this five more, which together unite into a strong cord, wrapt one within the other (*vide* diagrams figs. 59, 60, & 63). Meanwhile from each muscle there is continued posteriorly, quite to the end of the

¹ Paper cited.

² Carte and Macalister, *Memoir*, p. 228; Perrin, *P. Z. S.* 1870, p. 814, figs. 1 & 2.

³ Flower, *P. Z. S.* 1865, p. 705; and Struthers, *Journ. of Anat.* 1871, p. 110.

spinal column, a single, thick, massive tendon. Besides the foregoing, both longissimus and spinalis possess a deep series of long, narrow tendons, one to each vertebra, but mingled or bound together by interstitial fleshy fibres. It results that these dorsal muscles act upon every vertebra independently, whilst at the same time the motor power of the fibro-cartilaginous tail is derived from the lengthened and more powerful cords; for from these there extends backwards a firm, glistening fascia, spread over and incorporated with the deep tail-substance. The latter, composed of closely packed parallel fasciculi, something of the consistence of the dorsal fin, traverse the thickness of the tail, and here and there have slits for the passage of the nutrient vessels.

Supracaudal. The single muscle (or compound muscle, if so regarded) to which I give this appellation lies external to the last, along the narrow portion of the caudal vertebræ, and on the upper side of the transverse process. Narrow in front, where fleshy, it widens somewhat and forms a tolerably thick fusiform belly, which again flattens and becomes tendinous. In its course it is attached partly to the vertebral bodies and partly to the transverse processes, sending off a special tendon to each of the latter. Posteriorly the flattened tendon lies against the sides of the bodies of the terminal vertebræ, and ultimately is lost in the general expansion of the upper surface of the tail-flukes. For further remarks, see *infra*.

Coming under the denomination of multifidus spinæ and rotatores spinæ, because of their position, origins, and insertions, are a great number of musculo-tendinous bundles, very apparent and well marked, but difficult individually to separate and define. These are still more numerous and closely packed together in *Lagenorhynchus* than in *Globiocephalus*, in consequence of the number and approximation of the vertebræ in the former. Stannius recognizes such a deep set of muscles in the Porpoise; and I can corroborate his observation in that genus. Their general arrangement is by tendons from the dorsal metapophyses, and trending forwards and inwards are attached muscularly to the sides of the roots of the spinous process in advance of their origin. The most anterior one is fixed to the atlas.

But there are besides a deeper layer of fascicles springing tendinously from the spines and dorsal arches, and these becoming fleshy are inserted into the transverse processes of the same vertebræ—doubtless semispinales, as Stannius¹ names them in *Phocæna*. He alludes, moreover, to another set of fasciculi, close to the last, and connected with the vertebral processes, but he has not named them.

In the four-limbed mammals generally there are three, or at most four, muscles described as occupying the iliac region, viz. the psoas major, psoas minor, iliacus, and quadratus lumborum. But in Cetaceans, as most writers state, there is only one enormously large inferior lumbo-caudal muscle, which, at first sight, might be supposed either to represent the psoas magnus alone, or the psoas minor, iliacus, and quadratus lumborum incorporated along with it. Whatever relation exists, division at least is

¹ "Muskeln des Tümmers," Müll. Archiv, 1849, p. 30.

inappreciable in *G. melas*. This enormously developed sacro-coccygeus muscle is long and fusiform. On each side it occupies the lateral and inferior surfaces of the vertebræ and their transverse processes from the ninth dorsal vertebra backwards; and as the transverse processes of the caudal elements are lost, it still continues upon them in the shape of a bundle of tendons continued on to the very end of the spinal column. The volume of its solid fleshy fibre may best be comprehended in the fact that it ranges in our specimen of *Globiocephalus* from one foot to six inches in transverse diameter, and with a corresponding thickness or depth. Further to particularize attachments and relations—it passes beneath the diaphragm, has the kidneys &c. lying upon it, and narrowing behind the rectum sends off, downwards and backwards, superficially, a series of flat tendons. These are so connected together as to constitute a very strong tendino-aponeurotic sheath, which spreads out and is continued on to the inferior surface of the broad fibrous tail. The main body of the fleshy mass meanwhile terminates in a single strong tendon, which passes direct along the spine, and is fixed to the very last vertebra. Moreover there is an appreciable flat layer of fleshy fibres, which come from the sides of the vertebræ and spread over part of the aforesaid tendinous sheath. This muscular layer appears to be a kind of reduplication of the body of the muscle itself.

A muscle the exact counterpart of the supracaudal lies on the underside of the transverse processes of the caudal vertebræ, and it bears the same relation to the sacro-coccygeus that the supracaudal does to the longissimus dorsi, save the fact of inversion of position. I distinguish it as the infracaudal.

The long spinal muscles of Cetacea have received different names and significations from successive anatomists, though the descriptions, save that of Stannius, tally. Meckel¹ demonstrates the parts in the Narwal (*Monodon monoceros*) and the Dolphin (*Phocæna communis*!). His text appears to me to imply that he considers present and less or more differentiated:—1, an equivalent of the spinalis dorsi, biventer cervicis, and complexus, a longissimus dorsi, trachelo-mastoid, and splenius capitis; 2, a sacro-lumbalis, with cervicalis ascendens anteriorly (“trachélo-mastoidien, ou l’intertransversaire du cou” of his translators); 3, flexor caudæ lateralis; 4, depressor caudæ = quadratus lumborum, psoas, and iliacus; 5, an inferior depressor caudæ. Frederick Cuvier² speaks of a levator caudæ, evidently No. 3 above. Rapp³ and Stannius⁴ coincide that there obtains:—a splenius capitis, longissimus and spinalis dorsi, sacro-lumbalis, and transversarius superior and inferior. The former thinks the great lower loin-muscle a psoas major; to the latter it implies more. Stannius, moreover, describes a caudalis superior, a caudalis inferior, a longissimus inferior, a sacro-lumbalis inferior, and a set of caudal muscles unnamed by him. He also traces the short, deep spinal muscles, of which more hereafter. Carte and Macalister, in the Piked Whale⁵, have

¹ Anat. Comp. vol. vi. p. 128 *et seq.*

³ *Op. cit.* p. 83 *et seq.*

⁵ *Loc. cit.* p. 225.

² Art. Cetacea, Cyclop. of Anat. and Physiol. vol. i. p. 569.

⁴ Müll. Archiv, 1849, pp. 22–32.

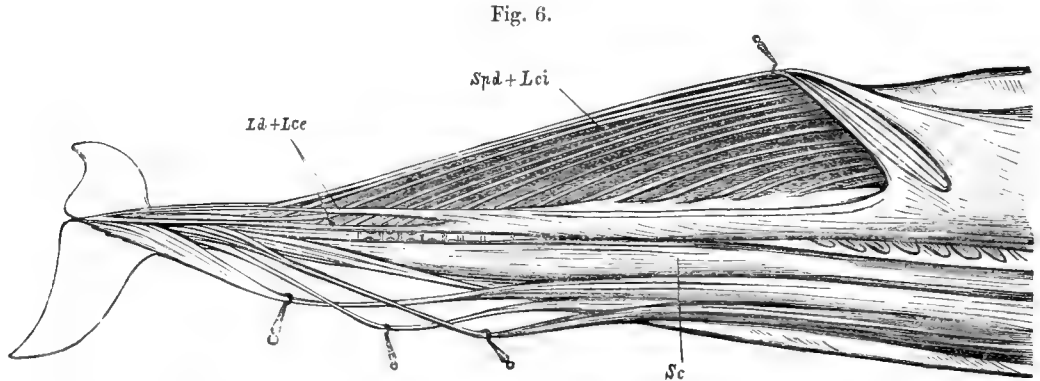
noticed a trachelo-mastoid, a longissimus dorsi, a sacro-lumbalis, with a slip supposed to be the homologue of splenius capitis, a levator caudæ, a depressor caudæ major, and depressor caudæ minor.

Notwithstanding amplitude of nomenclature, and recognition of two or more *en masse* or separate, the anterior divisions of the various observers present a certain harmony; but there is less concord of opinion regarding the posterior tendinous parts and infero-lumbar region. Rapp and Stannius differentiate as transversarius superior the compound tendinous enwrapping sheath of the longissimus and spinalis as described by me. But the latter, moreover, unites it with the anterior fleshy belly of my supracaudal, and traces it forwards to the ribs, thorax, and neck, *i. e.* includes part of what more strictly is sacro-lumbalis and cervicalis ascendens. Carte and Macalister's levator caudæ agrees partially with Rapp's transversarius, and partially with Stannius's caudalis superior. The latter muscle, again, is equivalent to Meckel's flexor caudæ lateralis and F. Cuvier's levator caudæ, one and the same with my supracaudal. None suggest the superior superficial terminal tendons, or aggregate fibrous investing-sheaths of the longissimus and spinalis dorsi, as the homologues of the levatores caudæ externus and internus of other mammals. Yet in every sense they are undoubtedly such, continuity with the dorsal fleshy masses being the only special deviation from their usual condition. The Cetacean supracaudal, again, offers homology in its posterior short slips with the intertransversarii caudæ of quadrupeds, its longer-bellied and more fleshy anterior moiety being occasionally in mammals almost separate from the intertransversarii caudæ, though not specially recognized as a distinct muscle. In *Manatus*, however, it is uncommonly well developed, and has been named by me lumbo-caudalis. The inferior depressor caudæ of Meckel, depressor caudæ minor of Carte and Macalister, caudalis inferior of Stannius, and his unnamed musculo-tendinous caudal bundles, correspond with the present infracaudal.

As regards the depressor caudæ of Cuvier and Meckel, the depressor caudæ major of Carte and Macalister, this undoubtedly is Rapp's psoas major &c. Stannius viewed it as composed of three divisions, equivalent to the dorsal muscles, and named by him respectively longissimus inferior, sacro-lumbalis inferior, and transversarius inferior. So far I agree with the latter, and therefore differ from Rapp, that the great sublumbo-caudal Cetacean muscle is not purely an ilio-psoas. This latter, I believe, as in *Manatus*, is all but aborted, certainly not recognizable. The homologue of the Cetacean sublumbar muscle, then, with its tendons and investing sheath, seems to me to be the sacro-coccygeus, whatever its significance as to the dorsal series. My infracaudal may represent partly inferior intertransversarii caudæ or perhaps include infra-coccygeus.

In default of being unable to determine with accuracy spinal insertions in *Globiceps*, I was more fortunate in *Lagenorhynchus*. In this genus the rectus abdominis tapers to a point at the fortieth vertebra, behind this intermingling with the caudal fascia. The

pubo-coccygeus goes to the chevron bones as far as the sixtieth vertebra. Sacro-coccygeus, muscular to forty-fifth, tendons to sixtieth; between these points the secondary tendons which form the sheath, emerge. Supracaudal from fortieth to sixty-sixth vertebra; the infracaudal is from two to three vertebræ shorter. Longissimus dorsi &c. narrows at sixtieth; two oblique tendons given off at thirty-seventh; the others behind, are producing aponeurotic sheath. The spinalis dorsi &c., its final tendons inserted from the sixty-fourth to the seventieth vertebral diapophyses.



Manner in which the fleshy imbedded inner deep tendons of the longissimus, &c., are distributed to the spine in Cetacea.

Spd+Lci, conjoined spinalis dorsi and levator caudæ internus, hooked upwards just posterior to the oblique bridging tendons from (*Ld+Lce*) the longissimus dorsi and levator caudæ externus; *Sc*, sacro-coccygeus, part of its constituent subsheathing tendon also dragged apart. Sketched from a dissection of *Phocæna communis*.

A series of levatores costarum, of moderate strength, and passing from the transverse processes to the ribs, exists in all the species of Whales I have dissected¹.

In the lumbar region of *G. melas* the intertransversales² are powerful; they diminish in strength forwards, and can barely be detected in the most anterior dorsals and cervicals. In *L. albirostris*, whilst fleshy, they are shorter, owing to the close approximation of the very numerous and long divergent transverse processes. In *P. communis* caudally they are tendinous; in the lumbar region, semitendinous and fleshy, a superior and inferior division is noticeable.

According to the development of the neural spines, cervical, dorsal, lumbar, and caudal, so are the interspinales³ strong or weak. But as a series of muscular bundles they are, I believe, present in every Cetacean. They have been met with by me in five genera.

Both Rapp⁴ and Stannius⁵ have described in the Porpoise a set of muscles linking together the chevron bones. They name these *M. interspinales inferiores*. They are

¹ Described also by the oft-quoted German authorities.

² The intertransversarii of the foregoing.

³ The *m. interspinales superiores* of the preceding writers.

⁴ *Op. cit.* p. 83.

⁵ *L. c.* p. 40.

distinctly marked in *Globiceps*, *Grampus*, and the White-beaked Bottlenose and Rorqual. They undoubtedly resemble the interspinales superiores of these authors, but pass from one chevron hæmo-spinal element to the adjoining. I prefer to designate them as interhæmo-spinales, this term being more in accordance with morphological anatomy. Stannius likewise differentiates, and names as *M. interaccessorii* a number of tendino-fleshy fascicles which intervene between the one and the other accessory spinous processes of the lumbar and dorsal vertebræ, in a longitudinal direction. These have not been observed by me; but I am inclined to regard them as intermetapophysales.

3. *Muscles acting on the Sterno-costal Framework.*—The rectus abdominis in the “Deductor” is striking on account of its vast thickness in the middle of the thoracic region. Springing by a strong aponeurotic tendon from the manubrium, becoming fleshy opposite the hinder border of the pectoral limb, it spreads out and covers a considerable share of the hinder surface of the chest. By degrees narrowing, it tapers and apparently ends near the generative aperture, though a portion is continued on towards the innominate bone, and by a tendon is fastened to the infracaudal fascia. The attachments of the rectus in the Porpoise are nearly similar. Stannius¹ notes a connexion with a tolerably strong aponeurosis, which proceeds from the pelvic region to the transverse process of the nineteenth lumbar vertebra and general caudal fascia investment. In the Piked Whale² penniform insertions into the second to sixth ribs are recorded. In Risso’s *Grampus*³ the muscular belly stops at the second rib, aponeurosis continuing to first rib and sternum; posteriorly it agrees with that of *G. melas*.

The obliquus externus, internus, and transversalis are relatively weaker than the preceding, though each is a great fleshy sheet. The former is attached to all the ribs about their middle, save the three anterior ones, where the fibres spring near their sternal ends. There are a few digitations with the serratus magnus; posteriorly the external oblique does not reach the pelvic bones.

Both external and internal intercostals seem to possess considerable motor power over the ribs, judging from their full development. More particularly is this the case with the first external muscle, duly commented on by Stannius in the Porpoise. I also specially noted the presence of strong fleshy fibres corresponding to the triangularis sterni in *G. melas* (*vide* fig. 69) and *L. albirostris*. Under the head of musculus ossium sterni costalium, Stannius⁴ describes bundles in the Porpoise which appear to me identical with the triangularis. The Rostock professor likewise alludes to a sterno-costalis⁵ in the same animal. This double slip, with obliquely set fibres, has one part attached to the sternum and first rib and its cartilage, another between the first and second costæ and sternal cartilages. I presume it agrees with what is now better known as the supracostal. Meckel⁶ describes, but does not name, a muscle identical with the above in Cetacea, which he regards as assisting respiration in the diving animals.

¹ *L. c.* p. 19.

² *Phil. Trans.* 1868, p. 224.

³ *Journ. of Anat.* vol. v. p. 134.

⁴ *L. c.* p. 38.

⁵ *L. c.* p. 37.

⁶ *L. c.* p. 190.

I distinguished two scaleni, a scalenus anticus and scalenus posticus. The former springs from the first rib and its sternal cartilage, where it is fleshy and broad; passing forwards it was inserted by a powerful tendon into the basiocciput, outside the rectus anticus major. The latter has a first costal origin, but not quite to the cartilage; anteriorly it is attached to the transverse process of the axis. I found precisely the same arrangement in *Lagenorhynchus*, both divisions being strong. Macalister records in *G. svineval*¹ a scalenus anticus attached to first rib and upper cervical vertebræ, and a scalenus medius and scalenus posticus conjoined, from first and second ribs to upper cervical transverse and spinous processes. But he suggests that one of the latter "was probably the germ of the serratus posticus superior, which otherwise was not visible." He and his colleague mention only a scalenus anticus in *Balanoptera*. Meckel², Rapp, and Stannius agree in there being two scaleni in *Phocæna*.

Sterno-mastoid, origin inner end of manubrium, outside the large sterno-thyroid; insertion by a strong tendon into the paramastoid along with the cephalo-humeral. Although in *Globiceps* it appears but a single muscle, yet there is a tendency to duplicity, inasmuch as the anterior portion rolls round posteriorly, and with what seems almost a separate deep tendon fixed to the manubrium. A double head, viz. from the sternum and cartilages of two costæ, obtains in the Piked Whale³. Cuvier⁴ and Meckel⁵ allude also to a cleido-mastoid in the Porpoise.

4. *Muscles connected with Neck and Head*.—What doubtless answers to the splenius, although it may include complexus, I find, in the Caaing Whale, to be a muscle of a most powerful character and of enormous size. The dorsal attachment is from the eleventh or twelfth vertebra; continuing thick and fleshy and widening, the muscles of opposite sides are fastened cranially the whole breadth of the exoccipitals. In the Porpoise⁶ it springs aponeurotically from the first dorsal spine, and terminates in a squamal tendon.

A trachelo-mastoid, according to my reading, obtains in a narrow longitudinal bundle arising from the transverse processes of the four anterior dorsals, and, running forwards, is fused anteriorly with the short oblique. Macalister gives the first cervical to the junction of the exoccipital and paramastoid as its attachments in his specimen of *Globiocephalus*⁷. In *Balanoptera* it is double-headed; one from the first dorsal, the other from the sides of three or four posterior cervicals, a vascular plexus divides these; cranially inserted into masto-squamoid. Although Meckel names such a Cetacean muscle, he confounds it with splenius capitis. Not mentioned by Rapp and Stannius.

The ordinarily small-sized, short, deep muscles of the neck in this Whale are of inordinate proportions, save the longus colli. The two pairs of recti postici are considerably interwoven. Occipitally they cover the whole surface of the bone below the inferior curved line, and thence extend to atlas⁸ and axis. Stannius⁹ unites under one

¹ P. Z. S. 1867, p. 481, and woodcut, p. 478.

² Anat. Comp. vi. p. 158.

³ L. c. p. 218.

⁴ Leçons, vol. i. p. 259.

⁵ Op. cit. p. 161.

⁶ "Splenius capitis," Stannius, l. c. p. 21.

⁷ L. c. p. 481, and woodcut.

⁸ Macalister, P. Z. S. 1867, p. 481.

⁹ L. c. p. 29.

heading the semispinalis and rectus capitis posticus in the Porpoise, the former stretching from the tenth dorsal spine to the atlas; the latter (a bundle derived therefrom) goes to the occiput. An obliquus superior springs from the lateral atloid bony ring in *Globiceps* as far as the root of the transverse process, and goes to the exoccipital. Beneath is another muscle from the axial process to the skull, apparently an obliquus inferior. Ventrally placed to the last, with similar attachments, is what I presume to be a rectus lateralis. Rectus capitis anticus minor, broader than the last, lies mesially to it, and is overlain by a great rectus capitis anticus major. This latter is fastened to the basi-occiput, to the ventral surface of conjoined atlas and axis, and partly cervicals beyond. The short and highly tendinous longus colli is forwardly fastened to the body of the axis, and, covering the posterior cervicals, goes backwards on the dorsal bodies as far as opposite the fifth rib. In the Porpoise it stretches over three dorsal bodies and all the cervicals¹. The great development of these muscles, in spite of shortness and coalescence of the neck-bones in Cetacea, is an interesting fact.

Masseter short, narrow, but thick. Origin, angle of mandible; insertion, area below the eye; its fibres have but slight downward obliquity. Above it and somewhat superficial, observed by me both in *Globiocephalus* and *Lagenorhynchus*, was another muscular plane, relatively sparse in fibre, which occupied the interspace between the last and the orbicularis palpebrarum. This latter, I opine, corresponds to the masseter malaris externus of Professor Stannius² in the Porpoise. He describes it as springing from the malar process (Jochfortsatz), sloping forwards to the outer angle of the orbit (Augenwinkel), and spreading out over fasciculi of the masseter orbicularis palpebrarum. A clearly double masseter is defined in *Balanoptera*³, the deeper layer arising tendinous from the margin of the glenoid cavity.

The narrow, fleshy, and thick temporalis fills the somewhat infundibular fossa back to the crescentic ridge, and has an insertion into the mandibular coronoid process as far as its root.

There is a well-developed buccinator, whose posterior moiety is thick. Its broad maxillary origin is from the bony area anteriorly and inferiorly to the eye; its narrower insertion, the muscle being of an elongate triangular form, is the mandibular surface opposite the hindermost teeth.

Weak muscular fibres, representing an orbicularis oris, appear to be derived from, and almost are a continuation of the upper part of the buccinator. They thus proceed from the angle of the mouth and buccinator in a scattered manner, and curve forwards and upwards, thence partly interweave with the strong glistening tendino-fibrous material which goes to form the overhanging buccal arch or projecting upper lip, and merge into the blubber-like fat and the premaxillary muscle. The single-bellied representative of digastric (*antea*, p. 251) is little else than an inferior facial muscle.

¹ Rectus anticus major bound up with the longus colli in *Phocena*, according to Rapp, *l. c.* p. 82, and Stannius, *l. c.* p. 30.

² *L. c.* p. 4.

³ Carte and Macalister, *l. c.* p. 223.

In all the Cetaceans cut up by me I have observed well-developed and separate pterygoidei. The external, flat, broad, fleshy, and of a quadrilateral shape, is fixed to the outer surface of the pterygoid plate, and, with a downward and forward plane, goes to the inner surface of the lower jaw, chiefly to the upper margin of the bone. The internal muscle arises from the superficies of the prominent portion of the pterygo-palatine, passes backwards and downwards to the mandible. Inferiorly and at its posterior border the latter muscle sends off tendinous fibres, which join those of the articulating condylar process of the inferior maxilla. A pterygoid internus and externus are described both by Rapp¹ and Stannius² in the Porpoise; but Carte and Macalister³ state that in the Piked Whale no internal pterygoid was found.

IX. URINO-GENERATIVE ORGANS AND PELVIC-APPENDAGE HOMOLOGUES.

1. *Genitalia*.—The kidneys, as in other Whales, are conglomerate, and lie upon the great lumbo-caudal muscle. In this female the renal organ (fig. 36) upon the right side measured one foot long by about six inches across at its widest, and was of a longish oval figure. The left one was about an inch smaller, and rather narrower in proportion. The lobuli vary in size and shape, characteristically tending to the hexagonal form; their diameter ranges from 0.3 to 0.6 of an inch. They are further aggregated together in groups of from three to a dozen in number, and, when the kidney as a whole is slightly unravelled from the loosely connected but strong fibrous tissue, have an appearance not unlike the acini of a bunch of grapes. Each lobule (fig. 38) is composed of a thickish cortical layer and smooth tubular or medullary substance, which has a single broad hilus and papillæ, but no marked Malpighian pyramids⁴.

As Mr. Gulliver⁵ has remarked, "the bloodvessels enter the kidney, not near its middle, but at its fore and inner or atlanto-mesial side." The renal artery has a nearly straight course in the longitudinal direction of the gland, and sends off branches dichotomously. The blood is returned by the veins in a similarly dichotomous manner, which enter two large branches placed on each side of the artery; these join into a main vessel which lies to the outer side of the artery.

The ureters leave the kidney posterior to the entrance of the bloodvessels, and pass on to the urinary bladder somewhat apart and behind the neck. The bladder is small and pyriform, in this case containing a limited amount of dark coloured fœtid-smelling urine⁶. The urethra, 7 inches in length and posteriorly not well defined from the neck of the bladder, is adherent to the abdominal parietes of the vagina, and runs forwards

¹ *Op. cit.* p. 85.

² *L. c.* p. 6.

³ *L. c.* p. 222.

⁴ Turner, who made an injection, says (*l. c.* p. 75) that "the pyramidal substance was almost non-vascular."

⁵ *Loc. cit.* p. 65; also noticed by Turner.

⁶ Turner, *ibid.*, suggests that only "a small quantity of urine could collect in that organ prior to its excretion."

narrowing by degrees to the meatus urinarius, which opens at the deep surface of the clitoris.

The female external generative aperture in *Globiceps*, as in all true Cetaceans, is an elliptical fissure or median sulcus situate at the hinder end of the body, where commences the caudal narrowing, or near the middle of the third fourth of the animal's length, and inferiorly about vertical to the termination of the panniculus. The tegument around is dark-coloured, and thrown into a good number of minute parallel and wavy wrinklings chiefly transverse in direction. The opening of the vulva is 3·3 inches long, and it is less than a third of that across at its widest part. The anal orifice, not over half an inch in diameter, is distant 2·7 inches behind the posterior pudendal commissure. Immediately within each lip of the vulva, or what may be considered the labia majora, are some twenty or more short, but deep, folds of membrane, in the recesses of which are crypts, the openings of sebaceous glands. The homologues of nymphæ or labia minora are two prominent folds of the mucous membrane, each an inch in length, which lie within the anterior pudendal commissure, and slightly converge as they pass backwards. Between these and with lateral plicate sulci is a median ridge 1·3 inch long, which ends in a small but distinctly pronounced conical-shaped clitoris.

The vagina, 9 inches in length, whose mouth is about the middle of the external uro-genital fissure, sweeps diagonally towards the abdominal cavity. In the two latter points, as in the uterus entire, *Globiceps* agrees pretty well with the Whale type as described by John Hunter and others in specific forms. The lower vaginal half is widish and smooth, or with only fine longitudinal plications; the upper half, on the contrary, is narrower, and has a very uneven surface. This roughening depends on a numerous series of transverse rugæ or puckerings of the membrane, some four of which are extremely prominent. In alluding to these valvular folds, Hunter aptly compares them to a succession of ores tincarum. They are composed of thick induplications of the fibroid tissue of the wall of the vagina (fig. 74), inwardly lined by narrow longitudinal mucous rugæ, which fringe their free edges. The fold nearest to the os, and only a good thumb's breadth from it, has a thickness of $\frac{4}{10}$ of an inch. The true os uteri is only distinguishable from the preceding folds by its narrower and somewhat firmer ring-like aperture. The cavity of the uterus above in this specimen is only 2 inches in length, and then divides into right and left cornua. There is a circular membranous fold about half an inch above the os; but the mucous coat of uterus and cornua is longitudinal and wavy. The broad ligament and the fimbriæ of the Fallopian tubes form a delicate arched covering or pavilion which overarches the ovary. Each narrow oblong ovarian body is about two inches in extreme diameter, and is of firm consistence.

The mammary glands, as might be expected in a young animal, were but of moderate size, namely, about 4 inches long, and their glandular structure in consequence feebly developed. These organs, as in other Cetacea, lie upon each side of the vulva, and

open outwardly by a small slit containing a retracted nipple, in this case apparent, but only imperfectly pronounced. The glands themselves have a tough fibrous external coat, and are surrounded by a strong constrictor muscle.

The male organs of generation of *Globiceps*¹ have been described by Jackson; they resemble those of the Dolphin. He says, "connected with the vasa deferentia, and forming undoubtedly a part of the genital system, was a canal, $2\frac{1}{2}$ inches long, opening on the verumontanum, just in front of the vasa, and so closely connected with them as not distinctly to appear, except for about one third of an inch just before the vasa came together. At this last part, where it terminated in a *cul-de-sac*, it appeared as large as the vasa, but was thinner, and the cavity larger, the inner surface being white and rugous. It afterwards became smaller; but before termination the cavity enlarged to five or six lines. No glands were seen on the inner surface"². An organ resembling the above was found by the same author in the Sperm-Whale, the Dolphin, and the Porpoise³. I take it to be a uterus masculinus; and as I have myself seen it in two genera, one may infer its presence in most, if not in all the genera of the family (see woodcut *anteà*, fig. 3).

No sectional representation of the Cetacean penis, to my knowledge, is published, although the structures themselves have long ago received elucidation by Hunter⁴ &c. I incorporate in the Plates of this memoir, therefore, a drawing (fig. 56) of that of a large Fin-Whale⁵, typical in part of what obtains in the genera of smaller size.

2. *Pelvic Bones, Ligament, and Muscles.*—The pelvis in *Globiocephalus* is represented by a pair of short styliform bones (*ossa innominata*), which, at a moderate distance from each other, float free from the spine among the muscular and other tissues near the genital outlet. In this female each of these smooth tapering bones measured 4 inches in length, had a strong resemblance, in shape, to a first rib, concavity inwards, or looking towards its fellow. Anteriorly there was an inturned capitulum, as in *Orca*, just behind the neck of which the bone enlarged somewhat, and then tapered gently towards the narrow and pointed hind extremity. At the thickest belly-part of the bone the diameter was $\frac{7}{10}$ inch, proportionally less in front and behind. There was a

¹ In Dr. Williams's account of the generative parts of the Lewchew Whale he says, "there was an anomalous connexion between the urethra and rectum, near their termination, of a firm, round, imperforate band of a tendinous nature, half an inch in diameter, the use of which was not at all apparent," *l. c.* p. 412. Does he allude to the retractores? or the male parts representative of the mammary glands?

² *L. c.* p. 166.

³ See also a notice of the presence of a uterus masculinus in *Phocœna* by Huxley, *Hunt. Lect. and Lancet*, 1866, p. 381.

⁴ *Phil. Trans.* 1787, p. 441, and his original preparation, *Physiol. Cat. Coll. Surg.* no. 2527.

⁵ *Physalus antiquorum* = *B. musculus*, specimen no. 2524 E, *Coll. Surg. Mus.*, and same referred to in *P. Z. S.* 1865, p. 215.

I hazily remember having seen a lithograph of a view similar to that here given in Dupuytren's Museum in Paris.

nodule of cartilage tipping either end, that rearwards was very distinct. No osseous or ligamentous cross bar, representing rudimentary femur, existed, such as is met with in *Balæna* and *Balænoptera*. The smooth or only slightly roughened bone rather resembles the pelvis of the northern *Orca*.

Uniting the opposite pelvic elements was a strong X-shaped glistening fascia, fixed within a trifle of the whole length of the inner concave border of each bone. A number of muscles were attached, partly to this and to the bones themselves, and bloodvessels penetrated the two latter, which I have already referred to.

The muscular structures attached to the pelvic bones, and surrounding the generative outlet of Cetaceans, have heretofore been but imperfectly studied and figured. The pains-taking Stannius, in his "Myology of the Porpoise"¹, admits of anal and pelvic muscles the following:—a sphincter ani, an ischio-cavernosus, and a retractor ischi or ischio-caudalis. I believe no other author has stated there are more, though others are inferred to exist². In my researches on this female Deductor and other Whales, I have been fortunate in meeting with many more than the above; and these I shall describe in layers, from the superficial to the deep, as dissected (*vide* figs. 76 & 78 in my last Plate).

In a study of the parts it is well to keep in mind the sex.

I have already (*anteà*, p. 272) alluded to the inferior and posterior (puddendal) portion of the panniculus carnosus, shearing outwards and leaving the tail free; but there is, at the same time, a certain continuity with it of a thin superficial layer of transverse fibres. These of opposite sides form a long ellipse, whose apex anteriorly meets the divergent angle of the panniculi, partially cover the rectus abdominis and other genital and mammary gland-muscles, whilst posteriorly it reaches the perineal raphe and anal sphincter. It acts as a dilator of the vulva, whilst the portion continued to the anus serves as an anal protractor. This muscular sheet altogether appears to be the homologue of levator ani and probably combined superficial transversus perinei of human anatomy. I may as well mention that in the perineal region of Risso's Grampus, beneath the cross fibres of the levator ani, I observed a narrow oblique band of muscle which passed from the surface of the pubo-ilio-coccygeus to the perineal raphe. This slip doubtless would represent a superficial transversus perinei. Moreover, in the same female specimen, I noticed another short, broadish, fleshy band, which ran obliquely from the surface of the rectus abdominis, at the commencement of its posterior tendon, inwards towards the fore part and side of the clitoris. Its superficial position and inguinal relations suggest its being a homologue of a cremaster, though such an anomaly in the female sounds strange.

¹ Müller's Archiv, 1849.

² Professor Van Beneden has been kind enough to put in my hands a short paper of his, "De la Composition du Bassin des Cétacés," Bull. 2 ser. t. xxv. Therein he faithfully figures and describes the generative organs of *Delphinus tursio*, noting two muscles, viz. ischio-cavernosus and retractor of penis.

The sphincter ani consists of a circlet of coarse, strong, fleshy fibres, the true external sphincter; but there are, besides, circular fibres more deeply placed around the gut, which would represent a sphincter ani internus (*vide* fig. 48).

The rectus abdominis, which I have already described, partly mingles with the generative muscles, inasmuch as its posterior narrowed extremity and terminal tendon enclasp the deeper fleshy structures of the vulva and winds round each innominate bone, finally being inserted in the neighbourhood of the chevron bones.

What I assume to be the counterpart of an ischio-coccygeus is a thick and strong muscle which, with its fellow of the opposite moiety, constitutes a crescent-shaped perineal mass. Each muscle arises by narrow but somewhat strong tendon from the surface of the middle of the os innominatum. Passing backwards and inwards, its fleshy fibres expand and are inserted into the perineal raphe, and join those of the levator and sphincter ani. It is a retractor of the pelvic bone when the perineal attachment is the fixed point; reversely it may assist the levator ani. There is a likelihood also that after pregnancy, when the mammary gland is enlarged, it may exert pressure on that organ during lactation.

The erector clitoridis, or ischio-cavernosus, is a large diagonally placed fleshy band of muscle, of nearly equal breadth throughout. It lies partially beneath the last and between it and the rectus abdominis, with the compressor mammæ and gland to its inner sides. Before the positions of the parts are disturbed this muscle has a more curvilinear aspect than the deeper dissections (figs. 77, 78) warrant. It has an extensive origin from the surface of the posterior moiety of the innominatum bone, at least 2 inches, as also from the fibro-cartilage and broad pelvic fascia. With a direction forwards and inwards, it lies upon the sphincter vaginæ, and is ultimately inserted into the median line. In male Cetaceans the muscle corresponding to this is a very powerful one, with a great pelvic attachment, and stretching on to the side of the root of the penis.

Alongside and mesially from the erector clitoridis is a somewhat fusiform, moderate-sized, or, indeed, compared with the last, small-sized muscle. Its office I take to be chiefly a compressor of the mammary gland, as such I name it; for it constitutes a semi-circle round and partially over that organ. Its attachment posteriorly is beneath the ischio-coccygeus, from the strong perineal fascia in front of the rectum. From this the muscle, sweeping outwards, forwards, and then inwards, or embracing the mammary glands as a semilune, narrows anteriorly, and is fixed upon the strong fascia before and partially at the side of the mammæ¹.

Besides the two foregoing, two other muscles lie between them and the border of the rectus abdominis. The first, in proximity to the erector clitoridis, is a short and laterally compressed slip. Inwardly it is fastened to the median strong fascia of the

¹ Geoff. St.-Hilaire, 'Annales,' 1834, p. 183, alludes to a muscular covering of the mammæ, which, he thinks, presses upon the gland like the pouch of the Kangaroo.

vagina, and thence directed outwards and slightly backwards is attached to the fascia in front of the os innominatum. The second fleshy band is situated immediately in front of the last, the two being in close union. Anteriorly it has the same derivation, but posteriorly proceeds along the outer margin of the os innominatum almost to the middle.

This pair of muscles serves much the same office, viz. seem to draw inwards, or are protractors of the pelvis, and, through continuity by fascia across the urethra, may constrict this canal. As regards their homology, they bring to mind the two portions of Wilson's and Guthrie's muscles, the so-called compressores urethræ, or transverse and perpendicular constrictores urethræ. Possibly they may include the circular fibres of Santorini, =stratum internum circulare of Müller, if we take into account along with them their fellows of the opposite side. In studying the parts, I imagined for a time that the larger of the said muscles might be the representative of a pyramidalis. On the other hand there is more reason to believe them very fully developed urethral constrictores. Hence it is most interesting to find in Cetacea parts so manifest which in Man are mere rudimentary structures.

Deeper than the four preceding there is another muscle, which, without doubt, is a true sphincter vaginae, =bulbo-cavernosus in the male. It is exceedingly large, fleshy, and powerful. It is attached to the vagina near the anterior end of the pelvic bone, and, as a broad fleshy mass, encircles the generative canal, beneath the mammary gland. Broadest in front, as it narrows behind it becomes inserted on the strong median fascia posterior to the vulva.

I may next call attention to a small slip of muscle which bridges between the posterior corner of the os innominatum and the recto-pelvic fascia. Springing from the inner deep margin of the bone, it crosses inwards and slightly forwards towards its narrower insertion. It lies upon the broad belly of the combined lumbo- and iliococcygeus, and is covered by the erector clitoridis and compressor mammæ. The action of this diminutive muscle evidently is to pull each pelvic bone inwards from behind or, contrariwise, to render tense the pelvic fascia.

It appears to me to be the homologue of a deep transversus perinei.

Finally, I shall refer to a long, elliptical, fleshy and powerful perineo-caudal muscle. This in *Globiocephalus*, as in *Grampus* (?), is double-headed; or if considered two muscles, these are conjoined behind. It or they best comply with the pubo- and iliococcygeus of other mammals, which I am convinced is the true homology. If I understand aright, Stannius terms it retractor ischi in *Phocæna*, and Rapp ischio-caudalis. In the female Caaling Whale the narrow outer portion springs from the outer border of the posterior third of the os innominatum, thence goes backwards as a fleshy riband to the outside of the next. This much more bulky but also fleshy portion commences from the under surface of the deep pelvic fascia, and trends straight backwards along the middle of the narrowing portion of the caudal region. It has the rectum between

it and its fellow of the other side; but posteriorly the two meet mesially, and as they diminish in calibre are fixed to the chevron bones as far as the vertebræ.

X. REFLECTIONS, ZOOLOGICAL AND PHYSIOLOGICAL.

The skeleton, as I have intimated, is the standard whereby Cetacean generic segregation and affinities are best tested; consequently such parts of the organization of *Globiceps* as have been here treated, afford narrow limits in their applicability to taxonomy. One's eyes, however, must not be shut to the fact that among the Delphinidæ *Globiocephalus* seems to be established generically by its outward configuration alone, unless Dr. Gray's *Sphærocephalus*¹ assimilates; but the exterior aspect of this form is unknown. The truncate, globose, prenarial nodosity, fairly defined from the upper labial rim, the unusually long, narrow, tenuous pectoral limbs, and the low, falcate dorsal fin are very marked features in the genus under present consideration. The head of *Orca* and its ally *Pseudorca*, whilst rounded, is proportionally low; and their limbs and dorsal appendage sensibly differ. *Grampus* approaches our genus; but the facial prominence veers towards the outline of *Phocæna*, or with a gradual arched declivity, rather than the bold perpendicular fulness and labial emargination of *Globiocephalus*; besides, its dorsal fin is relatively high, and its limbs shorter and broader. *Phocæna* and the Dolphins (*Delphinus* &c.) are yet further removed in the points above indicated. Such differences, I grant, are gradational; but so are all osteological data. Within the limits of just comparison, however, they are not fanciful, but visually true, and have their special worth in the outward generic recognition of a group uncommonly like each other in their *tout ensemble*.

Eight species of *Globiocephalus* are recognized in the British-Museum Catalogue, and other synonyms &c. enumerated. My worthy friend Dr. Gray's method of recording scattered writers' indifferently determined species is decidedly useful, but not without objections. He himself allows that such handy lists require constant supervision.

His *G. affinis*, he surmises, is probably a young *G. vineval* (= *G. melas*). This opinion one can readily admit; for, unless in non-agreement of dental formula, there is no special characteristic to assign a separation. Now the numbers of the teeth in different specimens of *Globiceps* are most irregular, simply from the reason that they are so loosely implanted in their sockets that in early life, adolescence, and old age they not unfrequently drop out. But what is the *Grampus affinis*, p. 300, Cat.? The presumed anatomical distinctions of the American *Globiocephalus intermedius* rest on treacherous footing. To it fifty-eight vertebræ are assigned against fifty-five to the European form; yet in *G. melas* there obtain fifty-eight and fifty-nine, as authenticated by Professor Flower (Trans. Zool. Soc. vi. p. 349). Too much stress, I think, is laid on the cervical ossification of the former; and as to difference in dentition, the above remarks apply. *G. edwardsii* has no solid basis as a species. Regarding the South-Sea Blackfish

¹ P. Z. S. 1864, p. 244, and Cat. of Seals and Whales, 1866, p. 323.

(*G. macrorhynchus*), the *G. indicus*, the *G. sieboldii*, and *G. chinensis*, some confusion evidently reigns. Dr. Gray says Mr. Blyth's species (*G. indicus*) is "perhaps a *Neomeris*." But his own trenchant definition of the latter genus, viz. "dorsal fin none," does not harmonize with Blyth's recorded dorsal fin $2\frac{1}{2}$ feet in length. I have alluded frequently to the anatomy of Dr. Williams's Lewchew specimen, which agrees with the British *G. melas*; yet it is as likely as not to be the *G. indicus*, Blyth.

As far as I can draw a conclusion from what has to me been satisfactorily demonstrated by others concerning *Globiceps*, there is but one (or two?) well-determined species inhabiting the basin of the Atlantic¹. This is manifestly a migratory animal.

That in the Pacific and Indian Oceans the species are more numerous is possible; but how much separation or identity of specimens from different localities are entitled to weight requires more research and comparison than the subject has hitherto received.

As far as outward figure and colour are concerned, there appears considerable uniformity; but paucity of trustworthy observation may have something to do with this, if Couch's² assertion is well founded.

The precise position of the Cetacean dorsal fin would seem to be no sure specific test; for between fœtus and mother there is no unanimity: in other words, its position depends *pari passu* on the age of the animal.

Whilst the entire pectoral limb of the Whale is reduced to act in a watery mobile element, it acquires unusual power of a semirotatory kind. Professor Huxley³ remarked of the Porpoise, "it is not, however, by any motion of those fins that locomotion is effected, this being almost exclusively produced by the sculling action of the tail." True! still it seems to me that every movement must to some extent be influenced by these appendages. In nautical parlance, crank vessels require floats or outward balances. Now this is precisely the office of the semirigid extremity. It rotates, moreover, on its own axis, through the well-nigh ball-and-socket joint and fore-and-aft levers.

Has subservience to function, preservation of type, selective power, or hereditary transmission had the most enduring influence in the transference of such a complex fleshy arrangement of the naso-facial muscles? Huddled up beneath a mass of blubber,

¹ This opinion may seem very offhand as weighed against such authorities as Gray, Gervais, and van Beneden; but the wide geographical range of *G. melas* makes one hesitate to accept distinction unless well founded. I regret the cessation of the text of the 'Ostéographie des Cétacés,' which, in spite of pls. 51 & 52, leaves a loophole of uncertainty. Burmeister's *Globiocephalus grayi* (Anales, as cited, p. 367, pl. 21), as far as I can judge from a study of his text and plates, seems specifically identified more by abnormality in dentition than by strikingly trenchant cranial distinctions; and that, as I have intimated above, is a point of weakness in diagnosis. Regarding Malm's *Globiocephalus propinquus* (Svenska Kongl. Akad. 1871) I have not had an opportunity of mastering his differentiations. If, however, *G. melas*, as proved, ranges from the Polar seas to the Mediterranean, and possibly south of that, is it not probable the Gottenburg specimen may eventually turn out to be a variety of the common species? The skeletal changes from youth to age have yet to be worked out in *Globiceps* before species can be soundly established.

² Corn. Fauna, p. 10, quoted by Gray.

³ Hunterian Lectures, 1856.

as they are, they yet retain a physiological importance of no mean value. In them can rest no power of expression whatsoever; withal, what a development of parts which in higher mammalia are devoted mainly to such a faculty! It would seem as if there were no end to utilitarian purposes. The same tool which in the Cetacean is perforce adjunct to the respiratory act, is transformed in the Ruminantia to a grasper of herbage, in the Suidæ to a digging-instrument, in the Elephantidæ to a tactile flexible limb, and so on.

Again, in the fish-like form of body of Whales, there rules similarity of spinal tendino-muscular distribution. It is easy to trace the homologues of the great lateral piscine muscles and even their segments (myocommas). For whether studied in the longitudinal direction, or in cross section, there can be recognized counterparts of fibre, tendon, and flesh as found in the predacious Shark and others of the finny tribe.

There is one piece of organic mechanism in which, so far as *Globiceps* is concerned, I do not quite follow the descriptive evidence of previous anatomists. I allude to the motions of the larynx. As I find it in this form, it is difficult to conceive how it is thrust upwards and downwards, and firmly constricted at every expiration and inspiration. The chief directions it seems capable of moving in are fore-and-aft, with a limited power of elevation and moderate dilatation and approximation of the aryteno-epiglottic funnel. It appears to me that the upper portion of the funnel at all times rests in the posterior nares, upright, and with an obliquity corresponding to the direction of the inferior nasal channel. This leaves one of the pharyngeal passages wider than the other, along which the greatest bulk of the food must pass. It is during deglutition, not respiration, that the strongest action of a grasping and elevating nature takes place, in this presenting a certain agreement with the second phase of the act in ourselves. At such times perfect closure of the funnel by compression of the circular fibres of the superior constrictor, and elevation through contraction of the longitudinal ones, blockades the postnares and sends the food on to the œsophageal sphincters in the rear. When expiration and inspiration are about to take place, it is quite obvious that were the naso-laryngeal sphincter forcibly to grasp the aryteno-epiglottic tube, and powerfully drag it upwards, as some assert is the case, the consequence would be closure of the breathing-tube itself. I conceive that in the performance of respiration there is a firm but moderate contraction of the naso-pharyngeal parts, sufficient only to steady the aryteno-epiglottic funnel, and prevent passage of air into the gullet. At the same time those laryngeal muscles which act as dilators open the cartilaginous tube, and give free vent to the outgoing and incoming air. Meanwhile also the muscular and resilient cartilaginous parts at the spiracular orifice play in active unison.

The function of the retia mirabilia, with which Whales above all other vertebrata are copiously furnished, is still a matter of conjecture. Such men as Hunter, Cuvier, and Breschet have looked upon them in the light of reservoirs, to store up an excess of arterial blood, needful during the animal's long submersion—a kind of supplementary

oxygenated residuum in lieu of more frequent respiratory acts. With reference more particularly to their distribution in the limbs, Von Baer conceived the manifold subdivision as concurrent with paucity of movement of the members. Besides playing the part of great lagoons (reciprocal recipients of a circulatory overflow, as some put forward), Professor Turner avers, as Milne-Edwards¹ had already advanced, and reasonably, that such subdivision distributes, equalizes, and retards the blood's force ere reaching the sensitive nervous centres &c.

I believe they are designed to execute a highly important vito-physiological process, which may be combined with some subsidiary mechanical adaptation as has been asserted. Their office is equivalent to modified blood-glands, in some way related to pabulum or nutrient fluid. The retia mirabilia in Cetacea and many other Mammals are not confined to the cerebro-spinal tract and neighbourhood of the respiratory apparatus, but principally follow the lines in body and limbs where the lymphatics and absorbents are known to obtain in the greatest profusion. Moreover, in Cetacea, Sirenia, Phocidæ, and other forms where retia are very manifest, even some birds, the lymphatic glands are unusually abundant and of large size; so that their intimate connexion with the vascular plexuses is a most presumptive conclusion. I apprehend that the countless divisions, subdivisions, and minute vascular osculations, by coming in close contact with the lymphatic system, conduces to an interchange or exudation of their constituents². What further physiological process takes place I am not prepared to demonstrate, though inferentially I would adduce multiplication of the lymph-corpuscles; a view maintained by some as respects the office of the lymphatic glands. Such a proposition is applicable to many varied physiological phenomena of absorption and nutrition in divers animals well known to possess fully developed retia mirabilia.

¹ Leçons, Physiol. Anat. Comp. 1859, vol. iv. p. 260.

² I conceive, as already mentioned, that there is a certain functional homology between the so-called caudal hearts of lower vertebrates and the Cetacean mesenteric moniliform tube of Turner. In like manner I regard the human so-called coccygeal gland as strictly homologous with the inferior caudal plexus of Whales &c. Moreover, as the vascular retia distributed throughout the body and limbs are essentially similar in constitution, it follows they may all serve one office. As there is in the first case a manifest intermixture of plasma (Jones, *l. c.*), so in the second, by absorption or otherwise, may a phase of nutrition be subserved. Abnormal developments of the lymphatic and vascular systems are *pari passu* pronounced, though not restricted to the aqueous and amphibious vertebrates and those that hibernate; in them, though respiration may be checked or subdued, nutrition must perforce go on. Do the retia and lymph-sacs, then, supplant the necessity for frequent respiration, or substitute by subsidiary function a reserve force where depuration or nutritive quality of the blood is interfered with?

DESCRIPTION OF THE PLATES.

PLATE XXX.

- Fig. 1. Drawing from nature of the young female Pilot Whale, *Globiocephalus melas*, Traill. To a scale of $\frac{1}{1\frac{1}{3}}$ of the natural proportions.
- Fig. 2. Dorsal aspect of the same Whale.
- Fig. 3. Its blow-hole, of nat. dimen.: *a*, anterior, and *p*, posterior lip.
- Fig. 4. The eye, about nat. size.

PLATE XXXI.

- Fig. 5. Foreshortened view of the head, looking into the opened mouth of the same female *Globiocephalus*. Considerably reduced in size. *T*, tongue; *P*, palate; *f*, faucial membrane and folds; *a*, angle of the mouth.
- Fig. 6. Segment of the roof of the mouth, showing palatal rugosities, glands, and premaxillary teeth, the left series of which are complete: *g*, gutter; *a*, angle.
- Fig. 7. A left premaxillary tooth, nat. size, with outline of the gum (*g*): the ridges seen in cross section.
- Fig. 8. A longitudinal mesial section of the same tooth: *p*, pulp.
- Fig. 9. Left posterior mandibular tooth, seen from behind, and shown with gum-ridges as in fig. 7, also nat. size.
- Fig. 10. A small portion of the faucial part of the palate, showing mucous crypts, *c*, or fissures and glands, *gl*; *fg*, fungiform papillæ.
- Fig. 11. Underview of the tongue, larynx, and part of the trachea, prepared chiefly to show the muscular structures. The superficial layer remains on the left, but a deeper dissection is made on the right side.
- f*, frænum linguæ; *Gh*, *Gh**, genio-hyoid, entire and cut tendinous origin; *St.g*, styloglossus; *G.h.g*, genio-hyo-glossus; *Hg¹*, *Hg²*, hyo-glossus, first and second heads; *Ihy*, interhyoideus; *S.&Mh*, insertions of sterno- and mylo-hyoidei; *Th*, thyroideus; *S.th*, part of sterno-thyroid; *C.th*, crico-thyroid; *Th.gl*, thyroid gland; *O.thy*, occipito-thyroid; *th*, thyro-hyal; *T*, thyroid cartilage; *l*, thyro-hyoid ligament; *tr*, trachea; *sln*, superior laryngeal nerve; *S¹*, hypoglossal nerve.
- Fig. 12. Upper or palatal aspect of the same parts. Arytenoid conjoined with epiglottic cartilages are seen protruding upwards, surrounded by their sphincter.
- T*, tongue; *P.g*, palato-glossus; *P.ph*, palato-pharyngeus, cut across; *Cs*, *Cm*, & *Ci*, constrictores superior, medius, et inferior; *ep*, epiglottis; *A*, arytenoid cartilage; *la*, lingual (ranine) artery; *hp.n*, hypoglossal nerve; *Ihy*, interhyoideus; *Sph*, stylopharyngeus; *æ*, œsophagus; *tr*, trachea; *Shy*, stylohyoideus; *Stg*, styloglossus; *f*, frænum linguæ.

Fig. 13. A deep dissection of the hyo-laryngeal region seen laterally. On the left moiety, that towards the observer, the mucous and subjacent tissues have been cut away, bringing several of the small muscles into sight.

An arrow, partly in dotted line, denotes the floor of the pharynx, leading to the œsophagus, *œ*; two other short arrows indicate the canal of the glottis to the trachea, cut short; *A*, arytenoid cartilage; *ep*, epiglottis; *phv*, pharyngeal valley and ridge; *H.e*, hyo-epiglottic muscle; *Sqs*, squamo-styloid; *Ar*, arytenoideus; *Cap*, crico-arytenoideus posticus; *Cal*, crico-arytenoideus lateralis; *Tar*, thyro-arytenoideus; *ic*, inferior cornu of thyroid cartilage; *l*, thyro-hyoid ligament; *Ih*, interhyoideus; *sh*, stylo-hyal bone.

Fig. 14. Semidiagrammatic and much reduced sketch of the hyoidean arch, and the larynx from below, of the Pilot Whale.

sh, stylohyal; *ch*, ceratohyal; *bh*, basihyal; *th*, thyrohyal; *l*, the thyro-hyoid ligament, anterior et lateralis; *T*, thyroid cartilage: the latter is placed between the body and right ala; *i.c*, its inferior cornu; *C**, cricoid cornu; *tr*, trachea.

Fig. 15. Upper or pharyngeal surface of the same, and showing the oblique inclination of (*ep* and *A*) the aryteno-epiglottid projection; *c*, broad portion of cricoid cartilage; *l* & *ic*, as in fig. 14.

Fig. 16. An outline of the thyroid bones in profile. Letters as in fig. 14.

PLATE XXXII.

Figures 17–24 inclusive are a series of perpendicular sections of the dorsal fin, cut at points corresponding to the dotted lines, nos. 1–8, in fig. 25.

Fig. 17. Perpendicular and transverse section of the anterior portion of the dorsal fin, viz. 19 inches distant from its tip.

Fig. 18. Another segment, nearer middle, 13 inches from point.

Fig. 19. Another segment, 7·5 inches from tip: *a*, artery.

Fig. 20. Another segment, 6·2 inches from tip.

Fig. 21. Perpendicular section of the same fin, close to the posterior concavity, and 4·5 inches in front of the hinder point of fin.

Fig. 22. Section, free part of fin, 4 inches in advance of tip.

Fig. 23. Another slice, 3·2 inches in advance of tip.

Fig. 24. Another slice, 1·25 inch in advance of tip.

Fig. 25. Miniature outline of the fin of the back, representing by numerals (1–8) and dotted lines the positions where the slices, figs. 17–24, have been cut from.

Fig. 26. Skull of *Globiocephalus melas*, mandible attached. Also the right half of the great nasal protuberance, exhibiting its structure in mesial section and part of the narial passage and lower pouch.

Bl, blubber; *fa*, fibro-areolar glistening tissue; *p*, right premaxillary sinus, partially hidden by the fatty mass; arrow directed into blow-hole.

Fig. 27. The blow-hole of the White-beaked Bottlenose (*Lagenorhynchus albirostris*) opened by retroverting the lips. It shows the alar protuberances, smooth-surfaced posterior wall, and antero-lateral corrugated membrane. *a*, anterior, and *p*, posterior lips; *sp*, septum narium; *c*, cartilaginous cushion, the arrow being directed into the maxillary pouch; *r*, cuticular ridges of the spiracular cavity.

Fig. 28. Diagram of the narial pouches and spout-hole of *Globiceps*.

B, blow-hole; *spc*, spiracular cavity; *p*, premaxillary sac; *m*, maxillary, and *nf*, nasofrontal sacs.

Fig. 29. Sketch of the right orbito-auricular region of the male *L. albirostris*, showing a dissection of the ear-muscles &c.

ac, auditory canal; *Ret*, retrahens aurem; *Atr*, attrahens; *Atl*, attollens; *Te*, temporalis; *fav* × *std*, facial vessels, nerve, and Steno's duct.

Fig. 30. An underview of portion of the left mandible and pterygo-maxillary region of the same *Lagenorhynchus*. Dissected to show the vascular rete intervening between the lower jaw and basis cranii, and its relation to the pterygoid muscles &c.

Mn, mandible; *z*, zygomatic bar; *Ipt*, internal pterygoideus; *Ept*, external pterygoid, severed; *Rete*, of the basis cranii and mandible; *imx*, internal maxillary artery; *id*, inferior dental artery; *a*, artery, and *v*, vein, pterygo-maxillary branches; *pnm*, postnarial muscle.

Fig. 31. Segment of the base of the skull of the Caaing Whale, which displays from below the tympanic region, the Eustachian tube, its enlargement, and the extensive rete mirabile covering its membranous walls and the adjoining depressions.

c, left condyle; *Boc*, basioccipital; *Eoc*, exoccipital; *ty*, tympanic bulla; *ma*, malar; *z*, zygoma; *pt*, pterygoid; *P.na*, posterior nares; *ac*, auditory canal; *Eus*, Eustachian tube partially opened; *Rete*, basicranial plexus; *vp*, venous plexus; *cf*, condyloid foramen; *fn*, facial nerve; *shc*, stylohyal cartilage.

PLATE XXXIII.

Fig. 32. Portion of œsophagus, the compound stomach, and part of the duodenum of the Pilot Whale. All more or less opened to show their internal walls and connecting passages. Their relative positions are necessarily displaced, to exhibit interior structure.

œ, œsophagus; *gl*, œsophageal gland; *I*, *I**, *II*, *III*, & *IV*, the four separate gastric cavities or stomachs; nos. 1, 2, 3, 4, 5, 6, lie over the pointers which indicate the several passages from the œsophagus to the commencement of the small intestine;

no. 6 is the pyloric orifice, and 3, 4 the narrow openings at either extremity of the passage or diminutive cavity (*), through which a style is passed; *p.d*, pancreatic duct joining; *d.ch*, the ductus communis choledochus. The latter enlarges within the intestinal wall, shown by the dotted line, and pierces the inner coat of the gut at no. 7; *duo*, duodenum, smooth above, and with valvulæ conniventes below.

Fig. 33. Semidiagrammatic view of the liver, stomach, spleen, and part of the mesentery in their natural positions after removal from the abdomen, the stomachs being distended. Part of the lettering applies as in fig. 32. The dotted lines upon the surface of the gastric cavities give the places of attachment of the great omentum, which has been removed.

L, liver; *c.l*, coronary ligament; *j*, a modicum of the jejunum; *Me*, mesentery; *gl*, glands thereon; *Sp*, spleen; *Pa*, pancreas.

Fig. 34. Greatly reduced view of the under or postabdominal surface of the liver: *r.l*, round ligament; *v.c*, vena cava; *h.a*, hepatic artery; *h.v*, hepatic vein.

Fig. 35. Spleen, seen on its free or ventral surface.

Fig. 36. Right kidney partially dissected, showing the distribution of the vessels on its atlanto-mesial side. Renal artery, *a*, and vein, *v*.

Fig. 37. A few of the lobular acini of the kidney, of their natural dimensions. The connecting fibrous envelope has been removed.

Fig. 38. A renal lobule bisected, to exhibit its internal structure. Nat. size. *c*, cortex; *m*, mammilla; *h*, hilus.

Fig. 39. Suprarenal body, reduced in size to correspond with the kidney, fig. 36, and placed somewhat in the natural relation it bears towards it.

PLATE XXXIV.

Fig. 40. A side view of one of the vascular glands of the neck, drawn $\frac{1}{2}$ nat. size. *Px*, cut plexus of vessels.

Fig. 41. A mesial section of the same, the letters agreeing.

Fig. 42. Small portion of the œsophagus, displaying the longitudinal rugæ and a glandular crypt, *gl*, of nat. size.

Fig. 43. A vertical transverse section of the œsophageal wall, and cut through one of the glandular fossæ. The relative natural height of the ridges, depth of the furrows, and thickness of the muscular and mucous coats are preserved.

gl, glandular crypt; *m*, mucous and submucous coat; *l*, longitudinal layer of muscular fibres; *c*, cross fibres or circular layer.

Fig. 44. Portion of the duodenum with agminate patch: *P.gl*, Peyer's glands; *V.co*, valvulæ conniventes.

Fig. 45. Another piece of the jejunum, where Peyer's glands (*P.gl*) are elongate and narrow: *l.f*, the longitudinal folds.

- Fig. 46. Piece of the colon, displaying a pouched character: *S.gl*, some of the solitary glands.
- Fig. 47. A segment of the unopened bowel, intended to display the comparative narrow diameter of the gut as it approaches the rectum, and the appearance of the mucous folds and surrounding intestinal wall.
- Fig. 48. A portion of the rectum, cut open, showing the rugæ, the narrow anal aperture and thick sphincter ani muscle (*Sph*) in transverse section.

PLATE XXXV.

- Fig. 49. Heart and commencement of great vessels, partially enveloped by the inflated lungs. A bridge of fibrous membrane, conjoined to the diaphragm (*D*), unites the rear sternal angles of the lungs, and it encloses a pair of glands (*gl*): a small strip of the pericardium (*pe*) is seen above. *pa*, pulmonary artery; *ao*, arch of aorta; *i, i**, right and left innominate trunks; *m*, mammary artery; *l*, pulmonary lobule.
- Fig. 50. Superficial view. Segment of sterno-ventral corner of left lung, and special gland, &c. *L*, lung covered by (*p*) the pleura, which has been removed from the semilunar line towards (*gl*) gland, and exposing a series of convergent vessels (these, *a+v*, are partly serpentine in course); *phv*, phrenic vein; *sph*, superior phrenic vessels; *ph*, phrenic nerve; *pe*, portion of pericardium attached to (*D*) diaphragm.
- Fig. 51. Deep or posterior view of the parts figured in fig. 50; the internal mammary vessels, however, are not shown. *b*, bronchus. Other letters as in the preceding figure.
- Fig. 52. Upper view of the septal segment of the bicuspid valve of the heart of the female *Globiceps*, exhibiting an auxiliary valve: *s*, septal valve; * and the arrow point to the abnormal perforation.
- Fig. 53. Interior view of the same, auriculo-ventricular opening, the under surface of the septal valve, and its fleshy cords; also the supplementary orifice and its tendinous cords. One arrow denotes the blood's usual flow towards the right ventricle. The second starred (*) arrow passes through the orifice in the septal segment (*S*). *cc*, columna carnea; *ct*, chorda tendinea, and *ct**, supplementary chorda tendinea belonging to the secondary valve.
- Fig. 54. A lumbar vertebra of the Pilot Whale, to show (*Sp.px*) section of the spinal plexus of vessels; the large orifice is a vein, the smaller chiefly arteries. *sp.c*, spinal cord; *L.px*, lumbar arterial plexus or rete mirabile; *c*, centrum of the vertebra; *t*, transverse, and *s*, spinous process; *z*, zygapophysis.
- Fig. 55. Section of intercommunicating venous network.
- Fig. 56. A transverse section of the penis of the Razorback Whale (*Physalus anti-quorum*, Gray, = *Balænoptera musculus*).

u, urethral passage, surrounded by (*cs*) corpus spongiosum; *c.c.*, corpus cavernosum; *t*, trabecular glistening fibrous bands, and (*f*) fibrous tissue; *v.v**, venæ dorsales.

PLATE XXXVI.

Fig. 57. Body of the female *G. melas*, from which the skin and subcutaneous layer of fat have been removed, excepting on the tail, the pectoral fin, and an edging round the lips. Glistening fascia and fibrous tissue fill-in the areas unoccupied by the fleshy coat. *ac*, orifice of auditory canal; *Pc*, panniculus carnosus.

Fig. 58. Abdominal aspect of same specimen. The lower (left) half displays the superficial layer, the upper (right) half a deeper dissection.

Pc, Pc, panniculus, belly- and throat-portions; *P.ma*, pect. major; *P.mi*, pect. minor; *R.ab*, rectus abdominis; *E.o*, external oblique; *Sc*, sacro-coccygeus; *Ec+Isc*, erector clitoridis and ischio-coccygeus; *La.d*, latissimus dorsi; *S*, subscapularis; *Ch*, cephalo-humeral; *St.m*, sterno-mastoid; *Shy*, sterno-hyoid; *Sth*, sterno-thyroid; *M.h*, mylo-hyoid; *Gh*, genio-hyoid; *Stg*, styloglossus; *sk*, skin; *V*, vulva; *A*, anus; *v*, caudal vein.

Fig. 59. Diagram to illustrate the superficial oblique bridging tendons of the tail of *Globiceps*, and how each superficial long dorsal muscle terminates in a single, thick, apparently cordiform tendon. *Sp.d+Lci*, spinalis dorsi and homologue of levator caudæ internus; *Ld+Lce*, longissimus dorsi and levator caudæ externus.

Fig. 60. A transverse section of the terminal caudal tendons, and their fibrous (almost cartilaginous) investment, of the Great Northern Rorqual (*Balaenoptera musculus*, = *Physalus antiquorum*). Prep. No. 45 E, Coll. of Surgeons.

The tendons (*t*), as in fig. 59, are packed or overlap one another, so as to seem but composed of a single one when viewed longways, and with their fibrous coat *in situ*. The (*f*) investing mass or cushion has interlacing glistening fibres, here and there penetrated by bloodvessels (*a*) &c.

Fig. 61. Diagram showing the manner in which the tendons of the great inferior loin-muscle end in the Caaing Whale. *Sc*, sacro-coccygeal, secondary tendons dragged out; finally they enwrap (as above) in a sheath (*sh*) the thick compound terminal caudal tendon, whilst presenting continuity with the superficial fibrous layer of the tail.

Fig. 62. Semidiagrammatic representation of a transverse vertical section of part of the caudal keel of the Caaing Whale. It shows (*t*) the lateral compound or vaginate tendons of the sacro-coccygeus; *a*, arterial channel beneath, and piercing (*f*) the firm fibrous keel, overlain by (*sk*) the skin.

PLATE XXXVII.

Fig. 63. Body in profile, exhibiting the myology &c. when the panniculus has been taken away. The right moiety of the rostral blubber remains in place.

Letters other than those used in fig. 58 are:—*L.d.*, longissimus dorsi, + *L.c.e.*, levator caudæ externus; *Sp.d.*, spinalis dorsi, + *L.c.i.*, lev. caud. internus; *S.cd.*, supracaudal; *I.cd.*, infracaudal; *S.l.*, sacrolumbalis; *S.mg.*, serratus magnus; *Rh.*, rhomboideus; *C.a.*, cervicalis ascendens; *L.a.s.*, levator anguli scapulæ; *T.c.*, transversalis cervicis; *Sp.*, splenius; *I.sp.*, infraspinatus; *L.cl.*, levator claviculæ; *D.*, deltoid; *T.ma.*, teres major; *Di.*, digastric; *Ma.*, masseter; *, extra cheek-fibres; *Bu.*, buccinator; *Te.*, temporal; *Op.*, orbicularis palpebrarum; *Nl.*, naso-labialis or premaxillary; *Of.*, occipito-frontalis; *Llsan.*, levator labii superioris alæque nasi; *B.*, Blow-hole, and arrow leading therein; *f.*, hook pulling out tendons and superincumbent fascia of sacro-coccygeus.

Fig. 64. An upper view of the skull, in which the superior muscles of the blow-hole are dissected on the right side.

Fig. 65. Hinder part of skull, showing second layer of muscles acting on the blow-hole.

Fig. 66. Third layer of the same, also in profile.

Fig. 67. Short deep muscles of the neck, on their lateral aspect.

The lettering of these four figures runs:—*B.*, blow-hole; *spe.*, spiracular cavity; *p.*, premaxillary sac; *m.*, maxillary sac; *nf.*, naso-facial sac; *Nl* & *Nl²*, naso-labialis; *Of.*, occipito-frontalis; *Llsan.*, lev. l. s. al. nasi; *Lsp.*, levator superioris proprius; *Z.*, zygomaticus &c.; *Py.*, pyramidalis &c.; *Te.*, temporal; *Rp.*, recti postici; *Os* and *Oi.*, obliquus superior and inferior; *Tms.*, trachelo-mastoid; *Its.*, interspinales, anterior dorsal region; *Ch.*, *Stm.*, *Lcl.*, and *Las.*, cut insertions of ceph.-hum., sterno-mastoid, lev. clav., and lev. ang. scap.; *2.*, transverse process of axis.

Fig. 68. Partial view of under surface of the skull, the neck, and thorax, the ribs of the latter being taken away on the right side.

Sca., scaleni; *Lc.*, longus colli; *Ra.mi.*, rectus anticus minor; *Ra.ma.*, rectus anticus major, severed; *Rl.*, rectus lateralis; *Sph.n.*, sphincter of post-nares; *Pt.*, pterygoideus.

Fig. 69. Sternum and sternal ribs, from the inside: *St.*, osseous sternum; *Ts.*, triangularis sterni.

Fig. 70. Inner aspect of the left pectoral limb.

S., subscapularis; *Smg.*, serratus magnus, insertion cut; *Ssp.*, supraspinatus; *Tma.*, teres major; *Lad.*, *Pc.*, & *Ch.*, lat. dors., panniculus, and ceph. hum. insertions; *T.*, triceps; *Cb.*, coraco-brachialis; *Pt.*, palmar tendons.

Fig. 71. The right scapula, from within: *cp.*, coracoid process, and *Ssp.*, the supraspinatus, in its groove.

Fig. 72. Caudal moiety, minus flukes, of the White-beaked Bottlenose (*Lagenorhynchus albirostris*), dissected, and showing correspondence with what obtains in

Globiceps; compare fig. 63, with which references agree, save *Spc* and *Ifcd* to supra- and infra-caudals. The Nos. 40, 45, 60, denote the vertebræ, counting from the skull.

PLATE XXXVIII.

- Fig. 73. A posterior or deep view of the rectum, uterus, &c. of *G. melas*.
 Fig. 74. The uterus, its cornua, and the urinary bladder, opened, and from above.
 Fig. 75. Pelvic bones, and their ligamentous bridge &c., deep surface.
 Fig. 76. Dissection of the external genital region of the same animal, to show situation of the mammary gland and the muscles acting on it and connected with the genitals. An outline of the bladder and uterus are left in place. The superficial muscular layer remains on the right side; and on the left a deeper layer is displayed.
 Fig. 77. The left moiety of the same region, exhibiting a still deeper muscular layer.
 Fig. 78. Another view of fig. 77, but seen from the side, and with some of the muscles removed.

All the above sketches are reductions from nature; the lettering corresponds throughout. Whilst some of the muscles in one figure are shown entire, their origin or insertion only is displayed in the succeeding layer.

Ut, uterus; *os*, its os tincæ; *va*, vagina; *V*, vulva, and *cl*, clitoris; *c*, cornu, and *cc*, same opened on right side; *o*, ovary, and *o**, same split open; *pav*, ovarian pavilion; *B*, urinary bladder; *u*, urethra; *ue*, ureter; *A*, anus; *r*, rectum, *v*, hæmorrhoidal vein; *ii*, internal iliac artery; *Mgl*, mammary gland; *gl*, rectal glands; *Pl*, pelvis, * representing an anterior, and ** a posterior cartilaginous nodule; *Pf*, interpelvic fascia; *P.c*, panniculus carnosus; *L.a*, levator ani; *Sp.a*, sphincter ani; *Rab &c.*, rectus abdominis &c.; *E.c*, erector clitoridis; *C.m*, compressor mammæ; *C.ur*, constrictores urethræ; *Spv*, sphincter vaginæ; *Dtp*, deep transversus perinei; *Isc*, ischio-coccygeus; *P & Ic*, pubo- and ilio-coccygeus; *a × n*, artery and nerve transmitted through aperture in interpelvic fascia (probably the homologues of obturator artery and nerve in quadrupeds).





fig. 1.



Fig. 2.

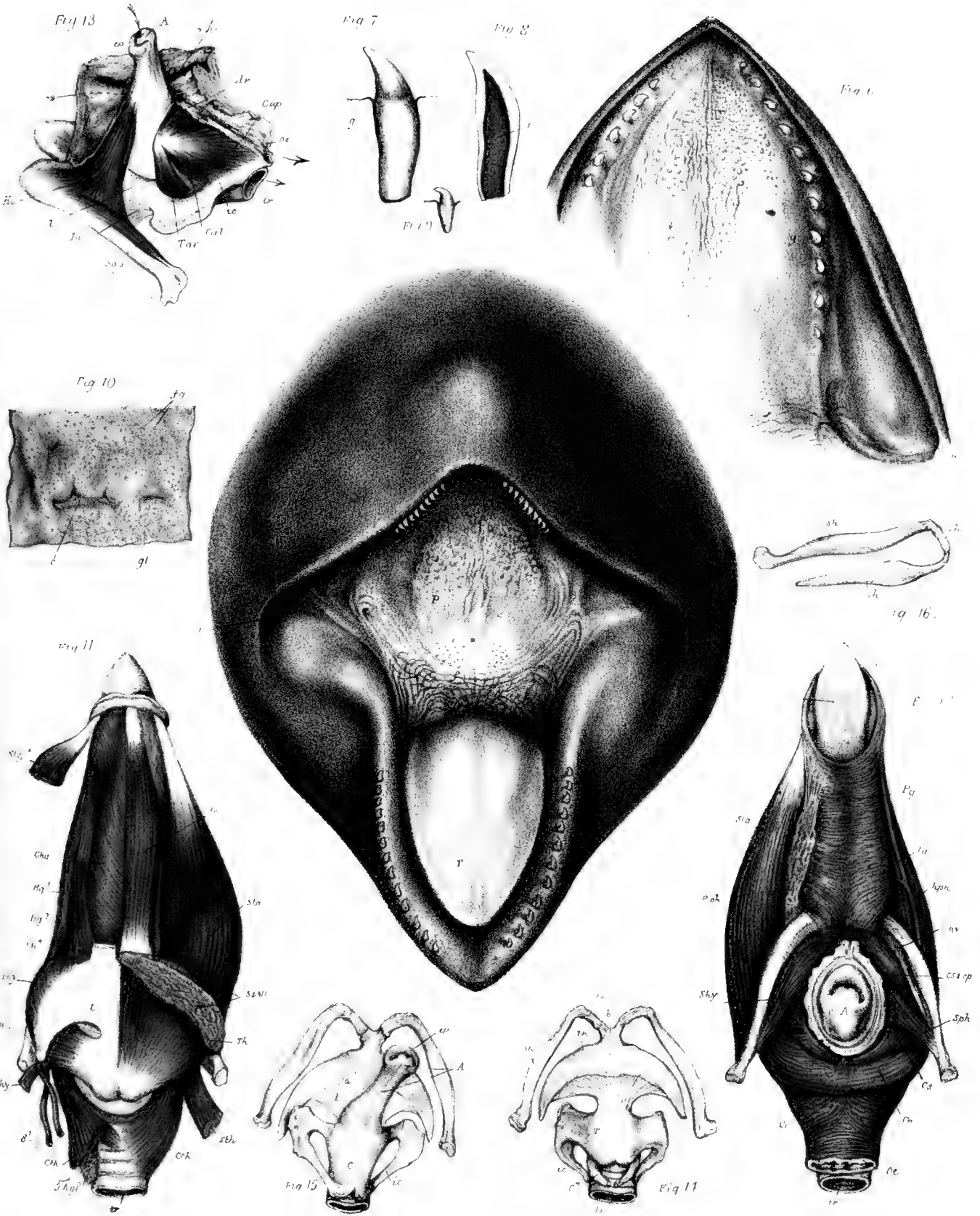


Fig. 3.



Fig. 4.









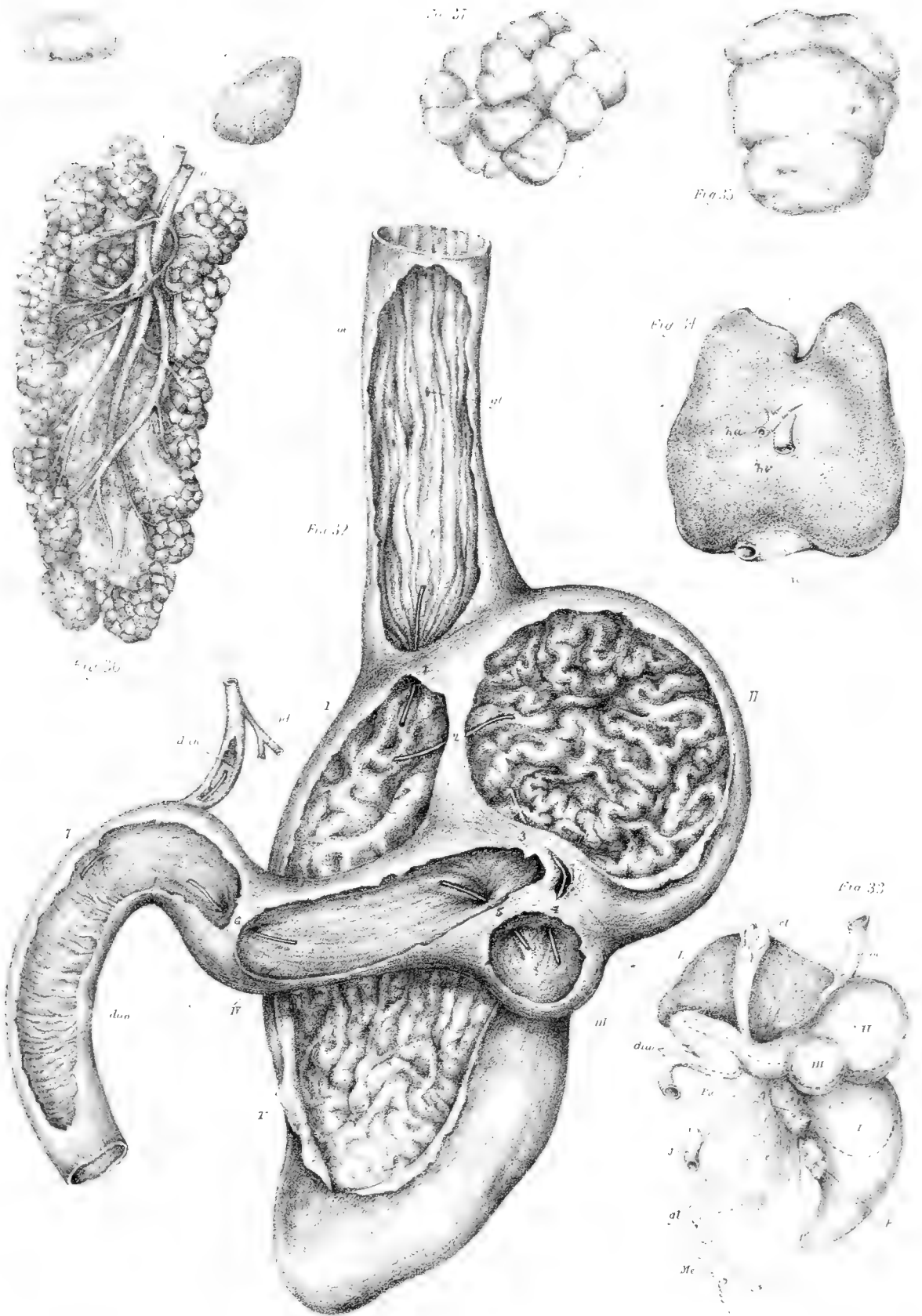




Fig. 10

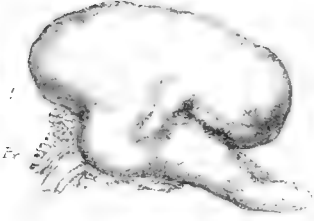


Fig. 11

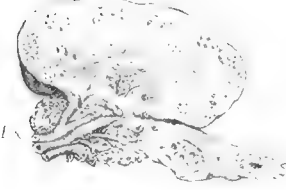


Fig. 12

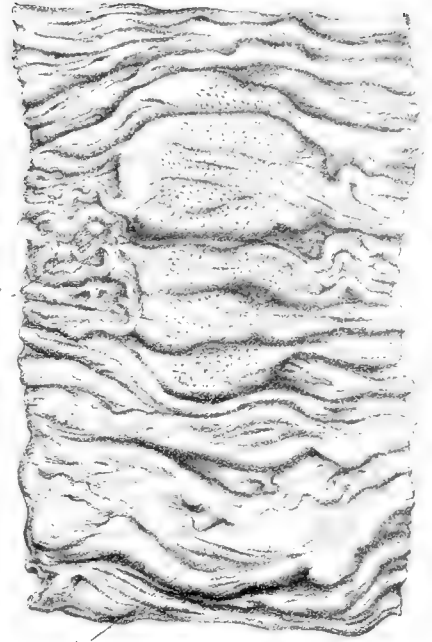


Fig. 13



Fig. 14

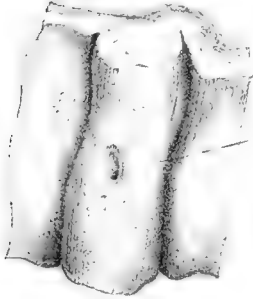


Fig. 15



Fig. 16

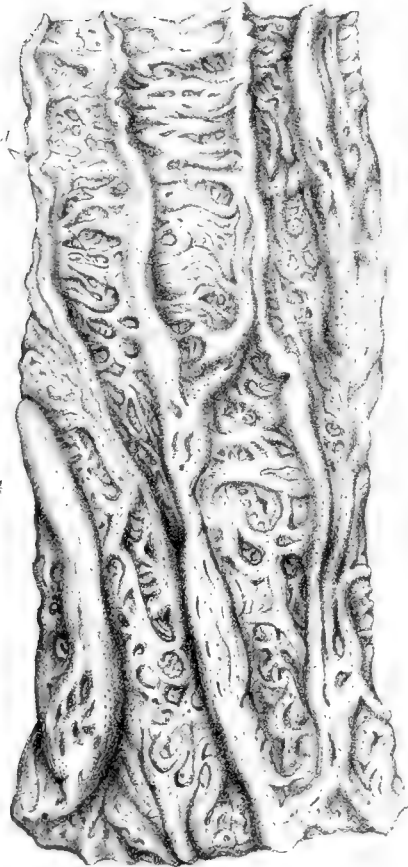


Fig. 17

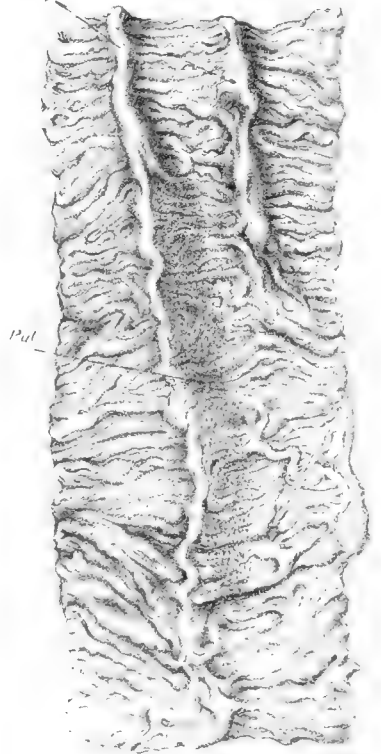


Fig. 18

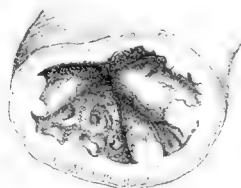




Fig 51

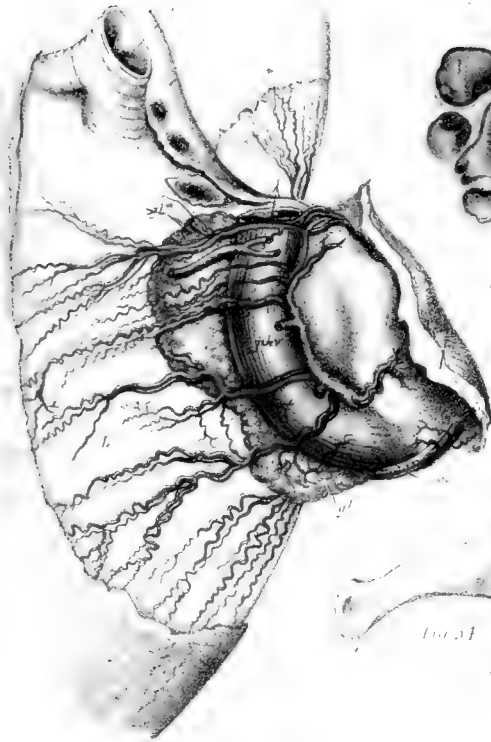


Fig 52

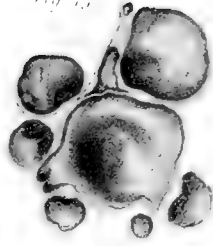


Fig 53

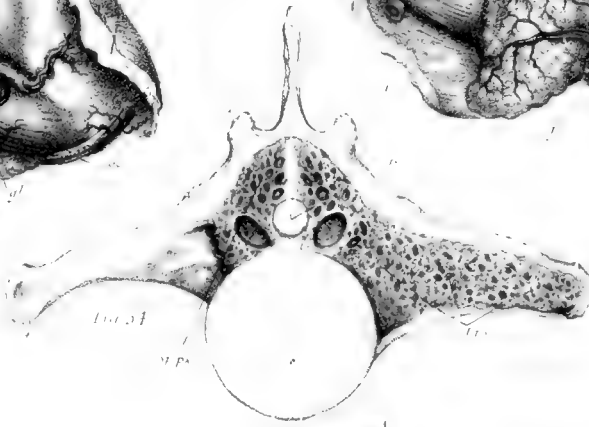
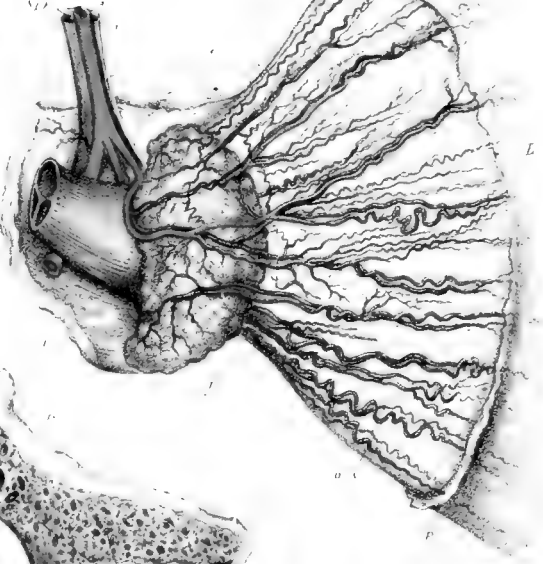


Fig 55

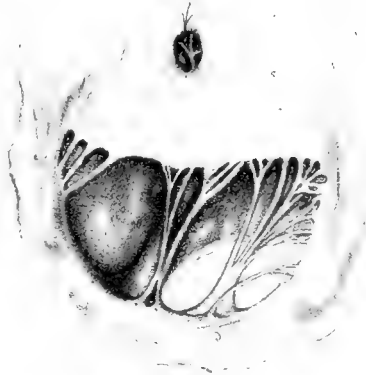


Fig 56

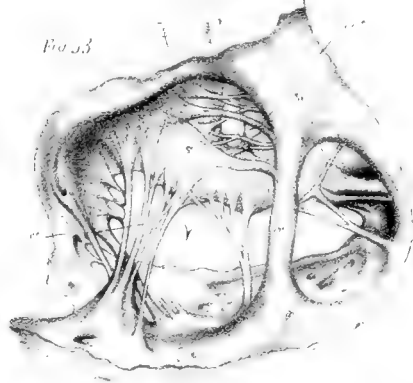


Fig 57

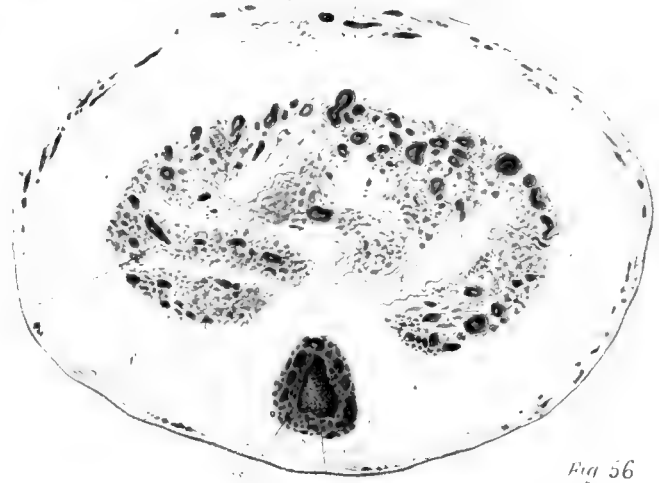


Fig 56





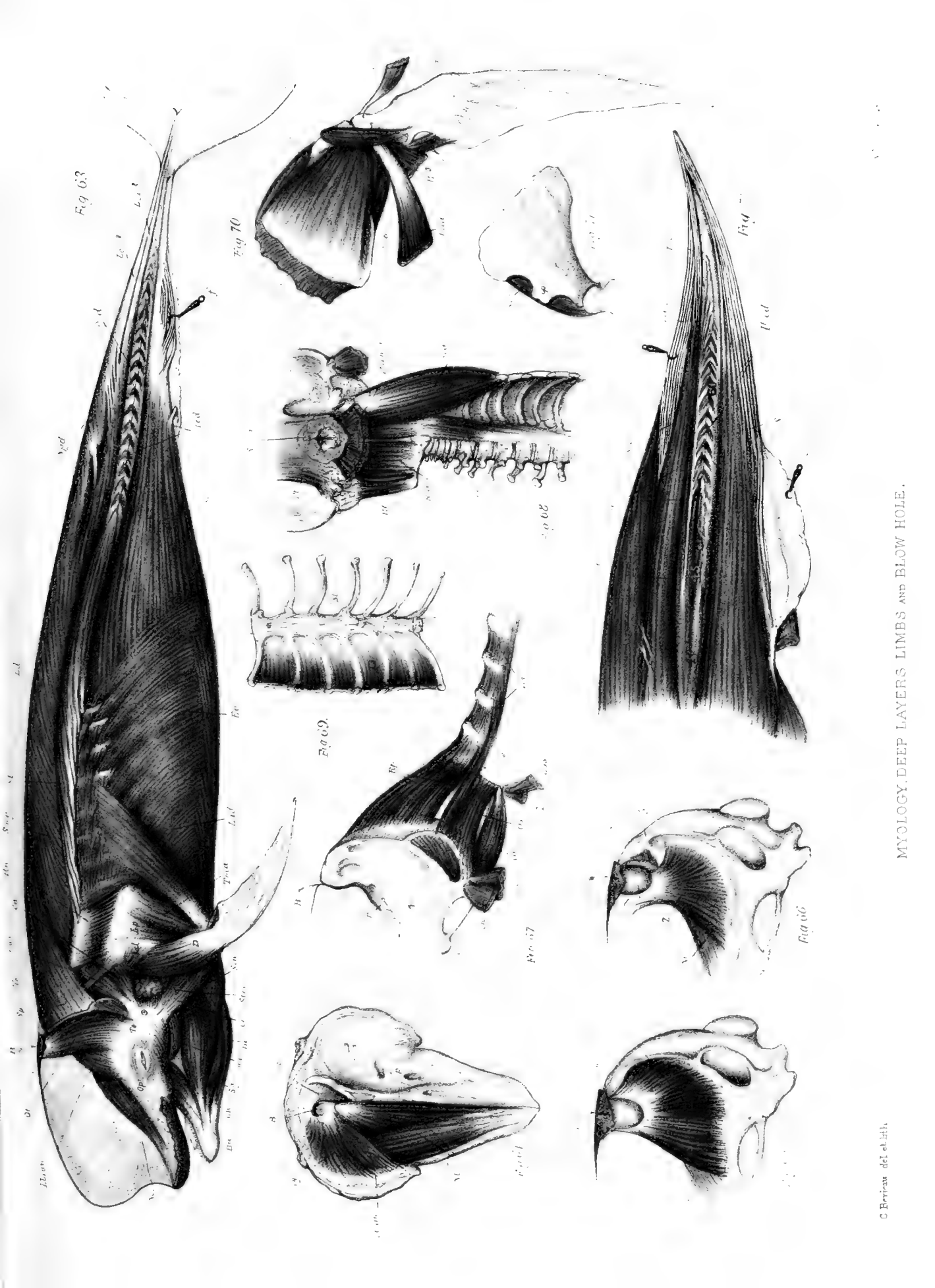


Fig. 63

Fig. 70

Fig. 64

Fig. 65

Fig. 67

Fig. 66

Fig. 68

MYOLOGY. DEEP LAYERS. LIMBS AND BLOW HOLE.





VIII. *A Description of the Madreporaria dredged up during the Expeditions of H.M.S. 'Porcupine' in 1869 and 1870.* By PROFESSOR P. MARTIN DUNCAN, M.B. (Lond.), F.R.S., F.G.S., Professor of Geology to King's College, London, &c.

Read May 16th, 1871.

[PLATES XXXIX. to XLIX.]

CONTENTS.

- | | |
|--|--|
| I. Introduction, p. 303. | III. Descriptions of and Remarks upon the Species, p. 309. |
| II. Classification of the Species, p. 306. | IV. Tables of Localities, &c., p. 338. |

I. INTRODUCTION.

ZOOPHYTOLOGISTS have long known that some simple Madreporaria, or Stony Corals, live at a depth of from 80 to 150 fathoms on the floor of the Atlantic and Pacific Oceans, in areas remote from coral reefs. The existence of Madreporaria at corresponding depths in the Mediterranean Sea has also been known practically to those interested in the red-coral fisheries. Nevertheless it was until lately tacitly admitted that all corals obeyed the laws which regulate the bathymetrical distribution of reef-building forms. But it is only during the last four years¹ that a fine and peculiar² coral fauna has been proved to exist not only at great depths but also in temperatures ranging from below freezing-point to 55° Fahrenheit. Although Foraminifera and Echinodermata have been brought up from profound depths by the sounding-apparatus, no trace of a stony coral had been observed; and it was not until the United-States Coast Survey dredged between Key West and Havana in 1867, that any proof of the existence of Madreporaria at a great depth was obtained. On May 24th, 1867³, stony corals were dredged up alive from the depth of 270 fathoms; and on May 25th the same species was obtained from 350 fathoms. In the following year, 1868⁴, many species were dredged up under the supervision of M. de Pourtales, as naturalist, off the Florida reef, in the course of the Gulf Stream, from 43 to 324 fathoms.

The expedition of H.M.S. 'Lightning,' in the same year, conducted under the super-

¹ The researches of Sars, MacAndrew, Norman, and J. Gwyn Jeffreys prepared the way for those of the United States Expeditions and of H.M.S.S. 'Lightning' and 'Porcupine,' under Fourtales and A. Agassiz, and Wyville Thomson, Carpenter, and Gwyn Jeffreys respectively.

² "Coral Faunas of Western Europe," Quart. Journ. Geol. Soc. 1870, P. M. Duncan.

³ "Contributions to the Fauna of the Gulf Stream at great Depths," by L. F. de Pourtales, No. 6 Bulletin of the Harvard Museum of Comparative Zoology, 1st series.

⁴ *Op. cit.* 2nd series.

vision of Professor Wyville Thomson, Dr. Carpenter, and Mr. J. Gwyn Jeffreys, in the North Atlantic, afforded satisfactory evidence of the existence of a coral fauna in the deep sea, and in water of a very different temperature from that usually considered necessary for the Madreporaria; but it was not until 1869 that, under the same able direction, the systematic dredgings of H.M.S. 'Porcupine' proved the existence of coral life at a depth of 705 fathoms¹.

A description of this dredging expedition was read before the Royal Society in 1870, by Messrs. Carpenter, Wyville Thomson, and J. Gwyn Jeffreys², and a report on the corals³ obtained by those naturalists, and intrusted to me for examination and description, was read before the same Society March 24th, 1870.

When the second expedition was preparing to start in 1870, under the same able guidance, particular requests were made to me to advise concerning the dredgings, so far as the corals were concerned. The employment of the "hempen tangles," instead of the crushing dredge, had already commended itself to the superintendents of the dredging operations; and it was a satisfaction to find that by using these simple means a fine collection of specimens was obtained off the west and south-west coast of the Spanish Peninsula and along the Mediterranean coast of Africa, from depths which reached to 1095 fathoms.

All the information I have required has been freely given me by the three naturalists who were responsible for the dredgings, and also by M. Lindahl their assistant.

Professor A. Agassiz and Count Pourtales were of great assistance to me by sending me their reports and also a collection of the specimens dredged up by them, so that I have been enabled to compare the North-Atlantic forms with the West-Indian and Floridan types.

I have also had the advantage of examining the results of the dredgings conducted by Mr. Kent, of the British Museum, and of his assistance in comparing specimens.

The majority of the specimens dredged up and entangled during the two expeditions of the 'Porcupine' were alive and in good condition; a few had been dead for some time and were covered with Sponges, Serpulæ, and Polyzoa. Specimens were not invariably obtained at every dredging; and it is evident that corals live here and there in patches, and that they mostly frequent rocky ground, although some species live in the Globigerine ooze. Fine muddy sediment appears to be unfavourable to coral life; and many of the dead specimens which came up in the dredge were filled with it.

It is somewhat remarkable that so many well-known species, especially of the Medi-

¹ Proc. Royal Society, 1870.

² W. B. Carpenter, F.R.S., Wyville Thomson, F.R.S., and J. Gwyn Jeffreys, F.R.S., "Deep-Sea Researches," Proc. Roy. Soc. 1870, vol. xviii. pp. 397-492.

W. B. Carpenter, F.R.S., and J. Gwyn Jeffreys, F.R.S., "Deep-Sea Researches," Proc. Roy. Soc. 1870, vol. xix. pp. 146-221.

³ P. M. Duncan, 'Porcupine'-Expedition Madreporaria, Proc. Roy. Soc. 1870, vol. xviii. pp. 289-301.

terrean coral fauna, should not have been obtained by the dredge and tangles. Some of them are dwellers in moderately deep water, and have been noticed by Forbes and Milne-Edwards and Jules Haime. On the other hand it is satisfactory to have obtained so many specimens of certain rare corals that the doubts about their classificatory position could be solved by subjecting a few to transverse and longitudinal section.

The results of this procedure, with respect to *Lophohelia prolifera*, Pallas, sp., and *Amphihelia oculata*, Linnæus, are very damaging to the integrity of the family of the Oculinidæ; for, as the corallites of these species do not fill up from within, they can no longer be separated from the Astræidæ. Moreover longitudinal sections of the corallum of specimens of the first-named species show dissepiments and large tabulæ; and thus the propriety of establishing a section of the Madreporaria which shall be differentiated by these perfect transverse floors of endotheca is strongly contra-indicated.

The specimens obtained in both of the expeditions of the 'Porcupine' can be arranged into forty-eight groups, consisting of species and varieties—*i. e.* twenty-seven species and twenty-one varieties. There are, amongst these, fourteen new species, twelve species already described, and one *incertæ sedis*. The varieties consist of four the typical forms of which are not present in the collection, and of seventeen which accompany the specific types also.

Owing to the extraordinary variability of some of the corals, I have been able, by comparing them with the descriptions and types of closely allied recognized species, to absorb several specific forms, and in two instances to treat genera so. Thus I have absorbed the genus *Ceratocyathus* in the older genus *Caryophyllia*, and *Thecopsammia* in *Balanophyllia*.

The species *Caryophyllia borealis*, Fleming, and *C. smithi*, Stokes, I have made varieties of the older type *Caryophyllia clavus*, Scacchi. The *Sphenotrochus intermedius*, Ed. & H., of the Crag and Tangier Bay, and *Sphenotrochus milletianus*, DeFrance, are varieties of the same type. Two species of *Desmophyllum* are absorbed into the species *cristagalli*; and its range, therefore, is enlarged. No less than seven species and two genera must now be aggregated in the *Amphihelia ramea* of Müller; and three if not four species of *Lophoheliæ* should be associated with the species *prolifera* and its variety *gracilis*.

At least fourteen old species have been thus absorbed, and, it is trusted, not to the detriment of truth or of a true classificatory philosophy.

The following is the list of the Madreporaria dredged up in the two expeditions of the 'Porcupine':—

II. CLASSIFICATION OF THE SPECIES.

ZOANTHARIA SCLERODERMATA¹.

Section APOROSA.

Group **Turbinoliidæ**.

Subfamily CARYOPHYLLIINÆ.

Genus CARYOPHYLLIA.

- Species 1. *Caryophyllia clavus*, Scacchi, sp.
 — —, variety *α. elongata*.
 — —, variety *β. exserta*.
 — —, variety *γ. borealis*.
 — —, variety *δ. smithii*.
 — —, variety *ε. epithecata*.
- Species 2. — *cyathus*, Ellis and Solander. A variety.
 3. — *arcuata*, Ed. & H. A variety.
 4. — *cylindracea*, Reuss. Two varieties.
 5. — *abyssorum*, Duncan. ✓
 6. — *inskipi*, Duncan.
 7. — *calveri*, Duncan.
 8. — *vermiformis*, Duncan. ✓
 9. — *pourtalesi*, Duncan.
 10. — *seguenzæ*, Duncan.

SYN. *Ceratocyathus ornatus*, Seguenza.

Genus BATHYCYATHUS.

- Species 1. *Bathycyathus atlanticus*, Duncan.

Subfamily TROCHOCYATHACEÆ.

Genus PARACYATHUS.

- Species 1. *Paracyathus agassizi*, Duncan. ✓
 2. — *striatus*, Philippi, sp.

Division TURBINOLIACEÆ.

Genus SPHENOTROCHUS.

- Species 1. *Sphenotrochus intermedius*, Münster, sp.

Genus SABINOTROCHUS, gen. nov.

- Species 1. *Sabinotrochus apertus*, Duncan. D ✓

¹ Hist. Nat. des Corall., MM. Milne-Edwards and Jules Haime. 1860, Paris.

Genus DESMOPHYLLUM.

Species *Dermophyllum crista-galli*, Ed. & H.Varieties (old species): α . *cumingi*, β . *costatum*.

Genus FLABELLUM.

Species 1. *Flabellum distinctum*, Ed. & H.SYN. *Flabellum extensum*, Mich.Species 2. *Flabellum laciniatum*, Ed. & H.SYN. *Ulocyathus arcticus*, Sars.

Genus RHIZOTROCHUS.

Species 1. *Rhizotrochus affinis*, Duncan. ✓

Division GEMMANTES.

Genus AMPHIELIA.

Species 1. *Amphihelia oculata*, Linnæus, sp.2. — *ramea*, Müller.SYN. *Amphihelia miocænica*, Seguenza.— *sculpta*, Seguenza.— *atlantica*, nobis.— *ornata*, nobis.*Diphohelia profunda*, Pourtales.— *meneghiniana*, Seguenza.— *doderleiniana*, Seguenza.— *gismondiana*, Seguenza.Family **Astræidæ.**

Division EUPHYLLIACEÆ.

Section EUPHYLLIACEÆ CÆSPITOSÆ.

Genus SOLENOSMILIA, gen. nov.

Species 1. *Solenosmilia variabilis*, Duncan. ✓

Division STYLINACEÆ.

Section STYLINACEÆ INDEPENDENTES.

Genus LOPHOHELIA.

Species 1. *Lophohelia prolifera*, Pallas, sp.SYN. *Lophohelia anthophyllites*, Ellis & Solander.— *subcostata*, Ed. & H.

SYN. *Lophohelia defrancei*, Defrance, sp.

— *sloppaniana*, Seguenza.

— *affinis*, Pourtales.

Variety *gracilis*.

SYN. *Lophohelia gracilis*, Seguenza.

Family **Oculinidæ.**

Subfamily STYLASTERACEÆ.

Genus STYLASTER.

Species 1. *Stylaster gemmascens*, Esper, sp.

Section PERFORATA.

Family **Madreporidæ.**

Subfamily EUPSAMMIINÆ.

Genus BALANOPHYLLIA.

Species 1. *Balanophyllia gaditana*, Duncan.

2. — *cellulosa*, Duncan.

3. — *socialis*, Pourtales, sp.

SYN. *Thecopsammia socialis*, Pourtales.

Varieties α and β .

Genus DENDROPHYLLIA.

Species *Dendrophyllia cornigera*, Lamarek, sp.

Family **Fungiidæ.**

Genus FUNGIA.

Species *Fungia symmetrica*, Pourt.

Section RUGOSA.

Family **Cyathaxonidæ.**

Genus GUYNIA, gen. nov.

Species *Guynia annulata*, Duncan. ✓

Genus incertæ sedis.

Species 1.

III. DESCRIPTIONS OF THE SPECIES, AND REMARKS.

ZOANTHARIA SCLERODERMATA.

Section APOROSA.

Group **Turbinoliidæ.**Genus **CARYOPHYLLIA**, M.-Edwards & Haime.

SYN. *Caryophyllia* (pars), Lamarck.

Cyathina, Ehrenberg.

This genus comprehends numerous species, many of which are peculiar to the recent coral faunas; but some belong both to the present and to the past assemblages of corals. The species are usually very variable; and the depth of habitat and the peculiar nature of the sea-floor appear to influence the amount and persistence of the variation. MM. Milne-Edwards and Jules Haime divide the genus into groups of species which are characterized by the persistence of particular septal numbers; and this method, if not a very natural one, is excessively convenient to the student. When a considerable series of closely allied species is examined, great variation will be noticed in the shape and size of the base of attachment in different specimens. Some, which evidently belong to the same species, and which have all the other structures in common, may have a broad and adherent base, or a narrow and pedunculate attachment; and a few may have a sharp and pointed or even a rounded end, indicating a former state of adhesion to a foreign body.

Thus the specific identity of the forms formerly called *Caryophyllia borealis*, Fleming, and *Caryophyllia smithii*, Stokes, is beyond doubt: yet the first-named has a narrow and curved peduncle attached to the *Ditrupa*-case and to shells; and the last has a broad base, which is adherent to rocks and shells.

When *Caryophyllia borealis* locates itself on stones or flat shells, it frequently assumes the form of *Caryophyllia smithii*, and grows with a broad base. And when a deposit collects around the normal *Caryophyllia borealis* its peduncle may diminish in size and become separated. This is a common occurrence in the neighbourhood of Valentia and Dingle Bay.

I trust that this statement will facilitate the absorption of the genus *Ceratocyathus*¹, Seguenza, into *Caryophyllia*, as they are only distinguished by the character of the peduncle.

It is therefore proposed to include the *Ceratocyathi* amongst the *Caryophyllie* described in this communication; and the last-named genus will be subdivided according to the plan adopted by MM. Milne-Edwards and Jules Haime².

¹ "Disquisiz. Paleont.," Mem. della Reale Acad. dell Sci. Torino, serie ii, tom. xxi, 1864.

² Hist. Nat. des Corall. vol. ii, p. 13 *et seq.*

Species with four perfect Cycles of Septa, and some orders of the fifth Cycle.

1. *Caryophyllia cyathus*, Ellis & Solander, 3. *Caryophyllia sequenzae*, Duncan. (Syn. *Ceratocyathus ornatus*, Seguenza.)
sp.
2. — *clavus*, Scacchi.

Species with four perfect Cycles of Septa.

1. *Caryophyllia arcuata*, Ed. & H.

Species with the fourth Cycle of Septa incomplete.

1. *Caryophyllia cylindræa*, Reuss. 4. *Caryophyllia calveri*, Duncan.
2. — *abyssorum*, Duncan. 5. — *pourtalesi*, Duncan.
3. — *inskiipi*, Duncan.

Species with three Cycles of Septa¹.

1. *Caryophyllia vermiformis*, Duncan.

The range of the species:—

Caryophyllia clavus and its varieties were found in nearly every dredging in the Mediterranean. The type and the varieties were dredged up at the depth of 364 fathoms, south of Cape St. Vincent, and of 705 fathoms in the North Atlantic (88 station). The sea-bottom off Unst, off the coast of Norway, and off the north-eastern coasts of Scotland, at a depth of 90 fathoms, is its commonest habitat. The species (a variety) is also common in shallower water off the west coast of Ireland, and as a littoral form on the south-west coasts of England.

The species is represented by fossil forms in the older Pliocene of Sicily.

Caryophyllia cyathus, Scacchi, is a well-known Mediterranean species; but the true typical form was not dredged up, although the red-coral fisheries abound with it. A variety with slender septa and a small base was found at 651 fathoms, due west of the Straits of Gibraltar.

Caryophyllia sequenzae, Duncan (syn. *Ceratocyathus ornatus*, Seguenza), was dredged up in the North Atlantic (station 88) from the depth of 705 fathoms; and it is known as a fossil form at Rometta, in the Zanclean formation or older Sicilian Pliocene.

Caryophyllia arcuata, Ed. & H., has hitherto only been known as a fossil form. A variety was dredged up (stations 19 & 20, 2nd expedition) in 248 and 304 fathoms, off the south-western coast of the peninsula.

The fossil forms are from the older Pliocene rocks in Sicily.

Caryophyllia cylindræa, Reuss. A careful examination of some specimens dredged up (9 & 17 a stations, 2nd expedition) from a depth of 539 and 740 fathoms leads to

¹ This is a new division; for *Caryophylliæ* with three cycles of septa have been hitherto unknown.

the belief that they are slight varieties of this well-known Cretaceous type. The species is common in the upper and middle white chalk of North-western Europe.

Caryophyllia abyssorum, Duncan, was dredged up from a depth of 1095 fathoms (No. 17 station, 2nd expedition). It is closely allied to the Cretaceous type *Caryophyllia cylindracea*, Reuss; but it has not been found elsewhere.

Caryophyllia inskipi, Duncan, was dredged up from 539 fathoms (No. 9 station, 2nd expedition). It has affinities with the Cretaceous species.

Caryophyllia calveri, Duncan, was dredged up from 292 fathoms (No. 24 station, 2nd expedition).

Caryophyllia vermiformis, Duncan, and *Caryophyllia pourtalesi*, Duncan, belong to a new type, and they are the first species of the genus which have been discovered to have only three cycles. Their range is restricted to the sea to the west and south-west of the Spanish peninsula, and they live at the depth of from 227 to 740 fathoms.

CARYOPHYLLIA CLAVUS, Scacchi. (Plate XLVIII. figs. 9, 10.)

The corallum is conical, and is fixed by a narrow peduncle to all sorts of foreign bodies.

The costæ are distinct from the base, are usually straight, and are most projecting near the calice. They are thin, slightly wavy here and there, granular, and unequal.

The epitheca occurs in some parts of the outside of the corallum in the form of detached bands.

The calice is elliptical, and the fossa is large. The columella is small, and is formed of from four to nine twisted processes.

The septa are thin and granular; the largest are slightly exsert and equal. There are four complete cycles of them, and part of the fifth cycle also. The higher orders of septa are small.

The pali are thin, long, projecting, and are marked with a concave cup-shaped ornamentation, or with granules.

The typical form was found in No. 28 dredging, 2nd expedition of the 'Porcupine,' in 304 fathoms, and also in dredgings Nos. 26, 29, and 57.

There is perhaps no more variable form of simple coral than *Caryophyllia clavus*, Scacchi, sp. It has a considerable horizontal range, being found throughout the Mediterranean at many depths, and in the Norwegian seas, and also in the western seas off Ireland. The species is, moreover, found in the Old Pliocene of Sicily.

✓ Variety *α. elongata*. (Plate XLVIII. figs. 7, 8.)

The corallum is tall, cylindro-conical, or almost cylindrical, compressed, often curved and twisted, and marked with epithecal rings and accretion-ridges.

The costæ are sharp, wavy, and rarely granular. The base is small.

These forms were obtained in the 2nd expedition of the 'Porcupine,' in dredgings No. 57, and off the Mediterranean coast of Africa.

✓ Variety β . *exserta*. (Plate XLVIII. fig. 5.)

The corallum is short, finely pedicillate, and then bulky and turbinate.

The primary and secondary septa are very exsert.

The costal ornamentation is like that of the type.

The epitheca is scanty.

From dredgings in Cartagena Bay.

Variety γ . *borealis*. (Plate XLVIII. fig. 6.)

This is the form described by Fleming, and is very common in the North Atlantic and off the north-east coast of Scotland.

The corallum is more compressed than the type.

The columella is larger.

The costæ are broader and more distinct, and often very granular or sharply aciculate.

The epitheca, or a granular state of the wall, reaches some distance from the base, which is small and attached.

This variety was found in the dredgings of the first expedition of the 'Porcupine,' No. 88 and No. 2; in the dredgings of the second expedition in No. 29. The specimens attach themselves to a *Ditrupa*, shells, and Echinoderm-spines.

Variety δ . *smithii*. (Plate XLVIII. figs. 11, 12.)

This is the *Caryophyllia smithii*, Stokes, which is so common on the shores of the extreme south-west of England. It has a broad base; but this is the only strong distinction between it and *Caryophyllia clavus*. The gradation of a delicate pedunculated *Caryophyllia clavus* into a broad-based form with all the other specific peculiarities, depends upon the depth of the water and the nature of the bottom; and the variety *borealis* gradually becomes variety *smithii*, both in the northern seas and in the Mediterranean.

The costæ are usually very distinct, and some are prominent, and are either granular or covered with sharp points. The columella varies in extent.

The specimens were derived from dredgings off the Mediterranean coast of Africa, and from the telegraph-cable at Malta, and from No. 88 and No. 2 dredgings in the first expedition of the 'Porcupine.'

✓ Variety ϵ . *epithecata*. (Plate XLVIII. figs. 13-16.)

This variety is very well marked in the numerous specimens which were dredged in

shallow water in Dingle Bay, and in from 90 to 110 fathoms in No. 6 dredging of the first expedition of the 'Porcupine.' The variety is also found off Valentia.

The corallum is attached by a small peduncle during the early part of its existence; and it usually, but not invariably, separates by friction subsequently; and then the peduncle diminishes in size.

The characteristic peculiarities are the curved compressed conical shape, the large growth, and the exsert septa, and the epitheca, which reaches close up to the calicular margin. The costæ are largely granular, and the fossa is deep.

CARYOPHYLLIA CYATHUS, Ellis & Solander, sp.¹

✓ Variety α . *africana*. (Plate XLVIII. figs. 3, 4.)

The corallum is compressed, curved, and attached by a delicate peduncle.

The septa are not so close or so short as in the typical form.

The epitheca is not so complete.

The specimen was dredged up in the second expedition of the 'Porcupine' (No. 32), in 651 fathoms.

CARYOPHYLLIA ARCUATA, Ed. & H.

✓ Variety α , with prominent costæ. (Plate XLIII. figs. 1-4.)

The corallum is tall, with a large incrusting base, a long cylindrical stem, and a conico-cylindrical termination.

The calice is subcircular, and the margin is irregular from the larger septa being on a higher level than the others.

The septa are stout, unequal, granular laterally, and rounded above. There are *four cycles* of them, in six systems. The primary and secondary septa are equal, are higher than the others, and are continued as prominent semicristiform costæ down two thirds of the outside of the corallum. The septa of the fourth and fifth orders are nearly as high as the larger ones, and higher than those of the third cycle.

The pali are large and rounded, and flat.

The columella is small, and is composed of eight processes.

The fossa is shallow.

The costæ are almost equal; but those of the tertiary and quaternary cycles are not prominent like the others, but are flat; and all are marked by close transverse rows of granules, separated by transverse grooves.

On the round part of the stem the costal ornamentation is simply granular.

Height of corallum $\frac{1}{10}$ inch; height of calice $\frac{7}{20}$ inch.

Dredged up in No. 19, from 248 fathoms, 2nd expedition; No. 28, from 304 fathoms, 2nd expedition.

An examination of the great series of *Caryophylliæ* which has been obtained during

¹ MM. Milne-Edwards and Jules Haime, *op. cit.* vol. ii. p. 13.

the dredgings, and of a number of forms from shallow water, proves that the shape of the peduncle and base of the corallum varies according to external conditions. To separate the forms which have peduncles attached to foreign bodies from those which are pedunculate but free, and with or without a scar, is not possible, according to the results of the above-mentioned examination, except on the plan of a necessary artificial division of a great and closely allied set of forms. *Ceratocyathus*, a genus founded by Seguenza to admit pedunculate forms, is thus clearly only a subsection of the *Caryophyllia*; and I propose to absorb it.

There is a very elegant coral which was dredged up from a depth of 705 fathoms, No. 88, first expedition of the 'Porcupine,' and which belongs to the species *Ceratocyathus ornatus*, Seguenza¹.

It appears to belong to the pedunculate *Caryophyllia* which have a thick granular epitheca. I have therefore named the form *Caryophyllia seguenzæ*; for there is a *Caryophyllia ornata* described by Seguenza.

CARYOPHYLLIA SEGUENZÆ, Dunc. (Plate XLIV. figs. 4-6.)

SYN. *Ceratocyathus ornatus*, Seg.

The corallum is short, conical, compressed, subgibbous, and has a very small, short, and twisted peduncle.

The epitheca is stout and very granular.

The calice is elliptical and open.

The columella is formed of three or more twisted processes, and is well developed.

The pali are long, and are granulated laterally.

The septa are very unequal, the last cycle being rudimentary, and very small. The larger septa are thick at the margin, and exsert. There are six systems of septa; and the fifth cycle is nearly complete.

The costæ are unequal, and they are prominent near the calicular margin.

Height of corallum $\frac{4}{10}$ inch; length of calice $\frac{8}{10}$ inch.

Caryophyllia with the fourth cycle of septa incomplete.

There are several specimens of species of *Caryophyllia* which have unequal septal systems owing to the imperfect development of the fourth cycle. This peculiarity is not accidental, or even produced by the forms not having reached their full growth; for it persists in tall, full-grown corals. It characterizes the Cretaceous *Caryophyllia cylindræa*, Reuss, and the existing *Caryophyllia berteriana*, Duchassaing, of Guadeloupe. In consequence of this alliance with a common Cretaceous type, it is requisite to examine the forms with the incomplete fourth cycle very carefully and critically.

The following is the diagnosis of *Caryophyllia cylindræa*, Reuss, a species from the Upper and Middle White Chalk².

¹ *Op. cit.* p. 431.

² MM. Milne-Edwards and Jules Haime, *op. cit.* vol. ii. p. 19.

The corallum is elongate, subcylindrical, and either straight or slightly curved. The wall is smooth and shining in its lower two thirds; and in the upper third there are small subequal costæ, which project very slightly. The calice is subcircular. The columella is fasciculate, and is formed of a small number of slender "tigelles." There are four cycles of septa; but in three systems one of the halves is deprived of the septa of the fourth and fifth orders. The septa are thin, and only slightly thickened externally. The pali are narrow and thick.

One of the specimens dredged up from No. 17 *a*, 740 fathoms, and off the Portuguese coast, is evidently closely allied to the Cretaceous form. It has all the peculiarities of *Caryophyllia cylindracea*, and differs from it in having the varnished-looking wall (epitheca) continued up to the calicular margin, and in having the septa rather stouter and the pali thicker. These are not specific distinctions in a genus which is most variable; and therefore I have retained the specific name, and have considered the existing form a variety of the Cretaceous type.

CARYOPHYLLIA CYLINDRACEA, Reuss. (Plate XL. figs. 5-8.)

✓ Variety *α*. With prolonged epitheca, thicker septa and pali.

Three dead specimens of an allied form were dredged up from the "Channel slope" (No. 9, 539 fathoms); and one is sufficiently well preserved to be drawn. It is a variety of the Cretaceous form; and the epitheca does not reach higher than in the type, but the pali are much thicker.

✓ Variety *β*. With very thick septa and pali (figs. 9-12).

✓ CARYOPHYLLIA ABYSSORUM, Duncan. (Plate XL. figs. 1-4.)

The corallum is elongate and slightly curved. It has a broad base and a long cylindrical pedicel, which gradually enlarges into a turbinate upper part.

The costæ are distinct from the base to the calice, and are larger and broader towards the calicular end. The costæ of all orders are equal and are granular.

The epitheca is finely granular, and is difficult to distinguish from the wall. The septa are thick, close, unequal; and the larger are exsert. They are granular, and are ornamented by radiating ridges. There are four cycles of septa, but the fourth and fifth orders are absent in some half-systems.

The pali are rounded, narrow, tall, and wavy, and have lateral swellings.

The columella is small, deeply situate, and is composed of eight or nine projecting and twisted processes.

The calice is elliptical in outline, and the margin is thick, the fossa being rather deep.

Height of corallum $\frac{1\frac{4}{10}}$ inch; length of calice $\frac{4}{10}$ inch.

Dredged up from 1095 fathoms (No. 17, 2nd expedition), and had not been dead any great length of time.

✓ *CARYOPHYLLIA INSKIPI*, Duncan.

The corallum is short and curved. It has a small base, which is marked by a fracture of its attachment.

The epitheca is dense, and covers the whole external surface; it is granular, and conforms to the subequal costæ, which extend downwards to the base without any marked diminution in their size. Superiorly the costæ join the stout and barely exert septa.

The calice is subcircular, shallow externally, and deep over the columella.

The septa are alternately large and small, are largest at the margin, and are granular. There are four cycles in most of the systems, and the higher orders are missing in the half of two systems.

The columella is very small, and situated deeply.

The pali are very tall, and rather thick, but small.

Height of corallum $\frac{4}{10}$ inch; breadth of calice $\frac{2}{10}$ inch.

The specimen from which this description is taken was dead, and came up in dredging No. 9, 539 fathoms, 2nd expedition. I have named it after Commander Inskip, one of the naval officers who contributed so much to the success of the deep-sea dredgings.

✓ *CARYOPHYLLIA CALVERI*, Duncan.

The corallum is short, subturbinate and cylindrical.

The costæ are subequal, flat and granular from their epithecal covering. The primary and secondary costæ reach highest.

The calice is circular in outline, is shallow; and the primary and secondary septa are very exert and arched.

The columella is small, and is composed of two or three processes.

The pali are curved, projecting and twisted; they are larger than the tertiary septa, before which they are placed.

The septa are unequal, and are marked by radiating eminences, which depend upon curving of the laminæ.

There are six systems of septa; and there are four cycles in five, and three in the remaining cycle.

Height of corallum $\frac{3}{10}$ inch; breadth of calice $\frac{2}{10}$ inch.

I have named this beautiful coral after Captain Calver, to whom the dredging-expeditions owe so much of their success. Dredged up from 292 fathoms (No. 24).

✓ *CARYOPHYLLIA VERMIFORMIS*, Duncan. (Plate XL. figs. 13-16.)

The corallum has a broad expanded base, a cylindrical and curved stem, and a slightly elliptical shallow calice.

The costæ are distinct near the calice, where they are alternately large and small, flat and granular; and they are less distinct towards the base, where the granules are still apparent.

The septa are stout, unequal, and crowded; none are exsert; but they are rather wavy. The primary are not readily distinguishable from the secondary septa; but these are longer than the tertiary. There are six systems of septa, and three cycles in each.

The columella is formed by one twisted process.

The pali are small, and are placed before the secondary septa.

Height of corallum $\frac{6}{10}$ inch; breadth of calice $\frac{3}{20}$ inch.

Dredged up No. 17 *a* dredging, 2nd expedition of the 'Porcupine.'

✓ *CARYOPHYLLIA POURTALESI*, Duncan. (Plate XLII. figs. 3-10.)

The corallum is subturbinate, curved, and swollen.

The calicular margin is circular; and the base, which is truncated, is marked by the results of displacement from the foreign body to which it was attached by a very small peduncle.

The costæ are flat, broad, equal, and terminate at the calice in angular points, which are much broader than the septa.

The epitheca is shining, and gives the chevron and granulated ornamentation to the costæ.

The calicular fossa is shallow. The columella is very small, and is formed by one or two twisted processes. The pali are irregular and tall.

The septa are unequal, not exsert, are wavy, very granular laterally, and delicate; they are wide apart, and are in six systems. There are three cycles of septa in each system, and some members of the fourth in some systems.

Height of corallum $\frac{6}{10}$ inch; breadth of calice $\frac{5}{20}$ inch.

There are some young specimens, which prove that the septal number is reached very early, and that the epitheca covers the costæ and intercostal spaces at first, and does not permit them to be seen (figs. 4-7).

Dredged up in the second expedition of the 'Porcupine,' in stations 24 and 29.

American *Caryophyllia*.

M. de Pourtales describes *Caryophyllia cornuformis*, Pourt., which he obtained in 237 and 248 fathoms, off Sand Bay and the Samboes, Florida, on a bottom consisting of Foraminifera. It has four cycles; but the pali are before the secondary septa. This anomaly separates the species from all others. Otherwise it belongs to the *Arcuata* type.

Caryophyllia formosa, Pourt., was found by the same excellent naturalist off Havana, in 270 fathoms. It is closely allied to *Caryophyllia arcuata*, Ed. & H.

Caryophyllia berteriana, Duchassaing, Anim. Rad. des Antilles, a form with four incomplete cycles of septa and large costæ, is found off Guadeloupe, and perhaps in 68 fathoms off the Tortugas (*Pourtales*).

Genus *BATHYCYATHUS*, Milne-Edwards & Jules Haime, 1848.

BATHYCYATHUS ATLANTICUS, Duncan. (Plate XLVIII. figs. 1, 2.)

The corallum is circular in outline at the base, but becomes compressed above, so that the axes of the calice are very unequal.

The corallum is in the shape of a reversed and compressed cone.

The calice is elliptical in outline, and the great axis is on a lower plane than the smaller.

The septa at the reticular margin are exsert, and project outwards so as to give a very open aspect to the deep calice. The septa are unequal, and the primary and secondary laminae are very prominent. The septa of the last cycle are larger than the penultimate.

There are four complete cycles of septa, and also three derived septa from the fifth cycle, so that there is an appearance of thirteen sets of three septa and thirteen large septa. The septa are granular, and ornamented with radiating lines of granules.

The pali are large, distinct, prominent, very granular, and are placed before the tertiary cycle.

The columella consists of essential and ribbon-shaped processes, and is well developed and deep in the fossa.

The costae are broad, granular, and subequal; but those of the largest septa are distinctly prominent far down towards the base.

Height of corallum 1 inch to $1\frac{1}{2}$ inch; length of calice $\frac{8}{10}$ inch; breadth of calice $\frac{7}{10}$ inch.

Some fragmentary specimens evidently belonged to larger forms. The coral was found in No. 17 *a* and No. 17 dredgings, in the second expedition of the 'Porcupine,' and in 740 and 1095 fathoms.

The genus *Bathycyathus* is closely allied to the *Caryophyllia*; and were it not for the peculiar structure of the upper part of the septal apparatus, it would be included amongst them.

The species hitherto described, viz. *Bathycyathus chilensis*, Ed. & H., *B. indicus*, Ed. & H., and *B. sowerbyi*, Ed. & H., have five complete cycles of septa. The first two are recent forms, and are probably identical, and were dredged up off the coast of Chili, at a depth of 80 fathoms, and off Juan Fernandez.

The fossil species (*Bathycyathus sowerbyi*, Ed. & H.) of the Upper Greensand is never found in a perfect state, and is closely allied to the recent forms.

Hence the new species, with its defective fifth cycle, is less closely allied to the Cretaceous type than its Pacific congeners. The genus has not been found represented in any Upper Cretaceous or Tertiary strata.

Subfamily TROCHOCYATHACEÆ.

(Pali in several crowns.)

Genus PARACYATHUS, Milne-Edwards & Jules Haime (1848).

PARACYATHUS AGASSIZI, Duncan. (Plate XLIII. figs. 5-8).

The corallum is tall, straight, and has a large incrusting base, and a narrow cylindrical stem spreading out into a subturbinate termination.

The calice is oval in outline, and not very deep, but widely open.

The columella occupies much space, and is made up of small processes.

The pali before the smaller septa are bilobed. The pali generally are not crowded, and are at different distances from the centre.

The septa are unequal, moderately close, largely granular laterally; and most of them terminate internally in an enlargement.

There are four complete cycles, and part of a fifth in some systems.

The costæ are distinct to the base, and are prominent in the upper third of the corallum; they are granular and subequal; but those of the larger septa are the most prominent above.

Height of corallum $\frac{5}{10}$ inch; length of calice $\frac{3}{10}$ inch.

Dredged up in No. 19 station, in the second expedition of the 'Porcupine,' from a depth of 248 fathoms.

I have named this beautiful species after Professor Alexander Agassiz, to whom I am much indebted for assistance in comparing the specimens dredged up in the first 'Porcupine' expedition with those of the American dredgings.

Paracyathus agassizi belongs to the group characterized by *Paracyathus crassus*, Ed. & H., of the London clay, and has greater affinities with that form than with any recent one.

PARACYATHUS STRIATUS, Philippi, sp. (Plate XLIII. figs. 9-13.)

An ill-developed corallum, springing by false calicular gemmation from a parent, was dredged off the Mediterranean coast of Africa. It probably belongs to this species, although the costæ are rather more developed than they are described to be by MM. Milne-Edwards and Jules Haime.

A worn specimen, much covered with serpulæ, was dredged up in 60 to 160 fathoms, seven miles off Rinaldo's Chair.

A tolerably perfect specimen was dredged off the Adventure bank, of which the following are the specific characters:—

The corallum is turbinate and straight.

The wall is granular.

The costæ are alternately slightly unequal.

The columella is deep and not very large.

There are four cycles of unequal septa in six systems.

The pali of the third order are higher than the others.

The calice is elliptical.

Height of corallum $\frac{3}{10}$ inch; length of calice $\frac{2}{10}$ inch.

The American deep-sea *Paracyathi* are *Paracyathus confertus*, Pourtales, rare, in 50 to 100 fathoms off the Florida reef; and

Paracyathus de filippi, Duch. et Mich., of the Antilles.

Division TURBINOLIACEÆ.

Genus SPHENOTROCHUS, Milne-Edwards & Jules Haime, *op. cit.* 1848.

SPHENOTROCHUS INTERMEDIUS, Münster, sp. (Plate XLI. figs. 1-5.)

MM. Milne-Edwards and Jules Haime distinguish between *Sphenotrochus intermedius*, Münster, sp., and *Sphenotrochus milletanus*, DeFrance, sp., by writing "cette espèce (*Sphenotrochus milletanus*) est extrêmement voisine du *Sphenotrochus intermedius*: elle nous paraît n'en différer qu'en ce qu'elle est un peu plus élevée proportionnellement à la largeur, et presque aussi épaisse à la base qu'au calice; de plus les côtes sont moins saillantes latéralement, et sont plus souvent interrompues" (Hist. Nat. des Corall. vol. ii. p. 69). I do not think this establishes a specific distinction; and it appears to me that the form from the British Crag, which was described by Mr. Searles Wood as *Turbinolia milletiana*, and which was decided to be *Sphenotrochus intermedius* by MM. Milne-Edwards and Jules Haime, is really a variety of the French Falunian form.

Many specimens resembling the Crag forms have been dredged up in Tangier Bay in 35 fathoms, and off Cape Sagres in 45 to 50 fathoms.

Genus SABINOTROCHUS, Duncan.

The corallum is simple, flatly turbinate, and adherent by a delicate peduncle. The calice is flat. The septa are exsert; the costæ are delicate and numerous; and the columella consists of growths from the septal terminations.

SABINOTROCHUS APERTUS, Duncan. (Plate XLI. figs. 6-9.)

The corallum is button-shaped.

The wall is nearly horizontal, and forms a flat inverted cone, which is marked with unequal costæ.

The calicular margin is open and circular, being festooned, however, by the projecting primary and secondary septa.

The fossa is shallow; and the calice, as a whole, is slightly concave.

There are four cycles of septa in six systems; but occasionally some members of the

fourth, which are usually rudimentary, are absent. The primary and the secondary septa are nearly equal in size, and are large, projecting, exsert, thin, and marked with distinct granules. The secondary septa are not so high as the primary. The tertiary septa are smaller and less exsert than those already mentioned, and they usually unite to the secondary near the false columella.

The columella is formed by processes from the ends of the larger septa.

The interseptal spaces are broad and shallow.

The costæ are more numerous than the septa. The primary and secondary costæ are slightly prominent at the calicular margin, and may be traced to the fine peduncle. The third and fourth orders are less so; and there are some traces of a fifth cycle in the form of wavy rows of granules or ridges.

The height of the corallum is $\frac{3}{20}$ inch; and the breadth of the calice is $\frac{4}{10}$ inch.

Dredged up in No. 16 dredging, second expedition of the 'Porcupine,' and in 994 fathoms.

I have named this new Turbinolian genus after Sir Edward Sabine, K.C.B., the President of the Royal Society.

Genus DESMOPHYLLUM, Ehrenberg.

DESMOPHYLLUM CRISTA-GALLI, Milne-Edwards and Jules Haime, 1848, *op. cit.* (Plate XLI. figs. 10-16.)

Desmophyllum dianthus, Ehrenb. 1834.

α . — *cumingi*, Milne-Edwards & Jules Haime, 1848, *op. cit.*

β . — *costatum*, Milne-Edwards & Jules Haime, 1848, *op. cit.*

If the variations of the typical form of this species are studied, it will be noticed that there are great differences in the position, size, and continuance of the costæ, in the exsertness and granulation of the septa, in the height, compressedness, and size of the base of the corallum, and in the granular ornamentation of the outside of the wall in different specimens. The recognition as varieties of the forms marked α and β , instead of species, is necessary.

The size, costal development, exsertness, and granular condition of the ornamentation of the septa and outside of the corallum depend upon the age and nutrition of the specimen. Very thin septa are not so granular superiorly as those of corallites which have very dense walls and thick septa; and the costæ of the latter kind are usually most prominent.

At great depths, 994 fathoms, No. 16 dredging; and where the Madreporaria appear to be very abundant the specimens of *Desmophyllum* are usually very granular externally; moreover they become attached to compound forms of corals, and both have the same ornamentation, so that it is difficult not to believe in the *Desmophyllum* being part and parcel of the growing mass. They are especially liable to be joined to branches of the fistulose bifurcating coral which will be described further on (*Solenosmilia variabilis*).

One specimen is attached partly to a broken specimen of a dwarfed variety with a small calice and without any costæ (No. 16 dredging).

A finely pedunculate form, with a wide base of attachment, is fixed on to the wall of a portion of a gigantic *Desmophyllum*. Both have exsert septa, and they project eccentrically also. The costæ of the perfect specimen are well developed; but the septa are thin, and the granular ornamentation is slight. The specimen came from a much shallower part of the sea than those of No. 16 dredging.

No. 6 dredging (second expedition), 358 fathoms, yielded two small specimens, parasitic upon a mass of *Amphihelia oculata*, Linnæus. The smallest, not more than $\frac{1}{10}$ inch in height, has six large primary septa, six rudimentary secondary septa, and traces of the tertiaries. A larger specimen, about $\frac{4}{10}$ inch high, has four perfect cycles, and resembles the full-grown *Desmophyllum stokesi* of Torquay, which is probably an immature form. The septa are feebly exsert.

No. 17 dredging, 1095 fathoms, second expedition, presented two specimens of varieties of *Desmophyllum*, which were more or less covered with serpulæ; they were granular externally.

The variety *costatum* is found in the Older Pliocene formations of Messina and Asti.

Genus FLABELLUM, Lesson, 1831.

FLABELLUM DISTINCTUM, Milne-Edwards & Jules Haime, 1848, *op. cit.* (Plate XXXIX. figs. 1-13.)

Flabellum extensum, Michelin.

Specimens of many different sizes and varieties of *Flabellum distinctum* were dredged up in No. 16 dredging (994 fathoms), No. 26 dredging (364 fathoms), and No. 28 dredging (304 fathoms) of the second expedition of the 'Porcupine.'

All have the peculiar and specific septal arrangement of the type described by MM. Milne-Edwards and Jules Haime; but there is great variation in the markings of the epitheca, the size of the lateral crests, the development of the other costæ, the size of the peduncle, and in the increase and diminution of the lateral angles. It is quite evident that *Flabellum extensum* must be absorbed; and it would have precedence were it a better species.

Flabellum distinctum is a Japanese form; and I have specimens of it in a fossil condition from the Tejares of Malaga, which are Miocene strata. *Flabellum extensum* has been found in the Turin Miocene, and in either Miocene or Pliocene strata at Villeneuve-lez-Avignon, and in deposits of unknown tertiary age at Antwerp.

FLABELLUM LACINIATUM, Ed. & H. (Plate XXXIX. figs. 14-18.)

SYN. *Phyllodes laciniatum*, A. Philippi.

Ulocyathus arcticus, Sars.

This *Flabellum* has a remarkably delicate wall, and a few well-developed thin septa alternating with others which are much smaller. The soft parts are excessively thick,

and they break the hard parts by their post-mortem contraction. I have only one small young perfect specimen out of many scores of large individuals. Consequently the species must be considered provisional.

It is a common form in the Norwegian and North Atlantic Seas, and has not yet been found in the Mediterranean or south of the British Channel. It is evidently the link between the genus *Flabellum* and *Desmophyllum*.

The species is found in the older Pliocene of Rometta.

Genus RHIZOTROCHUS, Ed. & H. 1848.

RHIZOTROCHUS AFFINIS, Duncan. (Plate XLVII. figs. 17-19.)

The corallum is covered with a stout, well-developed epitheca. The radicles are well developed. The wall is very thin. The costæ barely exist. The septa are slightly exsert, unequal, wavy, and granular. There are four cycles of them, and part of the fifth also. Calice most elliptical in old specimens, circular in the young. Height of corallum $\frac{8}{10}$ inch. Locality: Mediterranean. No. 50a, 152 fathoms.

The reasons for associating the next genus (*Amphihelia*) with the *Turbinoliaceæ* in a new group ("those increasing by gemmation") are given at the end of the description of the species. The position of the genus amongst the *Oculinidæ* can no longer be maintained.

Division GEMMANTES.

Genus AMPHIHELIA, Milne-Edwards & Jules Haime¹.

The genus is differentiated as follows by its founders:—"Le polypier est dendroïde et résulte d'une gemmation alterne et distique. Le coenenchyma prend beaucoup de développement dans les branches basilaires. Les polypières sont à peine costales au bord des calices. La columella est rudimentaire ou nulle. Il n'existe jamais de palis. Les cloisons sont peu nombreuses, entières, et débordent faiblement la muraille."

The typical form is the "white coral" *Madrepora oculata* of Linnæus; and M. Milne-Edwards states that it has a rudimentary columella, the surface of the wall striated here and there, and that there are three cycles of septa, the primary being slightly exsert and projecting outwards.

Their second species, *Amphihelia venusta*, has no columella, and three cycles of septa. There are short costal ridges near the calices, which are deep. The branches tend to develop on the same ventral plane.

M. Seguenza has described some fossil species from the Sicilian Tertiaries.

Amphihelia miocænica, Seg. It has a distinct columella; and the wall is deeply striated and closely granular.

Amphihelia sculpta, Seg. It has no columella, but has cristiform costæ; and the striæ are flexuous, anastomosing, and closely granular.

¹ Hist. Nat. des Corall. vol. ii. p. 119.

I described shortly, in the report on the 'Porcupine'-Expedition Madreporaria¹, two species, *Amphihelia atlantica* and *Amphihelia ornata*. Both of these forms have columellæ; and one is striated on its wall, and the other is not.

In examining a specimen of *Diplohelia profunda*, Pourtales, dredged up by Pourtales in deep water off Bahia Honda (324 fathoms), I was much surprised, not only at its resemblance to some of the results of the No. 54 dredging, first expedition of 'Porcupine,' but also to the Amphihelians with striated walls.

Lately M. Sars has sent me a specimen of the *Madrepora ramea* of Müller, from off the Norwegian coast, found in moderately deep water. It is an *Amphihelia* like Seguenza's *A. miocenica* and my *A. ornata*; and as it has an older date of publication, it must have precedence, and these and others be absorbed under the title of *Amphihelia ramea*, Müller, sp.

Now there is no distinction between *Diplohelia profunda*, Pourtales, and *Amphihelia ramea*, Müller, sp., and the first-named species must be absorbed.

What are the distinctions between *Amphihelia* and *Diplohelia*? *Diplohelia*, Milne-Edwards & Jules Haime, *op. cit.* vol. ii. p. 120, is differentiated as follows:—"Le polypier est dendroïde et présente dans les parties inférieures un cœnenchyma bien développé. Les calices affectent sur les rameaux une disposition alterne distique. La columella est spongieuse et bien développée. Il n'existe pas de palis. Les cloisons sont purement dentelées et débordent à peine la muraille."

Some of the species have granular walls, and others striated walls; and it will be readily observed that it is impossible to distinguish between Seguenza's and Müller's species of *Amphihelia* and the *Diploheliæ*, except on the plea that the species of the last-named genus have the septa finely toothed.

A careful examination of many specimens of *Amphiheliæ* has proved to me that the tertiary septa are often toothed in some corallites, and not in others of the same branch. The presence of a columella in the very numerous specimens of *Amphihelia oculata* and of *A. ramea* (which now includes the species already noticed) proves that the presence of one in *Diplohelia* is no differentiation. The absorption of *Diplohelia* by *Amphihelia* I consider necessary under our existing knowledge.

*Diplohelia*² *meneghiniana*, Seguenza, *D. doderleiniana*, Seguenza, *D. gismondiana*, Seguenza, *D. profunda*, Pourtales, are varieties of *Madrepora ramea*, Müller, or different parts of the same corallum possessing gemmative variation, as they all do.

All these striated *Diploheliæ* become classified under the species *Amphihelia ramea*, Müller, sp. (syn. *Madrepora ramea*).

The diagnosis of the genus *Amphihelia* by MM. Milne-Edwards and Jules Haime is not quite consistent with observations which those excellent authors could now make upon numerous and well-preserved specimens. Nor is my assertion, made in the Report

¹ Proc. Royal Society, March 24, 1870.

² Seguenza, *op. cit.* pp. 488, 489.

on the Corals of the First 'Porcupine' Expedition, respecting the very close alliance of *Amphihelia* and *Lophohelia* consistent with facts I have observed since. I find that there are never any dissepimental structures developed in *Amphihelia*, whilst they exist and even take up the tabulate form in many specimens of *Lophohelia*.

The absence of the columella, in all the specimens of *Amphihelia* I have seen, is very rare indeed; and as the structure is never observed to be wanting in many consecutive corallites on a stem (for even at the worst the large septa join centrally), the want of the organ may be an arrest of development.

Every now and then the third cycle of septa is so very rudimentary in *Amphihelia oculata*, Linn., that doubts may be expressed about its existence; yet in the same corallum it may be visible in remote calices.

The existence in *Amphihelia* of well-developed spongy and trabecular columellæ, of very small columellæ of the same consistence, and of those formed by a swollen state of the inner and adherent margins of the larger septa is beyond doubt.

The ornamentation of the costæ and their general development afford specific distinctions.

By grouping the specimens obtained from the first and second expeditions of the 'Porcupine,' the following series may be distinguished:—

1. Columella moderately developed.

Septa in two cycles, first and second equal, the third cycle either very rudimentary or wanting.

Surface of wall plain. Costæ very fine, and serpentine near the newest calices.

2. Columella very small.

Septa in three cycles, first and second unequal. Septa dentate.

Surface plain.

3. as no. 2. Surface minutely and sharply granular.

4. as nos. 2 & 3. Costæ fine and visible near the calices.

5. Columella moderately developed.

Septa in three cycles.

Surface marked by continuous costal striæ.

6. Columella very small.

Septa in three cycles, tertiary dentate.

Surface marked by continuous and noncontinuous costal striæ, and covered with granules.

7. as no 6.

Surface strongly striated. Septa not dentate.

8. Columella small.

Septa in three cycles: the primaries are often exsert.

Surface of wall plain. Costal striæ near new calices.

¹ Proc. Royal Society, 1870, P. M. Duncan.

9. as no. 8. The primary and secondary septa are exsert.

Surface of the wall sharply and finely granular. Costal striæ near new calices.

10. as no. 8. All the septa are exsert, and the costal striæ are strong.

11. as no. 10. The costæ are cristiform near the calices.

12. Columella well developed.

The septa are in three cycles; and sometimes one of a higher order is present.

Striæ long and granular, often not continuous,

Granules long.

13. Surface like shagreen, otherwise as no. 12.

It may be gleaned from this table that there are four groups:—1, with a plain wall-surface; 2, with a striated wall-surface; 3, with exsert septa; 4, with exsert septa and long striations and sharp granules.

Consequently the following diagnosis will include all the forms of *Amphihelia*.

Genus AMPHIELIA.

Syn. *Diphohelia*.

The corallum is bush-shaped; and the gemmation is alternate, marginal, and often double. The wall increases in thickness at the lower part of the corallum, and often includes the formerly free corallites. The corallites often coalesce. The columella exists. The septa are in six systems. There are not many cycles of them. The ornamentation of the wall may be none, or the costal striæ may exist.

The corallites do not fill up from below. There is no dissepimental tissue.

AMPHIELIA OCLATA, Linnæus, sp. (Plate XLV. figs. 1-3.)

Branches irregular and coalescent. Calices distant and circular in outline, very prominent on the younger branches, and immersed in the wall-tissue lower down in the corallum. Columella moderately developed. Septa in six systems; and either three cycles are developed, or only two, the third being rudimentary. Septa unequal in the first case, and equal in the second. Wall-surface plain, and striated near the new calices.

Variety α , with some septa slightly dentate.

Variety β , with the surface of the wall granular.

Variety γ , with exsert septa.

AMPHIELIA RAMEA, Müller, sp. (Plate XLV. figs. 4-6, Plate XLVI. figs. 1-19, and Plate XLIV. figs. 1-3.)

SYN. *Amphihelia niocænica*, Seguenza,

— *atlantica*, nobis.

— *ornata*, nobis.

Diphohelia profunda, Pourtales.

SYN. *Diplohelix meneghiniana*, Seguenza.

— *doderleiniana*, Seguenza.

— *sismondiana*, Seguenza; and all other *Diplohelix* with costal striæ.

Branches irregular, and often coalescent.

Columella moderately well developed.

Septa in three cycles in six systems.

Costal striations distinct, long, sinuous, general and often granular.

Variety α . Septa, especially of third cycle, dentate.

Variety β . Surface of wall very aciculate, with granules on the costæ.

Variety γ . Costal striæ interrupted, and also continuous and curved.

Variety δ . With exsert septa.

The question now arises, in which family must the *Amphihelix* be placed?

Are they Oculinidæ? Have they dissepiments? Are there any proofs forthcoming that the corallites fill up within?

It is very evident that the walls of the bud thicken immensely; but I cannot detect in any instance any diminution of the original calibre of the visceral cavity by a deposit of any kind. Yet this is a necessary characteristic of the Oculinidæ.

The ragged condition of the septal edges is evidently an occasional peculiarity in the *Amphihelix*.

The *Amphihelix*, having no infilling of the visceral chamber, no dissepiments and no pali, and having solid walls and septa, which are usually not dentate, must be allied with such simple forms as *Ceratotrochus*, *Conotrochus*, and *Desmophyllum* amongst the Turbinoliidæ.

From the presence of a columella, the *Amphihelix* may be regarded as *Ceratotrochi* and *Conotrochi* which increase by marginal gemmation.

The next species to be described is very remarkable, not only for the great depth at which it lives, but also for the size and blue tint of some of the specimens.

Family **Astræidæ.**

Division EUPHYLLIACEÆ, Milne-Edwards & Jules Haime, Hist. Nat. des Corall.
vol. ii. p. 183.

Section EUPHYLLIACEÆ CÆSPITOSÆ.

Genus SOLENOSMILIA.

Genus nov. The corallum is bush-shaped; and the corallites, which rarely unite, are cylindrical and bifurcate. The terminal calices are produced by a bi-gemmation; and their fossæ and columellæ are in common. The tissue between the new calices is usually

costulate, and that over the rest of the corallum granular and without any epitheca. The calices increase by fissiparity, and form occasionally short series. Septa numerous, and not very exsert. Dissepiments common.

SOLENOSMILIA VARIABILIS, Duncan. (Plate XLII. figs. 11–18.)

The primary corallites are not much larger than the others. Wall usually granular, but shining to the naked eye, and rarely costulate throughout. Terminal calices bifurcate, and usually separated by costulate tissue. Fossa very deep. The columella is formed of laminæ and the paliform ends of the septa, and is very deeply situated. Septa barely exsert, granular laterally, unequal, long, and curved.

Most of the septa terminate at the columella in paliform prolongations. The septal number is very variable. There may be three complete cycles in six systems, four cycles in two systems, and three in the others; fifty-eight septa may be placed irregularly, so that the septal number varies from that characteristic of three cycles to four cycles, with members of the fifth.

The shape of the calices is very variable.

The dissepiments occur in some corallites, and not in others.

The costæ usually terminate high up.

Height of corallum 3 to 4 inches; length of corallites $\frac{4}{10}$ to $\frac{6}{10}$ inch; length of calices $\frac{3}{10}$ to $\frac{5}{10}$ inch; breadth of calices $\frac{1}{10}$ to $\frac{2}{10}$ inch.

Variation.—The amount of bud-variation is extraordinary; and some of the calices are exceedingly like stunted specimens of *Desmophyllum*. The bud of one specimen was decidedly costulate throughout.

The corallum is fragile-looking but is strong; for the wall is thick. Often there is a faint bluish tinge in the calices and central hard parts.

In dredging 17, 1095 fathoms, abundant; in dredging 32, 651 fathoms, one specimen, which was lighter than those of No. 17, and tinged blue. (2nd expedition.)

Section STYLINACEÆ INDEPENDENTES.

Genus LOPHOHELIA.

LOPHOHELIA PROLIFERA, Pallas, sp., 1766. (Plate XLIV. figs. 7–11.)

MM. Milne-Edwards and Jules Haime¹ distinguish the genus and species as follows:—

The corallum is dendroid, and its form results from an irregular alternate and sub-terminal (submarginal) gemmation.

The calices have their margins everted oftentimes and lamellar; and their central cavity is very deep. The septa are entire, exsert, and meet internally at the bottom of the visceral chamber by their inner margins, and without the existence of a columella and pali. No true cœnenchyma exists.

¹ Hist. Nat. des Corall. vol. ii. p. 116.

In a note, the thick walls of the corallites are referred to, as well as the existence of "traverses." The genus is admitted into the family of the Oculinidæ by MM. Milne-Edwards and Jules Haime; and they state, p. 102:—"The visceral chambers [of the Oculinidæ] only exhibit a small number of 'traverses,' or of incomplete 'planchers;' but they [the visceral chambers] tend to become narrow and contracted inferiorly, and even to fill up from below upwards by the growth of the wall, and sometimes of the columella also." Subsequently (same page) the authors state that the wall has neither "traverses" in its interior, nor epitheca on its surface.

Now it is most important to distinguish between the words "traverses" and "planchers," even when the latter are said to be incomplete.

"Traverses endothéciales" correspond to the English term of endothecal dissepiments; and they extend between the septa, closing up the interseptal loculi; but they do not extend across the axial space in one uninterrupted tissue, so as to shut off the part below the calice above.

"Planchers," or "tabulæ," or "diaphragmes lamellaires," close the corallites at different heights, and form horizontal divisions, which extend from one wall to the other of the general visceral cavity, instead of occupying the breadth of the interseptal loculi above. The following words, however, complicate the matter somewhat:—"they [the planchers] differ from the 'traverses,' because "ils ne dépendent pas des cloisons," although the reference to the dissepiments which only close the interseptal loculi between the septa follows.

Tabulæ or "planchers" are independent of the septa, but they are formed by endothecal growth after the septal laminæ have been perfected in the visceral chamber. Then this is crossed by a development of hard structures within the membranes, and all below is shut off. The tabulæ extend across the axial space and between the septa, and in the interseptal loculi. An incomplete tabula is an anomaly, but may exist as the result of antecedent or of imperfect development.

The specimens of this genus are very numerous in the collection of dredgings; and I have had the opportunity of examining others from the American expedition, which were dredged off the Florida coast. M. Sars has sent me a Norwegian specimen; and Mr. Kent has shown me the beautiful series obtained by him south of Cape Finisterre, in 600 fathoms. The drawings of the fossil species described by M. Seguenza have been studied; and I have availed myself of a number of recent specimens obtained from unknown localities.

The result of my study of a great series of forms which must be included in the genus, is to prove that the corallites do not fill up inferiorly, but that the wall increases externally, that small dissepiments often exist, that perfect tabulæ are by no means uncommon, and that some specimens have no endotheca whatever.

The variability of the species is immense; and the corallites on the same stem are also variable.

The septa are not incised on their free margins, and are remarkable, so far as their number is concerned, for their very irregular cyclical arrangement. Some primary septa are very large, exsert, and project outwards; others of the same cycle are not much larger than the secondaries, and barely project at all.

The costæ may be but faint striations, or distinct crests on corallites of the same stem; and occasionally not a trace of any other markings than the granulation of the wall may be observed.

The position of the gemmation varies greatly, and may be on the calicular margin, a little way down or some distance down the wall on the same corallum; and the rest of the corallite varies as much as the other details.

I cannot understand why *Lophohelia* should be classified with the Oculinidæ, whose essential peculiarities are given by MM. Milne-Edwards and Jules Haime, Hist. Nat. des Corall. vol. ii. p. 102.

In estimating the value of their differentiation, it must be remembered that lateral gemmation is common to other families, that thick imperforate walls are so also, and that the thickness of the wall in the Oculinidæ is not produced by what is termed cœnenchyma in the aggregate Astræidæ.

The paucity of the peculiar endotheca is not characteristic. But the filling-up of the visceral cavity is rather peculiar, and in a general sense may be sufficiently correlated with the other characteristics to form a structure common to the family.

A careful examination has not proved that this filling up occurs in *Lophohelia*.

Lophohelia, as a genus, possesses entire septa; and as it has endotheca, and no true cœnenchyma, it must be associated with the Eusmiliinæ, amongst the Astræidæ.

The groups of the Trochosmiliaceæ and Euphylliaceæ will not admit the genus; but it is evidently closely allied to the genus *Dendrosmilia* of the Stylinaceæ (indépendantes, Ed. & H.), *op. cit.* p. 220.

I therefore propose to remove the genus *Lophohelia* from the Oculinidæ, and to re-write its generic diagnosis.

Family **Astræidæ.**

Subfamily EUSMILIINÆ.

Division STYLINACEÆ.

Section STYLINACEÆ INDEPENDENTES.

Genus LOPHOHELIA.

The corallum is dendroid, and its gemmation is subterminal and irregularly alternate. The wall is very thick. The calices are very deep. The septa are irregular in their cyclical arrangement. There is no columella. There are dissepiments, and strong well-developed tabulæ.

LOPHOHELIA PROLIFERA, Pallas, sp.

The corallum is tall, and either dendroid or boat-shaped; and the corallites often unite laterally.

The corallites are long, turbinate, subturbinate, cylindrical, claviform, and cyathiform, or short. They are often deformed.

The wall is finely granular.

The costæ may exist as crests here and there, as very fine curved lines, or they may be absent.

The wall is thick, especially inferiorly.

The calicular margin may be circular, elliptical, or deformed in outline; it may be open, inverted, everted, or not.

The calicular fossa may be very deep, or may be crossed by tabulæ at different depths.

The septa are never in three, four, or five perfect cycles in six systems. The number of the larger septa varies, as does the amount of the exsertness, projection outwards, and breadth.

The septal laminae are unequal, larger and thicker at the margin than elsewhere, and they approach each other at the bottom of the fossa.

The septal ends are usually not in contact; but occasionally some trabeculæ join them low down.

The tabulæ are thick and variable in their position.

The dissepiments are small, and rarely extend beyond the interseptal loculi.

The height of the corallum and the size of the corallites vary greatly.

The variability of the group of forms included in this species is extreme. On one stem corallites which answer to *Lophohelia prolifera*, Pallas, sp., *L. anthophyllites*, Ellis & Solander, sp., *L. subcostata*, Ed. & H., *L. affinis*, Pourtales, *L. defrancei*, Defrance¹, and *L. stoppiniana*, Seg.¹, can be observed; and other stems, or rather independent corals, consist of corallites possessing the special attributes of one of the species only.

The coalescence of the corallites varies in amount, as does the thickness and weight of the corallum.

In some large corallites, with calices measuring $\frac{1}{2}$ inch in breadth, there are four cycles and some septa of the fifth; but usually in calices of less size the fourth cycle is incomplete.

Two specimens were dredged up in the Mediterranean (No. 58, depth 266 fathoms), between Sicily and the African coast; and thus the coral must be received as one of the fauna of the Mediterranean, although previously doubt had been cast upon it.

Its usual habitat is in the North Sea, the North Atlantic, and off the French and Spanish coasts; and it frequents rocky ground.

¹ Fossil species.

LOPHOHELIA PROLIFERA, Pallas, sp. (Plate XLII. figs. 1, 2.)

Variety *gracilis*.

SYN. *Lophohelia gracilis*, Seguenza.

The fossil coral *Lophohelia gracilis* described by Seguenza¹, and associated by him with two varieties (α *striata* and β *latistella*), is represented by numerous living forms in deep sea (554 fathoms) to the west of the promontory of Tangier (No. 33).

The specimens I have had the advantage of examining from the dredgings are so numerous that I have been able to study their range of variation. It is evident that the delicate form *gracilis* is connected by intermediate ones with the dwarfed and then with the large *Lophohelia prolifera*. The pretty little type must then be considered a race or subspecies; and doubtless, when dredging operations are finished to the south of the Straits of Gibraltar, it will be found to replace the great *Lophohelia* of the north.

The variation of the corallites on the same corallum is very great.

Family Oculinidæ.

Subfamily STYLASTRACEÆ.

Genus STYLASTER.

STYLASTER GEMMASCENS, Esper, sp. (Plate XLIX. figs. 1-6, 8-10, 13-15.)

"The corallum is subflabelliform. The branches often coalesce; and the younger are crowded with small granulations, which are irregularly placed between the calices. The old branches are almost smooth. The calices are alternate on young branches, and sparingly developed on the old; they are circular, oval, or deformed, and have projecting margins. There are from twelve to sixteen septa, which are often irregular."

This is the diagnosis which is given by Milne-Edwards and Jules Haime²; and it accords closely with that characteristic of several specimens which were dredged up in the first expedition of the 'Porcupine,' and also in the previous expedition of the 'Lightning.' The specimens from the 'Porcupine' collection came from No. 54 dredging, at a depth of 530 fathoms. I considered the specimens to belong to the genus *Allopora*; but a reexamination of them, in which I have been greatly assisted by Mr. Kent, of the British Museum, determines me to associate them with the species just described. The type of the species came from the Indian Ocean; and the North-Atlantic forms are as well developed as those somewhat roughly drawn by Esper.

¹ Seguenza, Mem. della Reale Accad. di Torino, t. xxii. serie 2, p. 493.

² *Op. cit.* vol. ii. p. 131.

Section PERFORATA.

Family **Madreporaria.**

Subfamily EUPSAMMIINÆ.

Genus *BALANOPHYLLIA*, Searles Wood, Ann. Mag. Nat. Hist. 1844.

BALANOPHYLLIA GADITANA, Duncan.

The corallum is claviform and cylindrical, and has a rounded base, with a scar of former adhesion. The epitheca exists here and there.

The costæ are subequal and flat.

The calice is circular in outline, and is very deep centrally.

The septa are unequal, thick, and irregular. The smallest join the others near the calicular margin; others unite midway to the columella to the internal edge of the large septa.

There are four incomplete cycles of septa in six systems.

The columella is very small, and is situated deeply.

Height of corallum $\frac{6}{10}$ inch; breadth of calice $\frac{2}{10}$ inch.

Dredged in No. 29 station, and in 227 fathoms. The specimen was dead, and had been so for some time.

BALANOPHYLLIA CELLULOSA, Duncan. (Plate XLIX. figs. 11, 12.)

The corallum is subturbinate and curved. There is a very small scar of former attachment. The epitheca is well developed, and extends up to the calicular margin, and it gives the sharply granular character to the subequal costæ.

Costæ very distinct at the base and elsewhere.

The calice is circular in outline and not deep. The columella is cellular and small, and does not project.

The septa are few in number. The primary septa are large, thick, exsert, and consist of cellular tissue. The other septa are represented by trabeculæ, so that the cyclical arrangement cannot be discovered.

Height of corallum $\frac{1}{2}$ inch; breadth of calice $\frac{2}{10}$ inch.

Dredged up, somewhat injured, from 292 fathoms, No. 24. The specimen figured was probably alive when dredged up.

The epitheca, which is strongly developed in some species of the genus, affords but secondary characters for differentiation; consequently the genus must include *Thecopsammia* of Pourtales.

BALANOPHYLLIA SOCIALIS, Pourtales, sp. (Plate XLIII. figs. 14-19.)

Thecopsammia socialis, Pourtales.

This species has been described by Pourtales, under the generic name of *Theco-*

psammia, in the 'Contributions to the Fauna of the Gulf-stream at great Depths' (2nd series), p. 138.

The very stout and thick wall, and the complete epitheca, reaching up far towards the calicular margin in some and not so far in other corallites, are very distinctive. Moreover the bending and meeting of the smaller and larger septa is only visible low down and by a section. In some of the North-Atlantic specimens the epitheca is perfect, and only marked by circular ridges; in others there are traces of longitudinal costæ in the form of rows of granules. Some varieties present these costal markings very distinctly.

The origin of one corallum from another is evident in the American specimens; but it is probably an accidental circumstance.

The following is the diagnosis of the species:—

Corallum turbinate, rather long, conical, with a peduncle. Wall thick, very porous and vermiculated. Epitheca well developed and rising to various heights, marked with transverse ridges, and either perfectly plain or ornamented by longitudinal costa-like markings. Calice elliptical. Fossa deep. The septa are entire, smooth, crowded, not exsert, thick near the wall. There are five incomplete cycles of septa in six systems. The septa of the fourth cycle bend toward each other and meet in front of the tertiary septa in the deeper part of the calice. The fifth cycle is incomplete.

The columella is papillose and porous and situated deeply.

Common in 100 to 300 fathoms off the Florida reef.

Variety *britannica*. Has the epitheca close up to the calicular margin, and it is quite plain.

Variety *jeffreysia*. Has the costulate ornamentation.

The specimens of the species and the varieties were obtained during the first expedition of the 'Porcupine,' in from 345 fathoms to 363 fathoms, and in a temperature from 29°·9 F. to 31°·8 F.

Genus DENDROPHYLLIA, Blainville.

DENDROPHYLLIA CORNIGERA, Lamarck, sp.

A very old and worn specimen was dredged up from a depth of 207 fathoms (No. 54, 2nd expedition), off the Mediterranean coast of Africa.

The coral is a well-known Mediterranean form, and is also an inhabitant of the Gulf of Gascony.

It is found fossil in the Older Pliocene of Tremonte, in Sicily.

Family Fungiidæ, Dana.

FUNGIA SYMMETRICA, Pourtales. (Plate XLIX. figs. 16–19.)

A young specimen and some fragments of others were dredged up in 994 fathoms (No. 16 dredging, 2nd expedition). The description given by Count Pourtales in his

'Deep-sea Corals,' No. 4, Illustrated Catalogue, &c., 1871, of this coral, has enabled me to place it amongst the fauna of the eastern Atlantic.

Section RUGOSA.

Family **Cyathaxonidæ.**

Genus **GUYNIA**, Duncan.

The corallum is simple and long. The wall is thick and solid. The septa are well developed, lamellar, unequal, and are continuous from the base to the calice. There are four systems of septa; and one primary septum is longer and larger than the others. The columella is essential, and is attached to the larger septa.

There is no endotheca.

The costæ are visible on the growth-rings of the outside of the wall. There is an epitheca.

GUYNIA ANNULATA, spec. nov. (Plate XLVII. figs. 9-16.)

The corallum is long, cylindrical, and narrow. It is sometimes curved. The accretion-ridges are well developed and regular, and are marked with prominent short spinicles, laminae, or granules, which correspond with the costæ. The epitheca which ornaments the ridges is delicate. The costæ extend over the whole length of the corallum, and usually exist as flat bands between the close and rather wavy accretion-ridges. There are four principal septa, one of which is larger than the others, at the calice. The four secondary septa are often as large as the primary; but the eight tertiary septa are almost rudimentary. There are four systems of septa and three cycles in each. None are exsert. The columella is stout, cylindrical, deeply seated in the calice, and adheres to the larger septa. The interseptal loculi are large; and the transverse outline of the corallum is sometimes rather angular. The length of the perfect corallum probably $\frac{3}{4}$ inch, the breadth $\frac{1}{20}$ inch.

Locality: Adventure bank, in 92 fathoms. It is frequently found adherent by its side to shells and foreign bodies.

Longitudinal sections prove the absence of endotheca.

In three specimens there were evidences of an hexamerl septal arrangement. One had the octomerl at the base, but the hexamerl at the calicular end. A transverse section midway showed the eight large septa; so that there must have been an arrest of development during growth, and the specimen illustrates the formation of the neozoic type from the rugose. A second specimen, when scraped down, showed the union of a septum with another; and as this occurred in two instances, seen in one and inferred in another, the arrest of development was accounted for.

The interesting affinity of this form with the rugose coral *Haplophyllia paradoxa*,
VOL. VIII.—PART V. *March*, 1873.

Pourtales, dredged up in 324 fathoms off the Florida reef, is well worthy of study, and has formed part of a late memoir by me to the Royal Society¹.

The following species is remarkable, but I cannot place it in any satisfactory position:—

Genus incertæ sedis.

— ——. (Plate XLVII. figs. 1–8.)

The corallum is simple and flat; the calice is very open, shallow, and irregular, and unsymmetrical in shape, and its margin is broad.

The costæ are large, and irregular in their course and arrangement; they are in some places straight and subequal, in others curved and unequal; but all are finely granular and rounded.

There is no epitheca, no dissepimental tissue; but there are synapticulæ.

The septa are irregular, rather exsert, in places are thin, alternately large and small, and granular; they pass towards different parts of the centre of the calice. The columella is rudimentary in one portion of the calicular axis, and exists along what appears to be an old line of fracture, which forms a ridge at the base also. There are no pali.

The specimens appear to have been injured during life and repaired. A smaller specimen, which appears to have been fractured, has grown at the fractured end and developed small septa.

It is impossible to place these specimens satisfactorily in any genus: they may belong to *Diaseris*; but the resemblance of their bases to those of *Hemicyathus crassicosatus*, Seguenza, Older Pliocene, is most remarkable. The absence of pali, however, prevents the inclusion of the forms in that genus.

Genus *PLIOBOTHIRUS*, Pourtales.

PLIOBOTHIRUS SYMMETRICUS, Pourtales. (Plate XLIX. fig. 7.)

A specimen of this form was dredged up in the cold area of the North Atlantic, in 500 to 600 fathoms.

I doubt much whether it is one of the Tabulata; but I introduce it here, and refer to Count Pourtales's description in his 'Deep-Sea Corals,' No. 4 (Illustr. Cat. Museum Harvard Coll. 1871, p. 57)—a most remarkable and interesting work, which, unfortunately for me, came to hand many months after the completion of this essay.

¹ Phil. Trans. Royal Society, 1872.

Distribution of the Species in the Recent and Past Faunas.

| Name. | Recent. | Old Pliocene. | Miocene. | Cretaceous. |
|--|--|---------------|----------|------------------|
| <i>Caryophyllia clavus</i> | Mediterranean, North Atlantic, and West Indies. | + | — | — |
| — <i>cyathus</i> | Mediterranean and Straits | — | — | — |
| — <i>seguenzæ</i> | North Atlantic | + | — | — |
| — <i>arcuata</i> | Coast of Spain, 304 fms. | + | — | — |
| — <i>cylindracea</i> | Coast of Spain, 740 fms. | — | — | + |
| — <i>abyssorum</i> | Coast of Spain, 1095 fms. | — | — | a |
| — <i>inskipi</i> | Bay of Biscay, 539 fms. | — | — | a |
| — <i>calveri</i> | Coast of Spain | — | — | — |
| — <i>vermiformis</i> | Coast of Spain | — | — | — |
| — <i>pourtalesi</i> | Coast of Spain | — | — | — |
| <i>Bathycyathus atlanticus</i> | Coast of Spain, 1095 fms. | — | — | a |
| <i>Paracyathus agassizi</i> | Coast of Spain | — | — | — |
| — <i>striatus</i> | Mediterranean coast of Africa | — | — | — |
| <i>Sphenotrochus intermedius</i> | Tangier Bay | + | — | — |
| <i>Sabinotrochus apertus</i> | Coast of Spain | — | — | — |
| <i>Desmophyllum crista-galli</i> | Coast of Spain | + | — | — |
| <i>Flabellum distinctum</i> | Coast of Spain, Japanese seas | — | + | — |
| — <i>laciniatum</i> | North Atlantic | + | — | — |
| <i>Rhizotrochus affinis</i> | Algerian coast | — | — | — |
| <i>Amphihelia oculata</i> | Mediterranean and North Atlantic | — | — | — |
| — <i>ramea</i> , and varieties | Mediterranean, North Atlantic, and Florida. | + | — | a |
| <i>Lophohelia prolifera</i> , and varieties .. | Mediterranean, North Atlantic, Florida, and Indian seas. | + | — | — |
| <i>Stylaster gemmascens</i> | North Atlantic | — | — | — |
| <i>Balanophyllia gaditana</i> | Coast of Spain | — | — | — |
| — <i>cellulosa</i> | Coast of Spain | — | — | — |
| — <i>socialis</i> | North Atlantic and Florida | — | — | — |
| <i>Solenosmilia variabilis</i> | Coast of Spain, 1095 fms. | — | — | — |
| <i>Dendrophyllia cornigera</i> | Mediterranean coast of Africa | + | — | — |
| <i>Fungia symmetrica</i> | Cuba and coast of Spain | — | — | — |
| <i>Guynia annulata</i> | Adventure Bank | — | — | — |
| | Recent, no. 30. | 9 | 1 | 1, and 4 allied. |

Résumé.

1. That the deep-sea corals differ from the reef-building forms in not possessing certain important cœnenchymal structures.
2. That deep-sea corals have been dredged up from a depth of 1094 fathoms.
3. That deep-sea corals live in very different temperatures, from 29°·9 to 56°·3 Fahrenheit.
4. That the growth of deep-sea corals is very vigorous at great depths and in low temperatures.
5. That the variability of deep-sea species is very great.
6. That genera and species exist at great depths which are unknown elsewhere.
7. That the horizontal distribution of many deep-sea forms is great.
8. That the present deep-sea coral faunas contain species and varieties of species of

the Pliocene, Miocene, and Cretaceous deep-sea faunas, and offshoots of the Palæozoic fauna.

9. That, omitting varieties, and counting species only, there are thirty species in the 'Porcupine' dredgings, and of these eleven are known as fossil forms also. Moreover four others are closely allied to fossil forms.

IV. TABLES OF LOCALITIES, &c.

First Expedition of the 'Porcupine.'

| Station. | Latitude north. | Longitude west. | Depth. fathoms. | Temperature of bottom. |
|----------|-----------------|-----------------|-----------------|------------------------|
| 2 | 51° 57' | 10° 23' | 30-40 | 52.0 |
| 3 | 51 51 | 11 50 | 370 | .... |
| 5 | 52 4 | 12 8 | 364 | 48.8 |
| 6 | 00 00 | 00 00 | 000 | 00.0 |
| 13 | 53 42 | 13 55 | 208 | 49.6 |
| 14 | 53 49 | 13 15 | 173 | 49.6 |
| 15 | 54 5 | 12 7 | 422 | 47.0 |
| 25 | 56 41 | 13 39 | 164 | 46.5 |
| 54 | 59 56 | 6 27 | 363 | 31.5 |
| 65 | 61 10 | 2 21 | 345 | 29.9 |
| 88 | 59 26 | 8 23 | 705 | 42.65 |

SPECIES DREDGED UP.

No. 2. *Caryophyllia clavus*, variety borealis.

3. *Flabellum laciniatum*.

5. *Lophohelia prolifera* and varieties.

6. *Caryophyllia clavus*, var. *epithecata*.

13. *Lophohelia prolifera*, and varieties.

14. *Lophohelia prolifera*, and varieties.

15. *Lophohelia prolifera*, and varieties.

25. *Flabellum laciniatum*, *Lophohelia prolifera*, and varieties.

54. *Lophohelia prolifera* and varieties, *Amphihelia oculata* and varieties, *Amphihelia ramea* and varieties, *Balanophyllia socialis* and varieties, *Stylaster gemmascens*.

65. *Balanophyllia socialis*, variety.

88. *Caryophyllia clavus*, and varieties.

Caryophyllia seguenzæ.

Pliobothrus symmetricus, Pourtales, I do not consider to be a Madreporarian.

Second Expedition.

| | | | | |
|------|-------|------|------|---------|
| 6 | 48 26 | 9 44 | 358 | 50.3 F. |
| 9 | 48 6 | 9 18 | 539 | 48.0 |
| 16 | 39 85 | 9 56 | 994 | 40.3 |
| 17 | 39 42 | 9 43 | 1095 | 39.7 |
| 17 a | 39 39 | 9 39 | 740 | 49.3 |

| Station. | Latitude north. | Longitude west. | Depth. fathoms. | Temperature of bottom. |
|----------|-----------------|-----------------|-----------------|------------------------|
| 19 | 39° 27' | 9° 39' | 248 | 51.7 |
| 24 | 37 19 | 9 13 | 292 | 52.7 |
| 26 | 36 44 | 8 8 | 364 | 52.7 |
| 27 | 36 37 | 7 33 | 322 | 51.3 |
| 28 | 36 29 | 7 16 | 304 | 53.3 |
| 29 | 36 20 | 6 47 | 227 | 55.0 |
| 32 | 35 41 | 7 8 | 651 | 50.0 |
| 33 | 35 33 | 6 54 | 554 | 49.7 |
| 36 | 35 35 | 6 26 | 128 | 55.0 |
| 45 M. | 35 36 | 2 29 | 207 | 54.7 |
| 50 a M. | Algerine coast | | 150 | 54.7 |

SPECIES.

No. 6. *Amphihelia oculata*, *Amphihelia ramea*, *Desmophyllum crista-galli*.

9. *Caryophyllia cylindracea*, var. *a*, *Caryophyllia inskipi*.

16. *Desmophyllum crista-galli*, *Flabellum distinctum*, *Caryophyllia pourtalesi*, *Sabinotrochus apertus*, *Fungia symmetrica*.

17. *Desmophyllum crista-galli*, *Caryophyllia abyssorum*, *Solenosmilia variabilis*, *Bathycyathus atlanticus*.

17 a. *Bathycyathus atlanticus*, *Caryophyllia vermiformis*, *Caryophyllia cylindracea*, var.

19. *Paracyathus agassizi*, *Caryophyllia arcuata*, var.

24. *Caryophyllia pourtalesi*, *Caryophyllia arcuata*, var., *Amphihelia oculata*, *Lophohelia prolifera*, var. *gracilis*, *Balanophyllia cellulosa*, *Caryophyllia calveri*.

26. *Amphihelia oculata*, *Caryophyllia clavus*, *Flabellum distinctum*.

27. *Amphihelia oculata*.

28. *Caryophyllia clavus*, *Caryophyllia arcuata*, var., *Lophohelia prolifera*, var. *gracilis*, Gen. incert. sedis. *Flabellum distinctum*.

29. *Balanophyllia gaditana*, *Caryophyllia pourtalesi*, *Caryophyllia clavus*, var. γ , and *Caryophyllia clavus* (type).

32. *Caryophyllia cyathus*, var., *Lophohelia prolifera*, var. *gracilis*, *Amphihelia oculata*, *Solenosmilia variabilis*.

33. *Lophohelia prolifera*, var. *gracilis*.

36. *Lophohelia prolifera*, var. *gracilis*, *Amphihelia ramea*, *Caryophyllia clavus*.

45. *Dendrophyllia cornigera*.

50 a. *Rhizotrochus affinis*.

| | | | | |
|----------------------------------|---------------------|----------|--------|------|
| 57 M. ¹ | 36 6 | 13 10 E. | 224 | ? |
| 67 M. | Strait of Gibraltar | | 188 | 55.3 |
| Adventure Bank | | | 92 M. | |
| Coast of Tunis | | | 40-100 | |
| Mediterranean coast of Africa | | | M. | |
| Cape Sagras and Tangier Bay | | | 35 | |
| Seven miles from Rinaldo's Chair | | | 60-160 | |
| Cartagena Bay | | | M. | |
| Malta Telegraph Cable | | | M. | |

¹ M. Mediterranean dredgings.

- Fig. 13. Corallum, nat. size, of *Caryophyllia vermiformis*.
 Fig. 14. Corallum, magnified, ,,
 Fig. 15. Costæ, magnified, ,,
 Fig. 16. Calice, magnified, ,,

PLATE XLI.

- Fig. 1. Corallum, nat. size, of *Sphenotrochus intermedius*.
 Fig. 2. Corallum, magnified, ,,
 Fig. 3. Corallum, magnified, variety ,,
 Fig. 4. Corallum, nat. size, variety ,,
 Fig. 5. Calice, magnified, ,,
 Fig. 6. Upper view of corallum of *Sabinotrochus apertus*.
 Fig. 7. Side view of corallum ,,
 Fig. 8. Calice, magnified, ,,
 Fig. 9. Base, magnified, ,,
 Fig. 10.)
 Fig. 11.)
 Fig. 12.) Views of *Desmophyllum crista-galli*.
 Fig. 13.)
 Fig. 14.)
 Fig. 15.)
 Fig. 16. Section of the peduncle of a small specimen, magnified.

PLATE XLII.

- Fig. 1. *Lophohelia prolifera*, var. *gracilis*.
 Fig. 2. Calices, magnified.
 Fig. 3. Costæ, magnified, of *Caryophyllia pourtalesi*.
 Fig. 4. Corallum (young), nat. size, ,,
 Fig. 5. Same, magnified, ,,
 Fig. 6. Calice, magnified, ,,
 Fig. 7. Very young calice, magnified, ,,
 Fig. 8. Corallum, nat. size, ,,
 Fig. 9. Costæ, magnified, ,,
 Fig. 10. Calice, magnified, ,,
 Fig. 11. Portion of corallum of *Solenosmilia variabilis*.
 Fig. 12. Calice, magnified, ,,
 Fig. 13. Costal ends, magnified, ,,
 Fig. 14. Calice, magnified, ,,
 Fig. 15. Corallum ,,
 Fig. 16. Costæ, magnified, ,,

Fig. 17. Calice, magnified, of *Solenosmilia variabilis*.

Fig. 18. Corallum (old) „

PLATE XLIII.

- Fig. 1. Corallum of *Caryophyllia arcuata*, variety.
 Fig. 2. Calice, magnified.
 Fig. 3. Costæ, magnified.
 Fig. 4. Ornamentation of the septa, magnified.
 Fig. 5. Corallum of *Paracyathus agassizi*.
 Fig. 6. Its calice, magnified.
 Fig. 7. The costæ, magnified.
 Fig. 8. Septum and pali, magnified.
 Fig. 9. Corallum of *Paracyathus striatus*.
 Fig. 10. Its calice, magnified.
 Fig. 11. The calicular termination, showing the tall pali.
 Fig. 12. A septum, magnified.
 Fig. 13. A corallum growing from the calice of a parent.
 Fig. 14. }
 Fig. 19. } Corallites of *Balanophyllia socialis*.
 Fig. 15. Calicular view.
 Fig. 16. Calicular view, magnified.
 Fig. 17. View of fractured peduncle.
 Fig. 18. The costæ and epitheca, magnified.

PLATE XLIV.

- Fig. 1. Corallum of variety of *Amphihelia ramea*.
 Fig. 3. Another specimen, slightly magnified.
 Fig. 2. A calice, magnified.
 Fig. 4. Corallum of *Caryophyllia sequenzae*.
 Fig. 5. Its costæ, magnified.
 Fig. 6. The calice, magnified.
 Figs. 7 & 8. Side views of unusual shapes of buds of *Lophohelia prolifera*.
 Fig. 9. Magnified stem, showing the increase of wall-thickness outside the visceral cavity.
 Fig. 10. Section of a corallite, showing tabulæ.
 Fig. 11. Magnified view of a calice.

PLATE XLV.

- Fig. 1. Corallum of *Amphihelia oculata*.
 Fig. 2. Calicular ends, magnified.

- Fig. 3. Calice, magnified.
 Fig. 4. *Amphihelia ramea*.
 Fig. 5. Ornamentation of the corallites, magnified.
 Fig. 6. Calice magnified.

PLATE XLVI.

- Fig. 1.)
 Fig. 3.)
 Fig. 6.)
 Fig. 8. } Corallites of varieties of *Amphihelia ramea*.
 Fig. 11. }
 Fig. 14. }
 Fig. 17. }

The other figures represent magnified views of branches, of ornamentation and calices.

PLATE XLVII.

- Figs. 1 & 5. View of corallum of a species the genus of which is doubtful.
 Fig. 2. Side view, magnified.
 Fig. 3. Calicular surface, magnified.
 Fig. 4. Base, magnified.
 Figs. 6 & 7. Base and calice of another specimen, magnified.
 Fig. 8. Costæ, magnified.
 Fig. 9.)
 Fig. 11. } Corallites of *Guyonia annulata*. Figs. 11 & 13. On shells.
 Fig. 13.)
 Fig. 10. } Side view, magnified.
 Fig. 12. }
 Fig. 14. Corallum adherent by its side, magnified.
 Fig. 15. } Calice, magnified.
 Fig. 16. }
 Fig. 17. Group of *Rhizotrochus affinis*.
 Fig. 18. Corallum, slightly magnified.
 Fig. 19. Calice, magnified.

PLATE XLVIII.

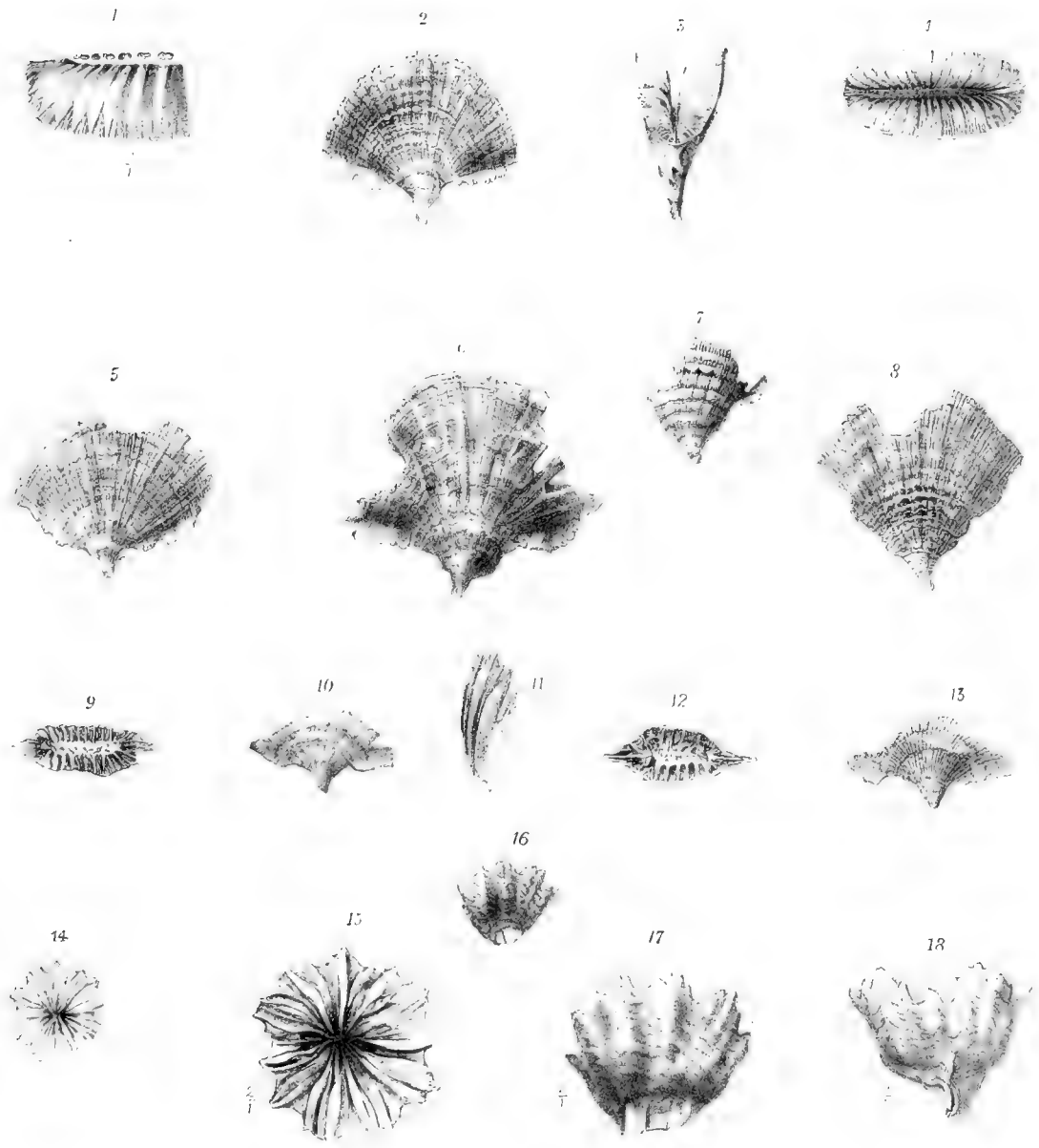
- Fig. 1. Corallum of *Bathycyathus atlanticus*.
 Fig. 2. Calice, magnified.
 Fig. 3. Corallum of *Caryophyllia cyathus*, variety α .
 Fig. 4. Calice, magnified.
 Fig. 5. Corallum of *Caryophyllia clavus*, var. *exserta*.
 Fig. 6. " " var. *borealis*.

- Fig. 7. Corallum of *Caryophyllia clavus*, var. *elongata*.
 Fig. 8. Calice magnified.
 Fig. 9. Corallum of *Caryophyllia clavus*.
 Fig. 10. Calice, magnified.
 Fig. 11. Corallum of *Caryophyllia clavus*, var. *smithii*.
 Fig. 12. Calice (worn), magnified.
 Fig. 13. }
 Fig. 14. } Corallum of *Caryophyllia clavus*, var. *epithecata*.
 Fig. 15. Corallum of an aberrant specimen of var. *epithecata*.
 Fig. 16. Calice, showing a circular outline.

PLATE XLIX.

- Figs. 1-6. Corallites and details of *Stylaster gemmascens*.
 Figs. 8-10. " " "
 Figs. 13-15. " " "
 Fig. 7. *Pliobothrus symmetricus*.
 Fig. 11. *Balanophyllia cellulosa*, corallum of.
 Fig. 12. Corallum, greatly magnified.
 Fig. 16. }
 Fig. 17. } Corallum of *Fungia symmetrica*.
 Fig. 18. The calice magnified.
 Fig. 19. Costæ with synapticulæ, magnified.

Antipatharia



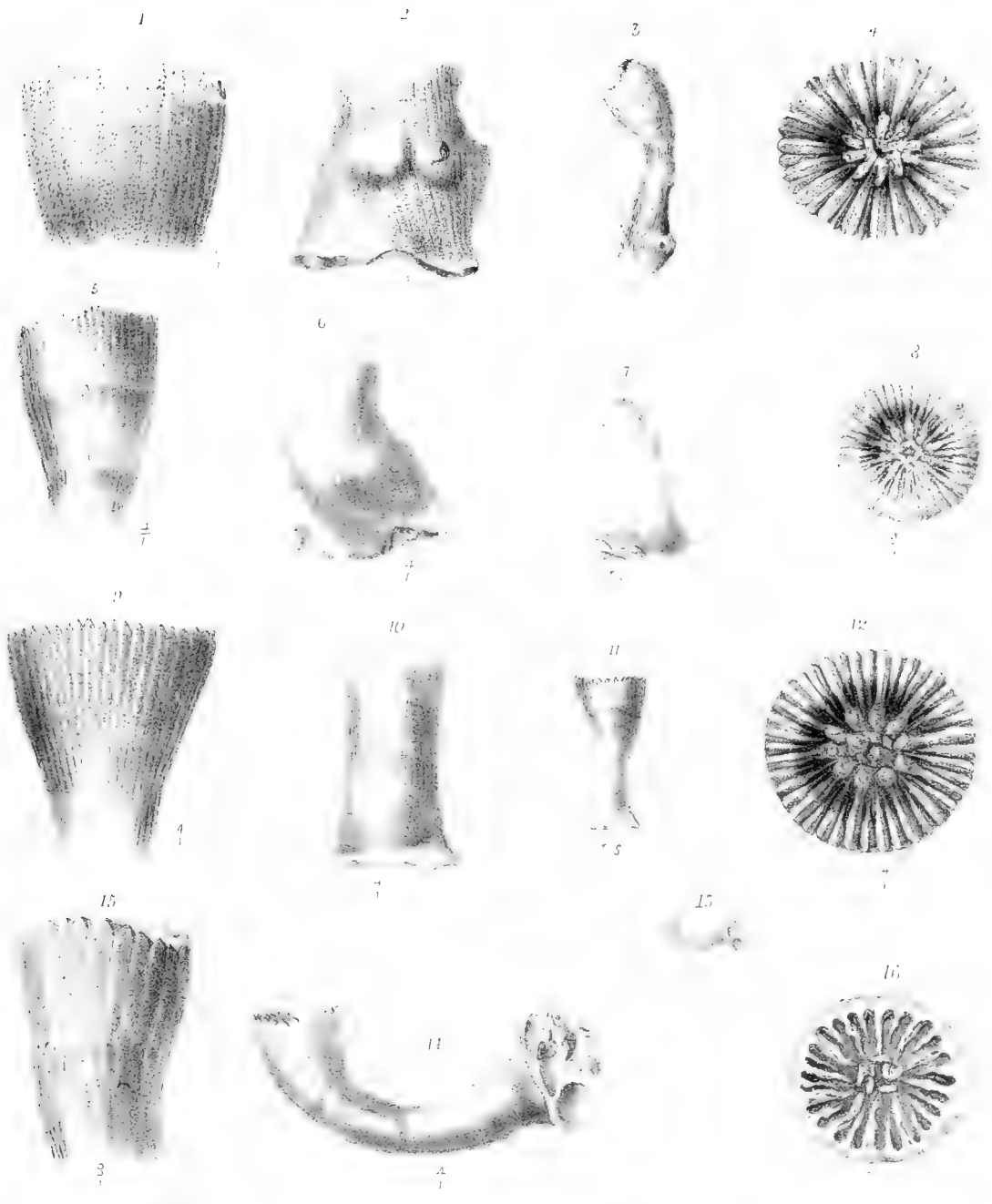
From nat. on Stone by J. Erzleber

X 1/2 Hannart imp.

DEEP SEA CORALS



Favosites *...*

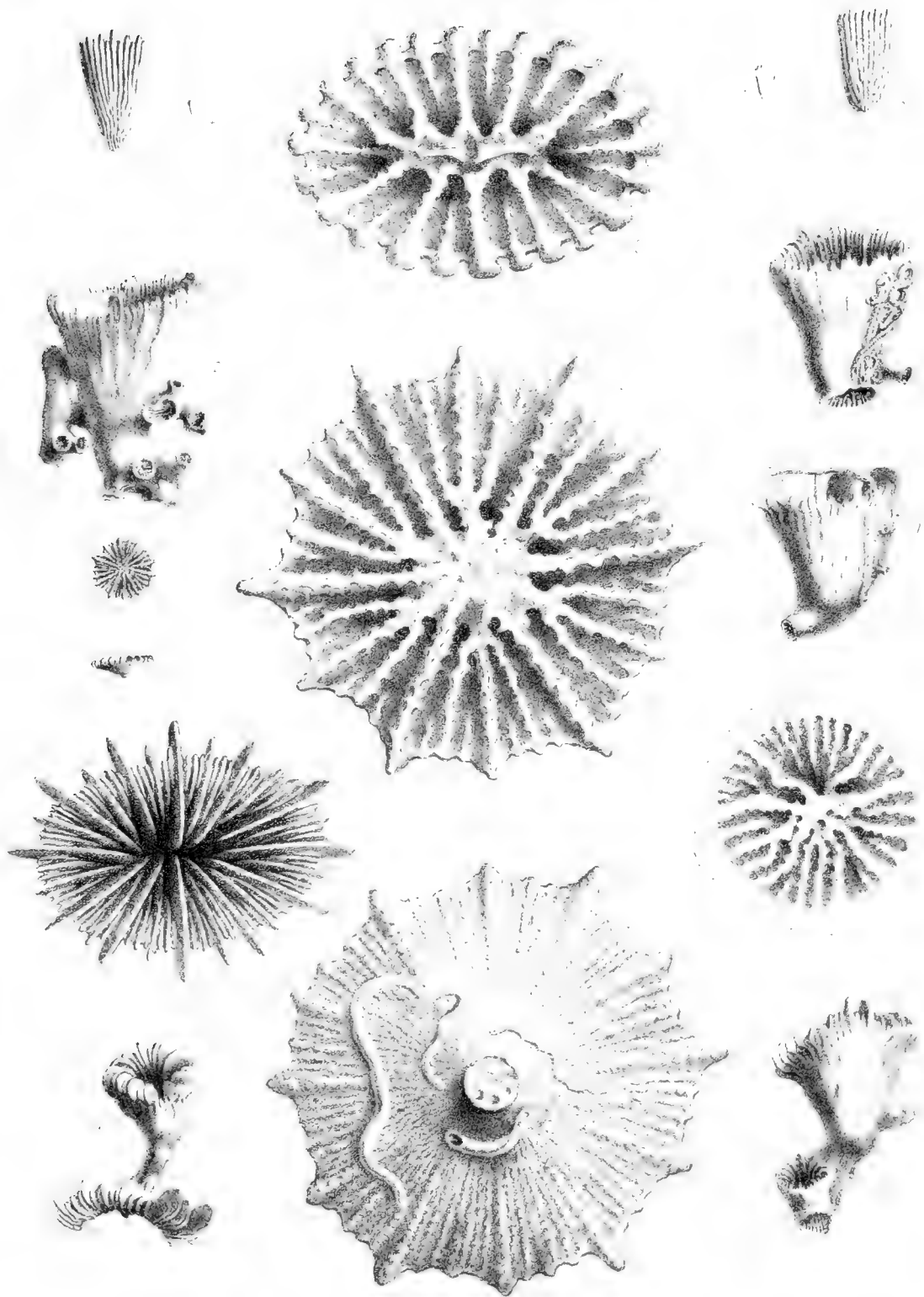


From an original by J. Euzleben

M & N Harhart imp

DEEP SEA CORALS



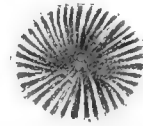
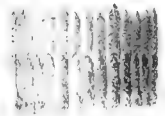
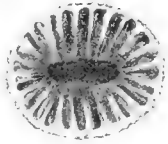


DeWilde 1914

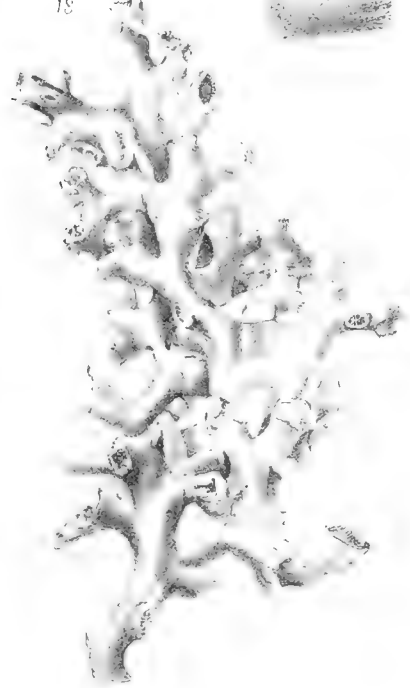
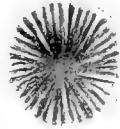
M&N Herbst 18

DEEP SEA





18

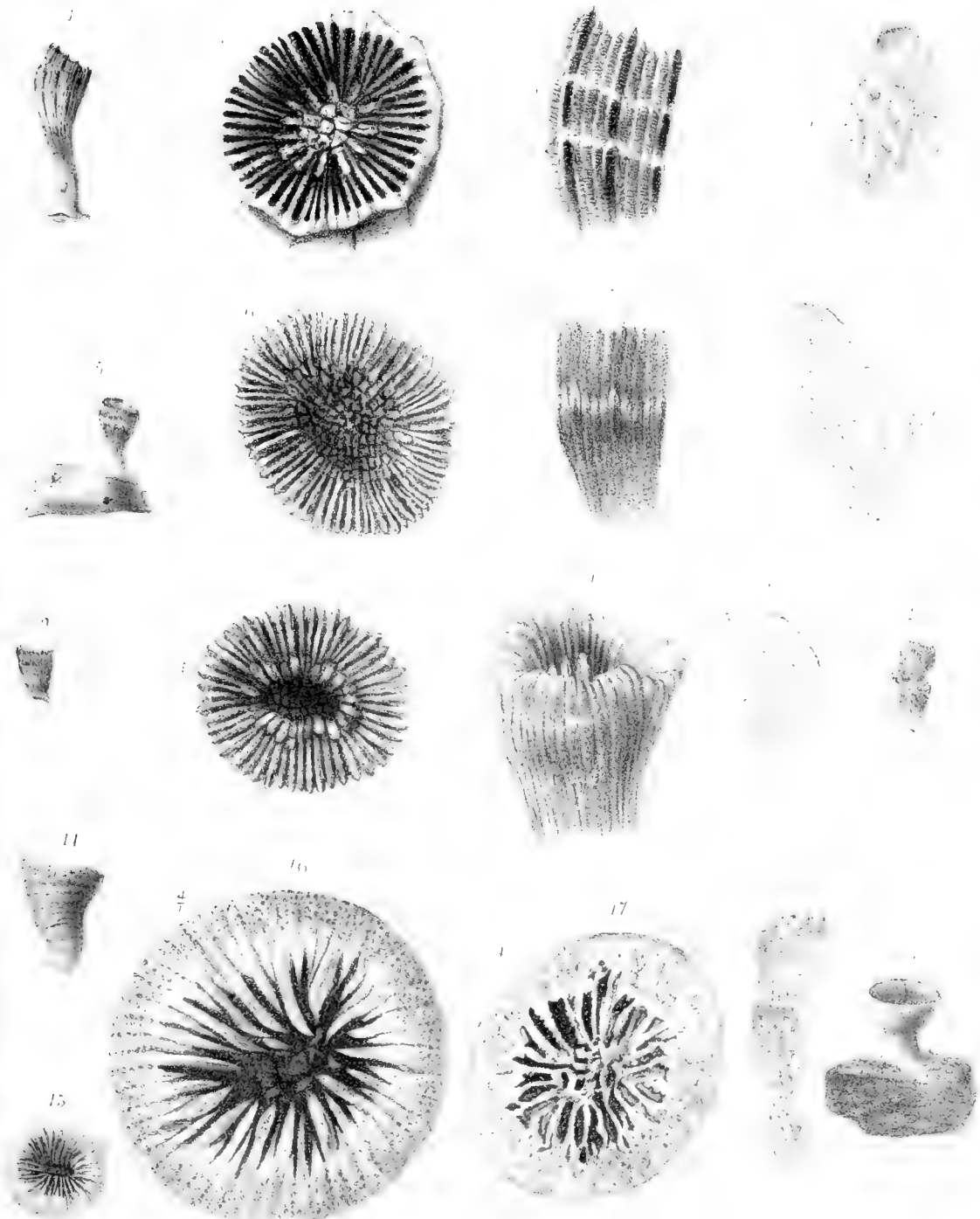


From natural Stone by J. Ford

M. & N. Pinhart sculp



Section of a coral

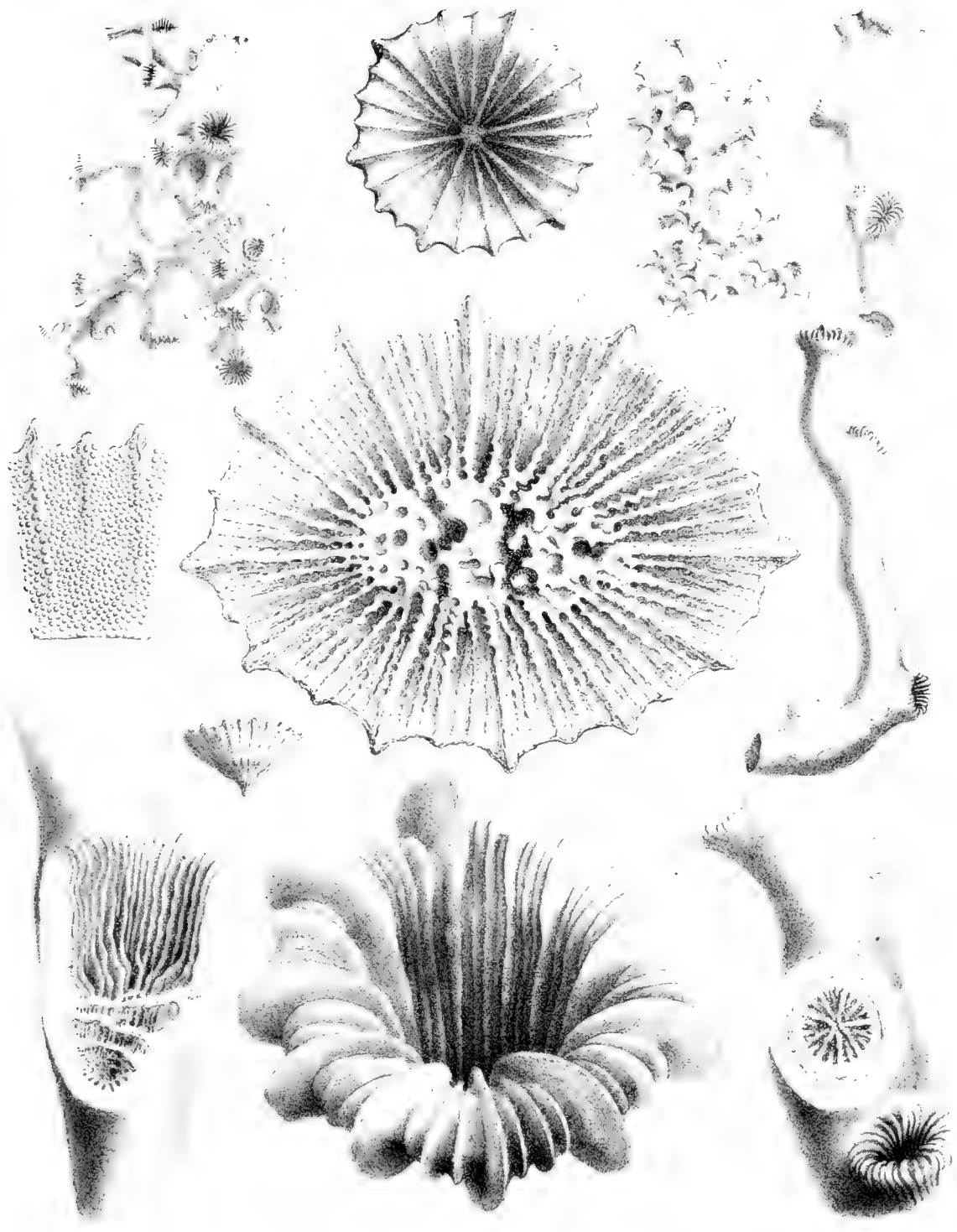


From nat on Stone by J. E. S. P. 1848

M. & J. H. 1848

DEEP SEA CORALS



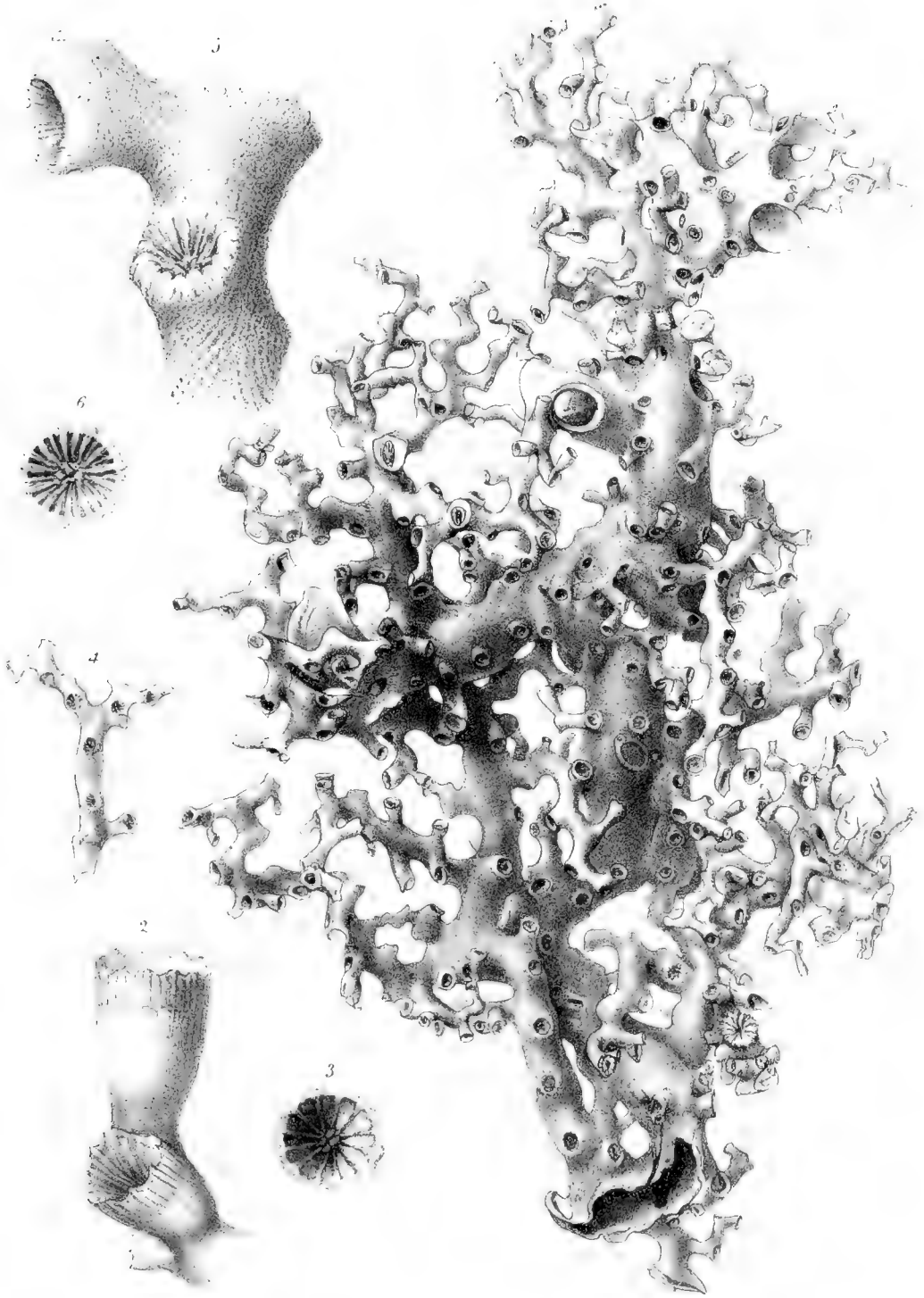


De Wilde lith

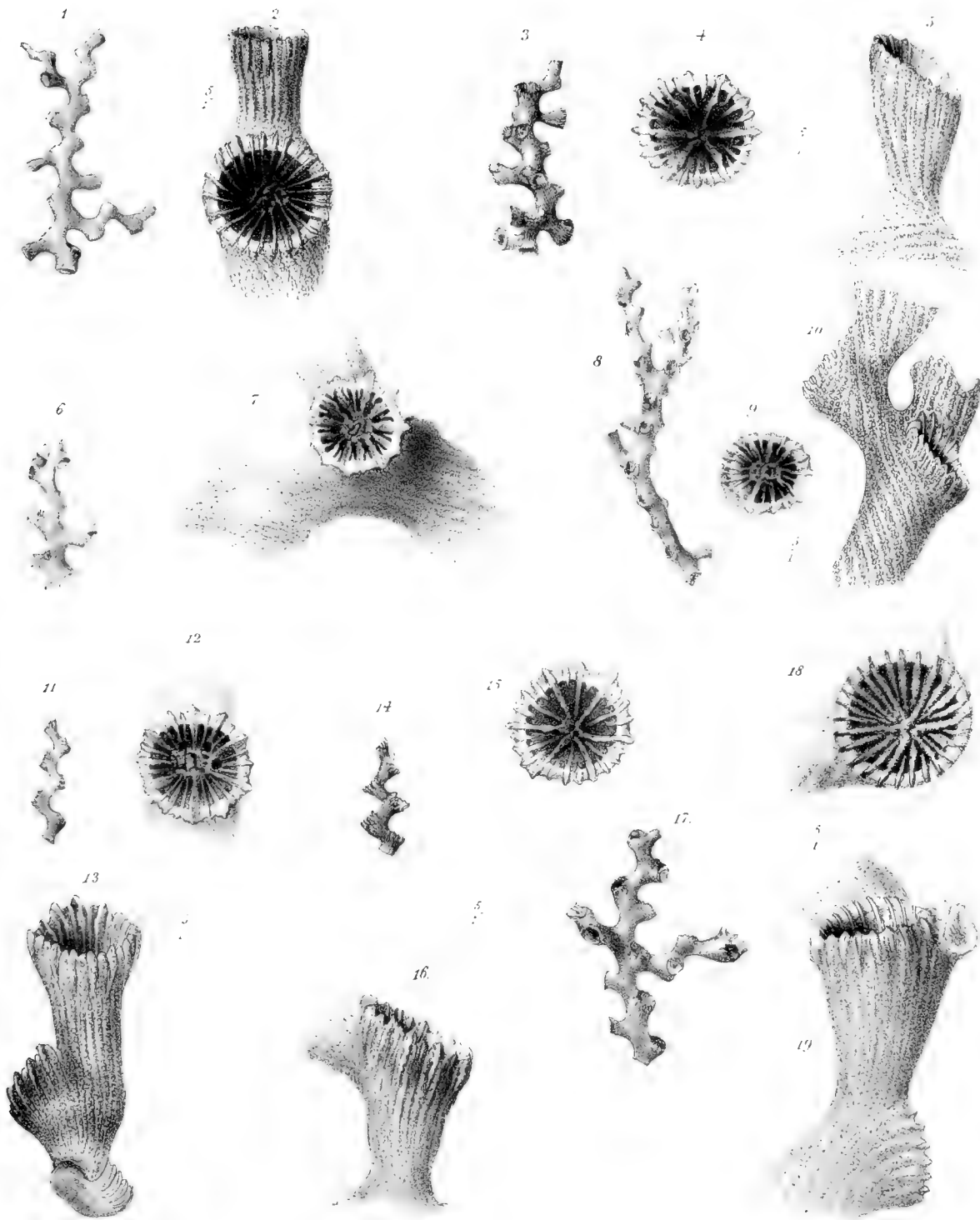
McNEES, art. imp.

DEEP SEA CORALS







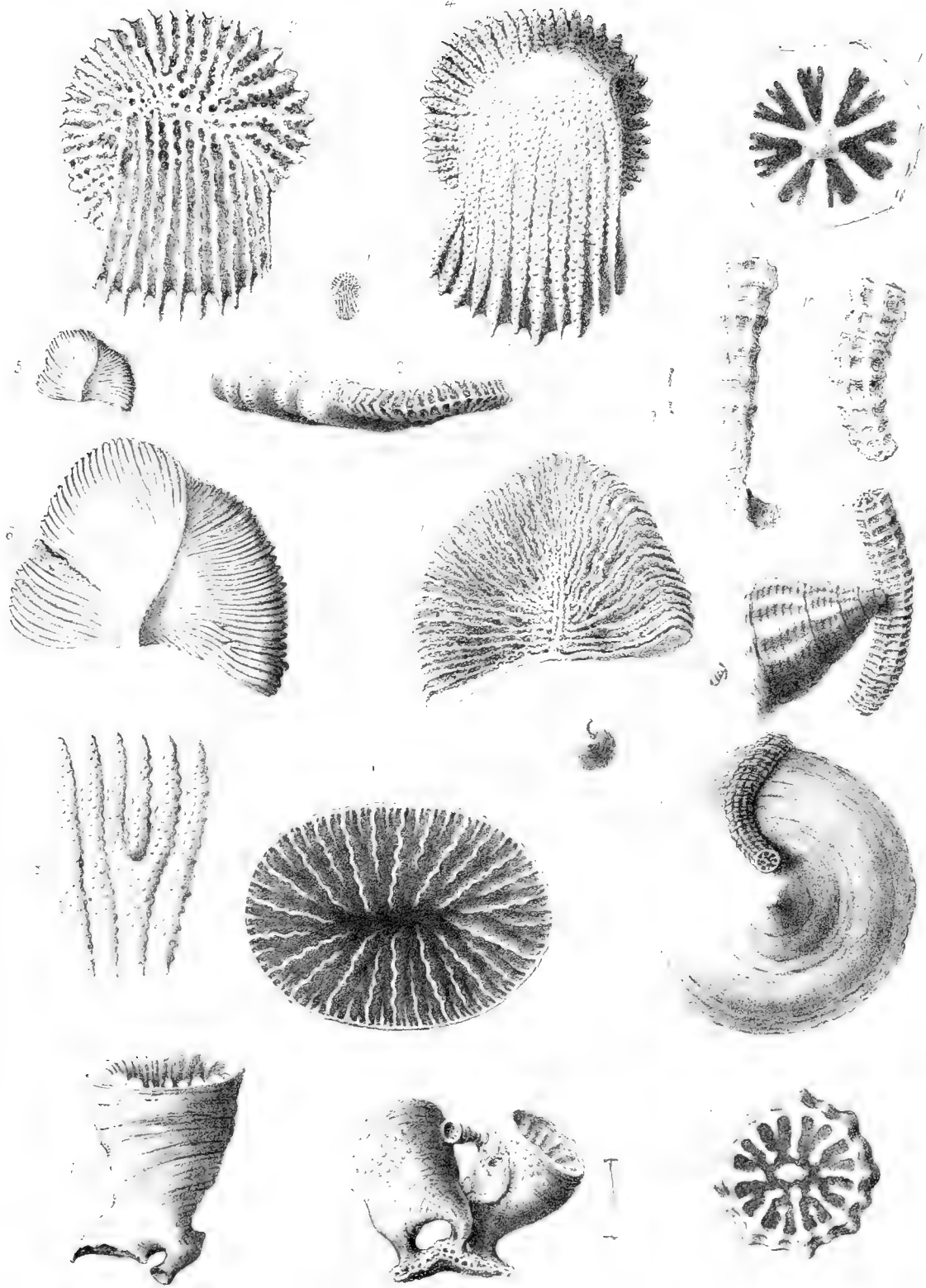


From nat. on Stone by J. Erxleben

M & N. Haubert. sculp.

DEEP SEA CORALS.



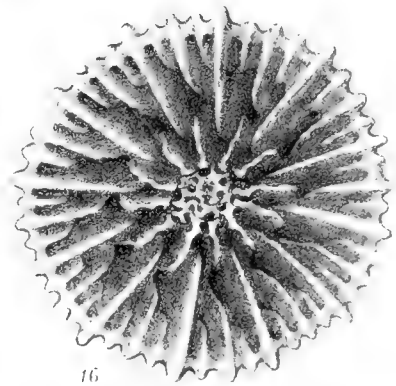
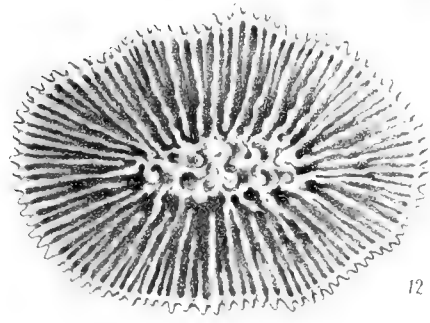
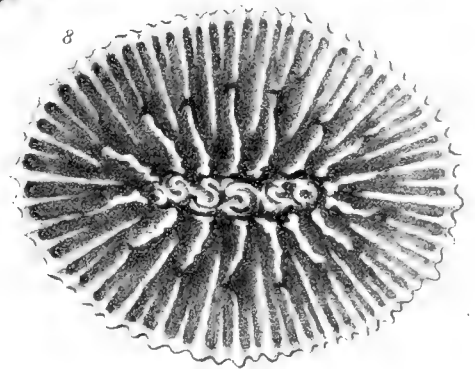
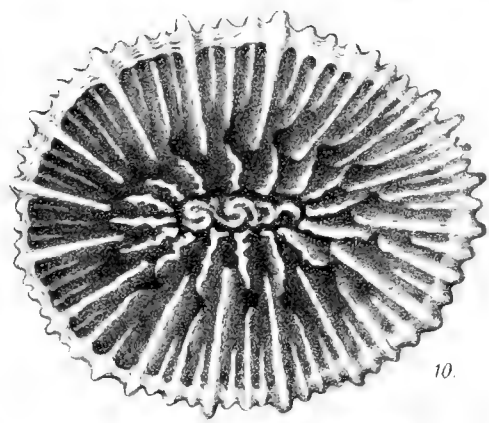
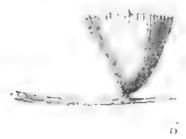
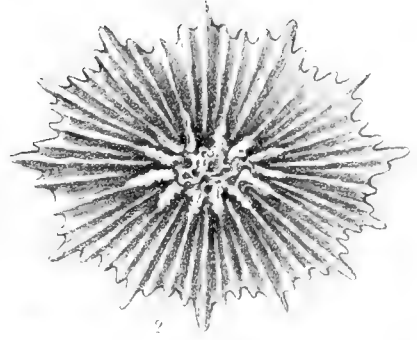
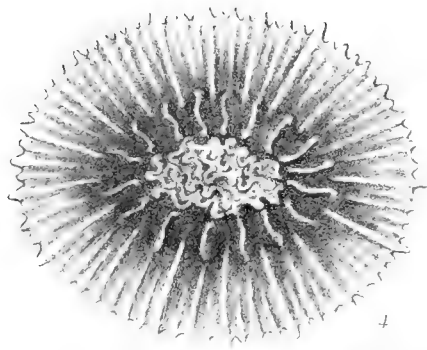


L. W. Se. 24

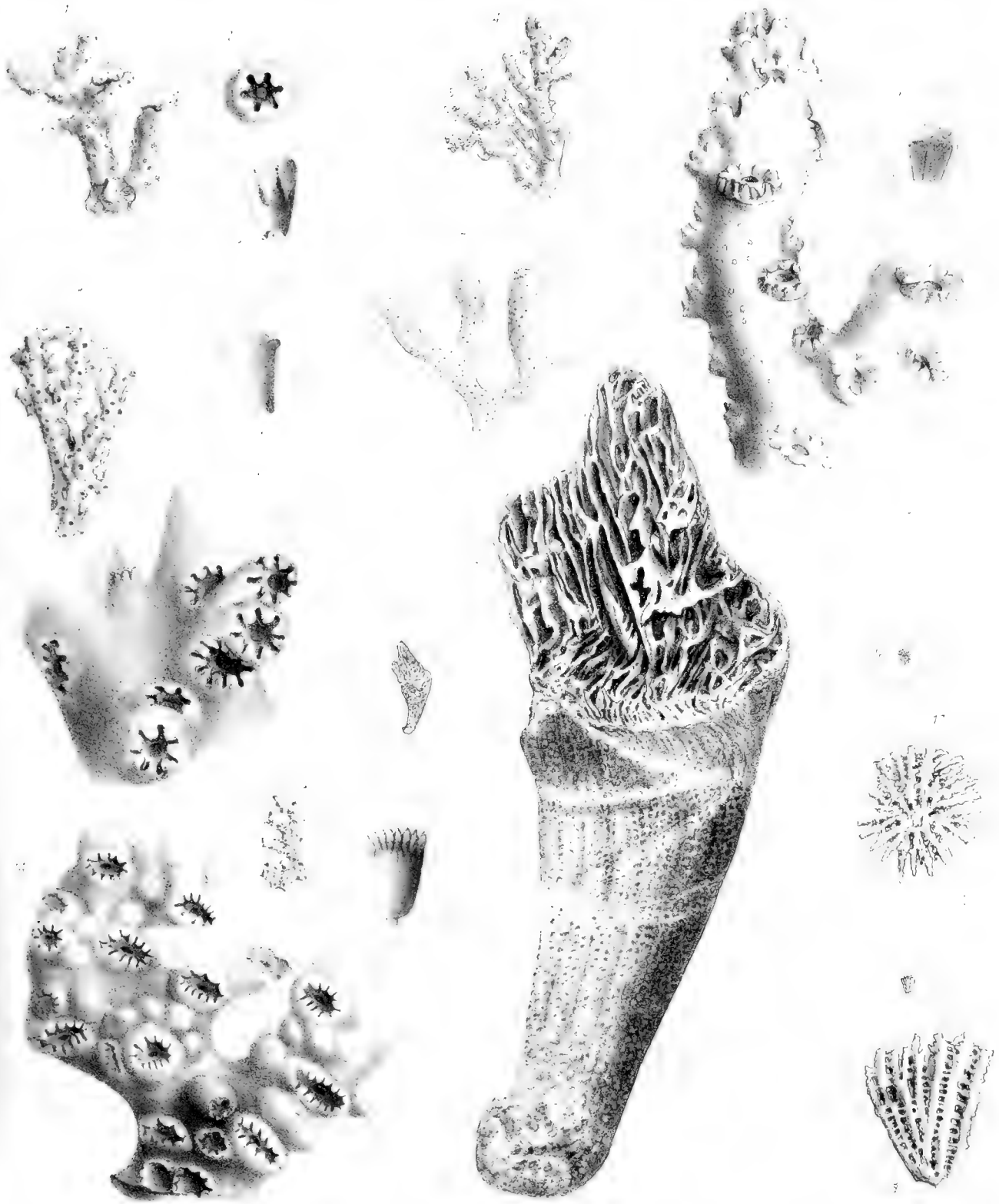
DEEP SEA CORALS

M & N. Hanhart. imp.











IX. *On the Osteology of the Marsupialia. (Part III.) Modifications of the Skeleton in the Species of Phascolomys.* By Professor OWEN, F.R.S., F.Z.S., &c.

Read 21st November, 1871.

[PLATES L. to LVII.]

§ 1. *Introduction.*

MY first Paper on this subject was devoted to the osteological characteristics of the Marsupialia generally¹; the second to the specific characters afforded by the skeleton, as illustrated by certain cranial ones in the genus *Phascolomys*². But subsequent acquisitions of fossil remains of Australian marsupials have impressed me with the inadequacy of the facts and figures communicated in these papers to the requirements of the palæontologist.

Fellow-labourers in the field of recent osteology, such as my esteemed colleague Dr. Gray, F.R.S., Prof. McCoy of the Melbourne University, and more especially Dr. James Murie, F.Z.S., F.L.S., have contributed valuable observations on the osteology of the Wombats, whereby three existing species, *Phascolomys vombatus*, Geof.³, *P. platyrhinus*, Ow.⁴, and *P. latifrons*, Ow.⁵, seem to be well established by cranial and dental characters.

But the illustrations of these—the more requisite through the difficulty of acquisition of skeletons of the rarer marsupial quadrupeds of Australia and Tasmania, especially by foreign museums—are very much below the needs of this limited field of scientific research.

Dr. Murie repeats, by original drawings from later acquired specimens, the upper views of the cranium of the Tasmanian and latifront Wombats, given in my second Memoir, with the addition of a similar view of the cranium of the platyrhine species.⁶ But these three figures are reduced to half the natural size; and experience of much perplexity and loss of time in the attempt to apply such reduced views to the determination of fragmentary fossils has led me more than once to denounce that seeming economy, where the size of originals is not such as to preclude representation in full.

I am therefore led to believe, and, indeed, encouraged by the uniform liberal reception by this Society of my contributions to the science for the promotion of which the Society was founded, that the illustrations accompanying the present Paper or 'Part,' may be permitted to appear in the 'Transactions.' That they will be acceptable to

¹ Trans. Zool. Soc. vol. ii. 4to (1841), p. 379.

² Ibid. vol. iii. (1845), p. 303.

³ Syn. *Didelphys ursina*, Shaw. ⁴ Syn. *Phascolomys angusii*, Gray; *Ph. niger*, Gould; *Ph. setosus* (?), Gray.

⁵ Syn. *Phascolomys lasiorhinus*, Gould; *Lasiorhinus M'Coysi*, Gray.

⁶ Proceedings of the Zoological Society, 1865, p. 844. (See this excellent paper for other synonyms.)

zoologists generally is the more probable since the grand 'Ostéographie' of De Blainville was interrupted by the regretted demise of the indefatigable author before it had reached his subclass DIDELPHYS¹.

§ 2. Cranial Characters of *Phascolomys*.

The characters of the skull of *Phascolomys platyrhinus*, briefly defined in the 'Descriptive Catalogue of the Osteological Series in the Museum of the Royal College of Surgeons'², have subsequently been determined by Prof. M'Coy³ and Dr. Murie⁴ to be those of the continental or Victorian bare-nosed, large, brown or black Wombat.

A skull of this species, figured of the natural size in Plate LI. fig. 1, gives a length, from the hindmost ridge of the occiput to the front border of the incisor-alveoli, of 8 inches. Another skull in the British-Museum collection exceeds this only by one line; a third is in the same slight degree smaller. The specimen submitted to me by Dr. McBain of Edinburgh, in 1855, yielded a length of 8 inches; two other specimens have the length of 7 inches 8 lines (Pl. L. fig. 1), and 7 inches 6 lines (Pl. LII. fig. 1). Dr. Murie gives minor dimensions of some, probably female, specimens⁵.

The occiput (Plate L. fig. 1, 2, 3, & fig. 2) rises vertically from the foramen magnum at the median line, but curves a little backward laterally, where it forms the sides of the broad superoccipital (ib. fig. 2, 3). The lower and lateral parts of the occiput are formed by the exoccipitals (ib. fig. 2, 2), the mastoids (8), and squamosals (27). The occiput is higher in proportion to its basal breadth than in *Phascolomys vombatus* (ib. fig. 3); it is more quadrate in form; it does not curve upward and inward so regularly from the mastoid processes (8) to the summit, as in *Phascolomys latifrons* (ib. fig. 4).

The composition of the occipital region agrees with that illustrated in Pl. lxxi. fig. 6 (Trans. Zool. Soc. vol. ii.), in *Phascolomys vombatus*. But the portions contributed by the squamosals (Pl. L. fig. 2, 27, 27), do not reach so low down upon the mastoid process as in *Phascolomys vombatus* (figs. 3, 6, 27, 8). The basioccipital (Pl. LII. fig. 1, 1) contributes about half an inch of the thick lower border of the foramen magnum. The exoccipitals (Pl. L. fig. 2, 2) form the lateral borders, developing there the condyles; and the superoccipital completes the middle of the upper border, which is sharp; and as ossification of the latter element does not usually extend so low down as to fill up the whole interspace left by the exoccipitals, the

¹ The 'Prospectus' of this work was issued after the reading of my first memoir on the osteology of the *Marsupialia*; see Zool. Trans. vol. ii. p. 379. The character and form of the work, especially the richness and beauty of its illustrations, exemplified in the Part which appeared after the communication of my second memoir, led me to abandon that subject, as being likely to meet with more complete illustration in the 'Ostéographie du Squelette et du Système Dentaire des cinq Classes d'Animaux Vétébrés récents et fossiles,' 4to, Paris, 1840-1860.

² 4to, 1853, vol. i. p. 334. no. 1841.

³ Transactions of the Royal Society of Victoria, vol. viii. (1868), p. 267.

⁴ Proceedings of the Zoological Society of London, Dec. 1865, p. 838.

⁵ Ibid. p. 845.

foramen presents a somewhat trilobate or trefoil figure, as noticed in *Phascolomys vombatus*, in my first memoir.

Since the date of its communication specimens have come to hand which show that this character is not constant in either species, although the exceptions are rare. In fig. 5, Pl. L. is shown one of these exceptions in *Phascolomys platyrhinus*, and in fig. 6 another in *Phascolomys vombatus*. The foramen magnum has always a greater transverse than vertical diameter; and the exceptions to the trefoil figure show it to be transversely elliptical, as in figs. 5 & 6.

In *Phascolomys latifrons* this is the common form of the foramen magnum, with the ellipse more depressed, as in fig. 4. But of this species I have received the skull of a young, though nearly full-grown, animal, in which the sutures between the ex- and superoccipitals (Pl. L. fig. 7, 2, 3) are not obliterated, and in which an unossified space or emargination exists between the exoccipitals below the superoccipital. In two skulls of *Phascolomys latifrons* the occipital part of the mastoid (8, fig. 7) ascends above the process (8), of nearly uniform breadth, to the superoccipital (3), and separates the exoccipital (2) from the squamosal (27). In a third this character obtains on one side; on the other side it is obscure. In *Phascolomys platyrhinus* (ib. fig. 2) and *Phascolomys vombatus* (ib. fig. 6) the upper part of the exoccipital (2) usually articulates more extensively with the squamosal (27).

The characters afforded by the upper surface of the skull differentiate the platyrhine as strongly as they do the Tasmanian Wombat from the latifront species¹; the differences shown in this respect between the platyrhine (Pl. LI. fig. 1) and Tasmanian Wombats are less easily seized. In all the skulls I have yet seen of both species the temporal fossæ (ib. fig. 1, 7, 27) approach each other more nearly, absolutely as well as relatively, in the larger continental species²; yet this character may be shown to be exceptionally affected in an aged male Tasmanian Wombat. Size, of course, is of itself a character of variety. The upper third of the fossa is formed by a longitudinal strip of parietal (Pl. LI. fig. 1 & Pl. LII. fig. 1, 7), and this bends down from the temporal ridge more abruptly in *Phascolomys vombatus* than in *Phascolomys platyrhinus*; while in the latter a slight rising or ridge is developed from the line of the parieto-squamosal suture. In *Phascolomys latifrons* the temporal ridges are less marked, and the parietals incline therefrom more outwardly to join the squamosals.

The feeble indication of the postorbital process (ib. 12), and the well-defined lacrymal tubercle (ib. 73) defining the fore and upper part of the orbit, are common to both the bare-nosed species, and distinguish them from *Phascolomys latifrons*.

We come next to compare the nasal bones (Pl. LI. figs. 1, 3, 4, 5, 15) in regard to shape, size, and connexions.

¹ Compare Trans. Zool. Soc. vol. iii. pl. xxxvii. fig. 1 (*Phascolomys vombatus*) and fig. 4 (*Phascolomys latifrons*) with fig. 1, Pl. LI. of the present paper.

² Compare fig. 1, *tom. cit.* with fig. 1 in Pl. LI. of the present paper.

In an old male Tasmanian Wombat their basal breadth equals three fourths of their length (Pl. LI. fig. 4)¹. The outer angles of the base are divided from the lacrymal tubercle (73) by a fronto-maxillary suture (11-21) 3 lines in breadth. The sides of the pair of nasals converge forward at the hinder third, then run parallel, gently curving inward, and finally run to the margin of the nostril, with a slight curve outward. Thus the course of each lateral border of the nasals is undulate. Their tips extend forward about 3 lines in advance of the naso-premaxillary suture (15-22), and are bevelled off to an obtuse point from without obliquely inward and forward. Together they form the middle third of the upper border of the bony nostril. The frontals (ib. 11) make a slight projection into the middle of the fronto-nasal suture (11-15), which from this shallow indent runs outward and a little forward to the nasal process of the maxillary (21). The naso-maxillary suture (15-21) forms the hind fifth part of the lateral border of the nasals; the naso-premaxillary suture (15-22) runs along the rest of the extent of the nasal bones, *i. e.* to the beginning of their free ends, which are short and subobtuse.

In a second Wombat the nasals differ in their breadth being equal to three fourths of their length, or as 75 to 100, in the absence of any median indent of the fronto-nasal suture, and in the sharper convergence of the hinder fourth part of the lateral margins. These margins describe a similar wavy course, convex outward along the middle, or a little in advance of it. The apices overhanging the nostril are sharper and more prominent than in the last specimen.

In a third, somewhat younger *Phascolomys vombatus* (Pl. LI. fig. 3), the lateral margins converge more gradually, and in an almost straight line from the base to the anterior fourth of the nasals, where the margins extend nearly straight to the nostril. The middle sixth part of the fronto-nasal suture (11-15) is nearly straight or transverse; the rest extends outward and more obliquely forward than in the two preceding specimens. The fronto-maxillary suture (11-21) is 4 lines in extent. The nasal apices projecting beyond the premaxillo-nasal sutures are sharp and form one fifth the length of the whole lateral margin. The basal breadth bears a greater proportion to the length of the nasals than in the first-cited skull.

Phascolomys platyrhinus (Pl. LI. fig. 1), in the shortness of the naso-maxillary suture (ib. 15-21) and the deep emargination of the fore part of the nasal process of the premaxillary (ib. 22), is more nearly allied to *Phascolomys vombatus* than either of these are to *Phascolomys latifrons*². But the nasal bones of *Phascolomys platyrhinus* are relatively broader than in *Phascolomys vombatus*; the outer basal angles approach nearer to the

¹ This proportion is expressed as follows by Dr. Murie in describing his specimen of *Phascolomys vombatus*. "The proportional breadth of the two nasal bones at their hinder ends is to their length, 68 to 100."—*Proc. Zool. Soc.* June 27, 1867, p. 802.

² This relation is well pointed out by Dr. Murie, who remarks that "*Phascolomys latifrons* shears off from the common form of Wombat, and reverts to the true marsupial type in several particulars."—*Loc. cit.* p. 800. He does not, however, exemplify his ideal type: the postorbital processes are almost peculiar to *Ph. latifrons* among Marsupials.

lacrymal tubercles, with a greater relative breadth of the skull at that part. In two skulls the lateral borders of the nasals have the same undulatory course as in *Phascolomys vombatus*, but more feebly marked. There is a narrow and irregular intrusion of the frontal at the middle of the fronto-nasal suture (11), sometimes at the expense of the right, sometimes of the left nasal bone. The breadth of the base equals five sixths of the length of the nasals in two specimens, and four fifths in a third. The apices projecting anterior to the naso-premaxillary suture are short and blunt, as usual in *Phascolomys vombatus*. The width of the nasals at their base, or fronto-nasal suture, begin to diminish at once as they advance by the converging course of the naso-maxillary and naso-premaxillary sutures. In not one of the three specimens before me is "the width of the nasals continued forward beyond their middles"¹.

In *Phascolomys latifrons*, where the breadth of the fore part of the frontals is made to contrast with the narrowness of the rest of the bones by the outward extension of the postorbital processes, the nasals (Pl. LI. fig. 5, 15) present a more regular triangular form through the prevailing transverse course of the fronto-nasal suture (11-15), and the more regular convergence of the lateral margins of the nasals to the fore ends of the naso-premaxillary sutures (15-22). Beyond these the lateral margins converge more rapidly to the apices, which extend freely forward further than in the two preceding species. The breadth of the nasals at the base of their free extremities is greater than in the other two Wombats, and the upper surface is flatter.

In one of four skulls before me of *Phascolomys latifrons* the left frontal breaks the transverse course of the fronto-nasal suture by a short pointed process or wedge between the two nasals; in a second skull the right frontal sends forward, in the same way, a more obtuse triangular process; in the type skull (Zool. Trans. vol. iii. pl. xxxvii. fig. 4), both frontals contribute equal shares to the wedge; in two later-acquired specimens the suture is uninterrupted. The transverse course of the fronto-nasal suture is constant and characteristic of *Phascolomys latifrons*. Moreover the suture (11-15) is not separated from the lacrymal (73) as it is in *Phascolomys platyrhinus* and *Phascolomys vombatus*, by the maxillary (21); or if, as in an exceptional skull, or on one side, the maxillary goes back as far as the frontal, it is by a very narrow strip.

The extent of the naso-maxillary suture (ib. fig. 5, 15-21) equals, in *Phascolomys latifrons*, that of the naso-premaxillary suture (15-22). These differences in the connexions of the nasals are more significant of specific distinction than is the shape of the bones. The naso-maxillo-premaxillary suture is very slightly concave outwardly; the free border of the nasal, beyond the suture, is of greater extent in the hairy-nosed than in the bare-nosed Wombats.

There would be no doubt in determining *Phascolomys latifrons* by the naso-maxillo-premaxillary part of the skull, at least as being distinct from the other two known recent species, if even the still more characteristic part of the frontal bones were wanting. There might be more difficulty in pronouncing from the same part of the skull

¹ Murie, *loc. cit.* at p. 803.

of a bare-nosed Wombat, as to whether it belonged to *Phascolomys platyrrhinus* or *Phascolomys vombatus*.

The basal view of the skull of *Phascolomys platyrrhinus* (Pl. LII. fig. 1) shows one of the degrees of variation to which the basioccipital is subject in the depth and breadth of the emargination of the part contributing to the lower border of the foramen magnum. In this skull the emargination is narrow and deep; in a second skull of like size it is less deep and wider. The basioccipital is subject to the same variety in *Phascolomys vombatus*.

In two skulls of *Phascolomys latifrons* the emargination of the lower border of the foramen magnum is wider, as in the subject of fig. 1, Pl. LIII., than in the two first-named species. In all the three species, the under surface of the basioccipital has a median longitudinal ridge, which slightly varies in its depth and sharpness; there is a shallow vacuity on each side of the ridge. Each exoccipital, where it coalesces with the basioccipital, develops a tubercle, which, in the platyrrhine (Pl. LII. fig. 1, *b*) and Tasmanian Wombats, abuts against the petrosal. In *Phascolomys latifrons* (Pl. LIII. fig. 1, *b*) the corresponding (exoccipital) tubercles are more prominent and project freely below the petrosals (16), resembling the pterapophyses of the basisphenoid in birds. The exoccipital is perforated anterior to the condyle by, commonly, two hypoglossal foramina; these are more equal in size in *Phascolomys latifrons* than in the other two species. There is usually a small vascular foramen external to the upper end of the condyle. The wedge-shaped petrosal (ib. fig. 1, 16) abuts against the side of the basioccipital, with the thin end directed forward. The squamosal (ib. 27) expands at the inner side of the mandibular articular surface (*g*) to form a tympanic cell or 'bullæ,' which is large and widely open backward, receiving the inner orifice of the tympanic (ib. 28) in *Phascolomys platyrrhinus* and *P. vombatus*. In *Phascolomys latifrons* this pre- or antetympanic cell of the squamosal (Pl. LIII. fig. 1, 27) is smaller than in the Tasmanian Wombat, much smaller than in *Phascolomys platyrrhinus*. External to this cell the squamosal develops, in the bare-nosed Wombats, a vertical ridge, which is wedged into a groove of the tympanic; it is scarcely marked in the hairy-nosed Wombat.

In *Phascolomys latifrons* (Pl. LIII. fig. 4) the articular bar of the squamosal (*g*) is relatively shorter than in the platyrrhine or Tasmanian Wombat; and its inner end is notched posteriorly, which receives and is reciprocally received by a notch in the fore and outer part of the tympanic (28). This bone sends forward a thick triangular plate, contracting to the part which is notched for the squamosal, in a way which offers a close and interesting analogy to the 'gomphosis' of 28 with 27 in Birds.

The more marked division of the supratympanic cell in *Phascolomys latifrons* (ib. fig. 4, *l, m*), and the greater size and depth of the anterior portion or cavity (ib. *l*), are noted in the cranial characters of the species, and have been found in all the skulls examined since the date of my second Memoir¹.

¹ Trans. Zool. Soc. vol. iii. (1845), p. 303. The "enormously excavated supratympanic cells" of *Ph. latifrons*, are noticed by Dr. Murie, *loc. cit.* (1865), p. 842.

In *Ph. platyrhinus* (Pl. LIII. fig. 6) and *Ph. vombatus* the two divisions of the supra-tympanic cell are more equal, and the 'gomphosis' of the squamosal with the tympanic is less marked. The malar part (Pl. L. fig. 1, 26) of the zygoma defines the orbit posteriorly by an angular process in both the bare-nosed Wombats; it is not developed in the hairy-nosed species, where the hind boundary of the orbit is indicated by the postfrontal process (Pl. LIII. fig. 1, 12) which is not present or is rudimental in the others.

The numerous irregular venous foramina of the squamosal (Pls. L., LI. 27) are notable in all the species of Wombat.

The superior maxillary sends outward and backward a process (Pl. LII. fig. 1, 21*) which contributes to and strengthens the anterior pier (ib. 26) of the zygomatic arch; it projects above the alveolus of the third and fourth molar teeth, at a greater height above the molars in *Ph. latifrons* (Pl. LVI. fig. 5, 21*) than in *Ph. platyrhinus* (ib. fig. 4) or in *Ph. vombatus*. In a skull of the larger bare-nosed species, with an upper molar series 2 inches 2 lines in extent, the process rises 7 lines above the outlet of the third molar alveolus. In the skull of a *Ph. latifrons* with a molar series 1 inch 11 lines in extent, the process rises 10 lines above that outlet. In other words, the outer alveolar plate of the maxillary is deeper, below the zygoma, in the hairy-nosed than in the bare-nosed Wombats: it is, also, more nearly vertical, less inclined mesiad as it descends to the outlets of the sockets.

In my first memoir I state that "*Phascolomys* resembles *Phascolarctus* and *Hypsi-prymnus* in having the posterior palatal openings large and situated entirely in the palatal bones," and that "posterior and external to these are two small perforations"¹. In the other two species (*Phascolomys platyrhinus* and *Ph. latifrons*), determined since the date of that remark, which was made on the skull of *Ph. vombatus*, the generic characters of the postpalatal apertures are repeated. In the skull of *Ph. vombatus*, figured in Pl. lxxi. fig. 6, of the 2nd volume of the 'Zoological Transactions,' these apertures are oval, the base, which is behind, being rounded; but the small end of the oval is so nearly pointed as to suggest the term 'triangular.' In two skulls of full-grown Tasmanian Wombats, since compared, these foramina present the same shape and proportions (Pl. LII. fig. 4, *b*); in two smaller and younger skulls of *Ph. vombatus* they are relatively smaller, and are rather elliptical than oval. In two skulls of *Ph. platyrhinus*, in the British Museum, the postpalatal apertures are longitudinally elliptical or oblong in one (ib. fig. 1, *b*) and are triangular in the other: in both, the apertures extend more forward and come near to the transverse parallel of the middle of the hindmost socket (ib. *ib.* *m* 3). In three skulls of *Ph. latifrons* the postpalatal foramina (Pl. LII. fig. 5; Pl. LIII. fig. 1, *b*) are relatively larger, especially longer, than in either the Tasmanian or platyrrhine Wombat, and are rounded anteriorly but less broad there than behind: they advance nearer to the fore part of the last molar alveolus, or reach

¹ "On the Osteology of the Marsupialia," Trans. Zool. Soc. vol. ii. p. 389.

that transverse parallel. Dr. Murie also notes the larger size of these foramina in the skulls of *Ph. latifrons* which he compared with those of the platyrrhine species¹. The intermolar part of the bony palate is more contracted anteriorly in the bare-nosed (Pl. LII. figs. 1, 4, 21, 21) than in the hairy-nosed Wombats (ib. fig. 5 21; Pl. LII. fig. 1, 21); the narrowest part is between the right and left second molars in *Ph. platyrrhinus* and *Ph. vombatus*; but in the *Ph. latifrons* there is little difference in the interval between the second (d_4) and that between the first (d_3) molars. The palate is slightly arched transversely, and is almost flat in some platyrrhine Wombats. In the latifront species it is always more vaulted, or deeper when viewed from below, at the diastemal part (Pl. LIII. fig. 1, 21), especially at the prepalatal openings (ib. a, a) than in the bare-nosed species; and the diastemal tract is more sharply defined, laterally, in the hairy-nosed Wombat. The antorbital vacuity is wider, less slit-shaped, in *Ph. latifrons* than in *Ph. platyrrhinus* (Pl. L. fig. 1, 21) and *Ph. vombatus*.

The cerebral cavity in *Ph. latifrons* (Pl. LIII. fig. 5) is, in length, 3 inches 5 lines, and equals one half the length of the cranium, which is 6 inches 9 lines in the specimen figured. The cavity is divided by two vertical ridges into the epencephalic (ep), prosencephalic (pr), and rhinencephalic (rh) compartments. The petrosal (16) contributes a vertical surface to the side of the epencephalic compartment, which is overarched by the superoccipital and parietal. The acoustic foramen or fossa is subcircular below the horizontal ridge bisecting the cranial surface of the petrosal. The cerebellar pit above the ridge is wider and more shallow than in *Thylacinus* and most other Marsupials². The 'vagal' foramen (ov) is between the petrosal and the exoccipital. Behind this, over the two or three inner orifices of the precondyloid canals (p), the foramen ovale (ov), $3\frac{1}{2}$ lines in long diameter, perforates the alisphenoid below the tentorial ridge (b'), and opens outwardly anterior to the excavation forming the fore part of the tympanic cavity. A groove runs forward from the foramen ovale to the foramen rotundum about 8 lines in advance: at the inner side of this groove the basisphenoid is perforated by the entocarotid. From the inner orifice of this canal a groove runs forward to the common prelacerate and optic fissure (op). The rhinencephalic fossa (rh) is 7 lines in vertical diameter, 5 lines in longitudinal extent. It has a large perforation at its lower and back part leading to the common orbito-temporal fossa; the floor and fore part of the fossa are perforated by the smaller foramina transmitting the olfactory nerves to the æthmo-turbinals. The nasal cavity is divided by a vertical septum extending from the rhinencephalic cavities to 8 lines behind the tips of the nasals. The anterior border of the septum is vertical, 1 inch in depth. In *Ph. platyrrhinus* the bony septum terminates 14 lines behind the tips of the nasals. The alisphenoid tentorial ridge is less developed in that species. The æthmo-turbinals (e) form a mass about an inch in antero-posterior and less in vertical diameter. The mid turbinal is elongate, developed from a ridge descending from the roof of the nasal cavity, a short distance external to the septum, and

¹ Proc. Zool. Soc. 1865, p. 848.

² *Loc. cit.* p. 390.

defining a longitudinal canal traversing the upper part of the nasal meatus. The pre-turbinal rises from the side of the floor of the chamber. The frontal is excavated by three sinuses above the rhinencephalic chamber and the hind part of the rhinal or nasal one. The roof of the cranium, at the section, has a close cancellous structure 5 lines thick above the prosencephalon, 11 lines thick above the epencephalon.

§ 3. *Mandibular Characters of Phascolomys.*

In differentiating from cranial characters the species of Wombat called *Phascolomys latifrons*, I noted, in comparing it with *Phascolomys vombatus*, that "The curve of the lower border of the lower jaw is deeper" (Pl. LIV. fig. 3); "the inner angle of the condyle" (ib. fig. 5, *b*) "is less produced; the coronoid process" (ib. fig. 3, *c*) "is higher and narrower, and the postsymphysial depression is almost obsolete"¹. With the exception of the latter particular, which is variable in both species, subsequently acquired skulls have confirmed the constancy of the above characters. They likewise serve to differentiate the mandible of *Ph. latifrons* from that of *Ph. platyrhinus*, save that the coronoid process rises higher in the platyrhine species (Pl. LIV. fig. 2, *c*) than in the Tasmanian Wombat (ib. fig. 1, *c*); but the broader proportion of the process, as compared with that in the hairy-nosed Wombat (ib. fig. 3, *c*) is retained. The deeper curve described by the lower contour of the jaw from the neck of the condyle to the incisive alveoli is a constant and well-marked character of *Ph. latifrons* (ib. fig. 3). So, likewise, is the less-produced inner angle of the condyle (Pl. LIV. fig. 5, *b*, and Pl. LVII. fig. 3, *b*). In both the Tasmanian (Pl. LV. fig. 5, *b*) and platyrhine (Pl. LIV. fig. 4, *b*) Wombats this angle is more produced and deflected.

The diastemal part (Pls. LIV., LV., & LVII., *l*, *s'*) of the long symphysis (ib. *s*, *s'*) is subject to some variety in existing Wombats. In two mandibles of *Ph. platyrhinus*, in which the length of the series of molar alveoli is 2 inches 3 lines, that of the interval between the first alveolus and the foremost angle of the symphysis is, in one skull 1 inch $7\frac{1}{2}$ lines (Pl. LVII. fig. 1, *s'*), in the other 1 inch $6\frac{1}{2}$ lines; the breadth of the diastema midway is the same in both, viz. 10 lines. In a mandible of *Ph. latifrons* with the molar series of alveoli 2 inches in extent (Pl. LVII. fig. 3), the diastema (*l*, *s'*), taken as above to the foremost point at the interspace of the incisors, is 1 inch 3 lines. In a second mandible, with the molar alveoli 1 inch $10\frac{1}{2}$ lines in extent, that of the diastema is also 1 inch 3 lines; the breadth of the diastema midway is, in the first mandible 8 lines, in the second 7 lines.

In the two mandibles of the platyrhine Wombat compared, the diastema is slightly convex both lengthwise and across; it is traversed by a pair of shallow longitudinal grooves (ib. fig. 1), and is not sharply defined from the sides of the symphysis. In a third mandible of the same species the defining ridges are better marked, the trans-

¹ "On the Osteology of the Marsupialia,"—Part II. (1845) in Trans. Zool. Soc. vol. iii. p. 304, pl. xxxvii. figs. 2 & 5.

verse convexity is less so, and this part of the symphysis is rather longer and narrower than in the other two mandibles. In these respects the third mandible approaches nearer to *Ph. latifrons*. But it differs, as do the other mandibles of the same species, as well as those of *Ph. vombatus* (ib. fig. 2, *l, s*), in the larger, especially broader incisive alveoli, and the oblique course of their upper margins from the mid line of the symphysis outward and backward. The fore end of the symphysis of *Ph. latifrons* is at once recognizable by the narrower outlets of the incisive alveoli, and the more transverse course of their upper border (Pl. LVII. fig. 3). The lateral borders of the outlets are also more nearly vertical (Pl. LIV. fig. 3, *s'*), and do not slope backward as they descend, like those of the incisor alveolar outlets in *Ph. platyrhinus* (ib. fig. 2) and *Ph. vombatus* (ib. fig. 1)¹.

With the narrower alveoli associated with the more compressed form of the incisors of *Ph. latifrons* one may predicate a generally narrower diastemal part of the symphysis, the upper surface of which, with a median canal towards the end and the two parallel longitudinal grooves obsolete or nearly so, is better defined from the sides of this part of the symphysis (Pl. LVII. fig. 3, *l, s'*). In one jaw of *Ph. latifrons* the defining ridges are sharp, and the intervening upper surface is concave transversely to near the incisive outlets, where the defining ridges subside. I may note that the anterior outlet (*v*) of the dental canal, in three mandibles of *Ph. platyrhinus* (Pl. LIV. fig. 2), is 1 inch 4 lines, or 1 inch 5 lines, behind the foremost point of the symphysis. In one mandible of *Ph. latifrons* (ib. fig. 3) it is 1 inch behind the fore end of the symphysis; in another mandible it is 10 lines from the same part. The foramen is more anteriorly situated in the broad-fronted or hairy-nosed species². I may further note that, in the mandibles of two individuals, examined since describing that of the type skull of *Ph. latifrons*, the intercommunicating foramen from the entry of the dental canal to the outer surface of the base of the coronoid is smaller in one (Pl. LV. fig. 4, *p*), as in the type mandible, than in the platyrhine and Tasmanian Wombats; while in another mandible of *Ph. latifrons* it did not exist. It is interesting to find this variety, because, in the great Diprotodon and Notothere, with some affinities to *Phascolomys*, the absence of the perforation of the base of the coronoid process is the rule, as in the Marsupialia generally, and this supports Dr. Murie's view of the hairy-nosed Wombat.

The mandible of the Tasmanian Wombat has the singular proportions of being as broad as it is long. In the specimen figured (Pl. LIV. fig. 1) the length is 4 inches 6 lines. In one jaw of *Ph. platyrhinus* the length is 6 inches, the breadth 5 inches

¹ This latter character, differentiating *Phascolomys vombatus* from *Ph. latifrons*, is shown in figs. 3, *c* & 7 *c* of pl. xxxvii. *tom. cit.*

² This character is shown in the figures of the mandible of the Tasmanian and continental broad-fronted Wombats in pl. xxxvii. of my "Second Memoir" (*tom. cit.*). But I could not then, as now, depend upon the constancy of such character, in which the platyrhine continental Wombat, as usual, resembles the Tasmanian species.

9 lines. In a second specimen, with a length of 5 inches 9 lines the breadth is 5 inches 3 lines. In a *Ph. latifrons* with a mandible 4 inches 10 lines in length, the extreme breadth is 4 inches 4 lines. In a second specimen the mandible, with a length of 5 inches, has a breadth of 4 inches 7 lines (Pl. LVI. fig. 3)¹.

The subsymphysial foramina (Pl. LVI., *r, r*) are usually closer together in *Phascolomys platyrrhinus* (fig. 1) than in *Phascolomys latifrons* (fig. 3).

§ 4. Dental Characters of Phascolomys.

The dentition of *Phascolomys* is unique in the mammalian class; its formula is well known; every tooth enjoys unceasing growth, is consequently rootless, and is curved in the segment of a circle, it has also a partial investment of enamel. This is not the case with the molars of any rodent, nor of any other marsupial save the Wombats. In the upper molars (Pl. LII. fig. 3, *e*, Pl. LIII. fig. 3, *e*) the enamel is laid upon the inner, in the lower molars (Pl. LVII. figs. 6 & 7) on the outer side. It is coated, with the rest of the tooth's surface, by cement.

The upper incisors in *Phascolomys platyrrhinus* (Pl. LII. fig. 1, *i*, figs. 2, 2') are sub-compressed, with a narrow subelliptic transverse section (fig. 2'), of which the long axis is directed from before rather outward and backward. Those of *Phascolomys latifrons* (Pl. LIII. fig. 1, *i*, figs. 2, 2'), with a fuller subelliptic section, have the long axis directed from before more outwardly as it extends backwards. The pair of teeth present a broader surface forward; in *Phascolomys platyrrhinus* they present a broader surface outward,—the surface in both species being the convex enamelled one; the enamel in both, also, is longitudinally striate. A larger proportion of the upper incisor is coated with enamel in *Phascolomys platyrrhinus* (Pl. LII. fig. 2') than in *Phascolomys latifrons* (Pl. LIII. fig. 2'). Commencing in the former near the hind border, it extends along the outside, over the front border, and along the inner side to a longitudinal indent, three fourths of the way toward the hind border. The enamel in *Phascolomys latifrons*, commencing at the hind border, which is, rather, the outer one, extends over the fore part and upon the inner surface to where it bends to form the hind surface. The extent of this hind part of the tooth, coated only with cement (Pl. LIII. fig. 2', *c*), is greater in *Phascolomys latifrons* than the unenamelled tract in *Phascolomys platyrrhinus*.

The first upper molar in *Phascolomys platyrrhinus* (Pl. LII. fig. 1, & fig. 3, *d 3*) presents a subtriangular transverse section or working-surface, the base being backward, the apex forward; the inner side is shorter than the outer side, and is indented near the apex by a groove traversing the tooth lengthwise; the outer angle of the base is sometimes, by oblique attrition, produced. The enamel begins anteriorly at the outer part of the apex (fig. 3, *e*), opposite the groove, is continued inward and backward, and upon the base two thirds of the way toward the outer angle, which, with the outer side of the tooth to near the anterior angle or apex, is coated only by cement (ib. *c*).

¹ In the type specimen (*tom. cit.* pl. lxxi. fig. 6, *d*) it is 4 inches 8 lines.

In *Phascolomys latifrons* the worn surface of the first upper molar (Pl. LIII. figs. 1 & fig. 3, *d* 3) is subquadrate; or, if viewed as triangular, the antero-internal surface forms the base, and the postero-external angle the obtusely truncated apex. There is a feeble indication of a longitudinal groove, representing that in *Phascolomys platyrhinus* (Pl. LII. fig. 3, *g*); but it does not mark off an anterior production of the tooth in the bare-nosed species, it simply indents the base or shorter side of the triangle. The enamel extends from the base upon the fore and outer part (Pl. LIII. fig 3, *e*) and upon the hind part of the tooth, leaving about the same extent of the outer and hinder part unenamelled and coated with cement (*c*) as in *Phascolomys platyrhinus*. The chief distinction is the deeper antero-internal longitudinal groove (Pl. LII. fig. 3, *g*) marking off a more definite anterior angle or lobule of the grinding surface of *d* 3 in both the bare-nosed Wombats; by which character a detached tooth might be determined as not belonging to the hairy-nosed species. There is only some difference in size between *d* 3, upper jaw, of *Phascolomys platyrhinus* and that of *Phascolomys vombatus*.

The second molar (*d* 4) assumes a greater proportional size to the first (*d* 3) in *Phascolomys platyrhinus* than in *Phascolomys latifrons*; and the succeeding molars repeat the same degree of superiority of size. The longitudinal extent of the upper molar series in *Phascolomys platyrhinus* averages 2 inches 1 line; in *Phascolomys latifrons* it averages 1 inch 10 lines: the admeasurements are here taken to include the alveolar outlets. In both species there is a slight decrease of size as the teeth recede in position, and chiefly in the hind lobe or division of the last molar; and in both species the second molar (*d* 4) is distinguished by the marked increase of size, especially transversely, of the hindmost lobe or division. The apex of the front lobe of the third molar (*m* 1) does not extend so far inward as that of the contiguous lobe of the second molar. The fourth molar (*m* 2) has a similar relative position to the third, so that the inner contour of the three mid molars is zig-zag, the palate gaining width between each as they recede in position. This character is better marked in the bare-nosed than in the hairy-nosed Wombat. The outer alveolar wall in all the species is deeper than the inner one, and is nearly on a level with the worn or working surfaces of the teeth. The enamel does not extend upon the outer surface, and thins off before it quite attains the angles between the outer and the fore and hind surfaces (Pl. LII. fig. 3, *d* 4, *e*; and Pl. LIII. fig. 3, *d* 4, *e*).

The right and left series of the upper molars, as may be inferred from the palatal characters, diverge from the second to the last, in a greater degree in *Phascolomys platyrhinus* (Pl. LII. fig. 1, *d* 4, *m* 3) than in *Phascolomys latifrons* (Pl. LIII. fig. 1, *d* 4, *m* 3).

In a not full-grown latifront Wombat, with a skull 6 inches 2 lines in length, the upper molar series has the same longitudinal extent (1 inch 10 lines) as in a full-grown individual with a skull 6 inches 9 lines in length. The teeth, including the incisors, have acquired their full size. This fact bears serviceably on the interpretation of fossil Wombats with markedly smaller molar teeth in upper and lower jaws not exceeding in size those of the young Wombat above compared.

The lower incisors of *Phascolomys latifrons* are more distinct in size and shape from those of *Phascolomys platyrhinus* than are the upper ones. The vertical diameter of the transverse section (Pl. LVII. fig. 5) is the longest, not the transverse diameter (ib. fig. 4). The outer surface (fig. 5, *a*), vertical, and slightly channelled, is divided by a well-marked angle from the lower surface (*b*), which is slightly and transversely convex. The enamel covering the lower surface bends over the angle dividing it from the outer surface and there stops (at *a*). In *Phascolomys platyrhinus* (ib. fig. 4) the lower enamelled surface (ib. *b*) bends up upon the outer (*a*) to near the upper surface, terminating there at an angle or ridge. A narrow longitudinal groove representing the wider outer channel in the hairy-nosed Wombat, divides the enamelled outer angle from the flat upper surface. The transverse section of the incisor may be called triangular in both species; but the base is internal and the apex external in *Phascolomys platyrhinus*, while the base is inferior and the apex superior in *Phascolomys latifrons*. The lower incisors are likewise smaller relatively to the jaw and to the molar teeth in the hairy-nosed than in the bare-nosed Wombat; and this character is more strongly marked in the large extinct Wombats indicated in my second Memoir on the osteology of the Marsupialia¹.

The first lower molar, on the other hand, is as large in *Phascolomys latifrons* (Pl. LVII. fig. 7, *d* 3) as in *Phascolomys platyrhinus* (ib. fig. 6, *d* 3); it is consequently larger in proportion to the size of the species, and in proportion to the other molar teeth; it has also a different form. In *Phascolomys platyrhinus* the transverse section and working surface of *d* 3, (fig. 6) is usually a full ellipse, with the long axis nearly parallel with that of the jaw. In *Phascolomys latifrons* the section is subquadrate (fig. 7). The anterior surface (*e*) usually shows a feeble longitudinal groove; the outer surface is rather narrower than the other three. The enamel covering it extends a short way upon the front surface, and then, after an interruption, is resumed upon the antero-internal angle: the outer enamel extends uninterruptedly over two thirds of the hinder surface. The other bilobed or biprismatic molars show little more than the difference of size, the four (*d* 4, *m* 1, 2, 3, fig. 3) equalling in longitudinal extent three and a half of those in *Phascolomys platyrhinus* (fig. 1). In all the species the enamel is wanting on the inner side of the tooth, which is nearly on a level with the inner wall of the alveolus; the outer wall is lower and exposes more of the tooth; the curves of the positions of the prismatic surfaces are reversed in the upper and lower molars.

Mr. Waterhouse, in his instructive paper on the Dentition of the Flying Opossums², pointed out two subgenera as having four true molar teeth on each side of both jaws, and a third subgenus as having three true molars on each side of both jaws; but the observations on marsupial modifications of dentition were not carried further in that paper.

In January 1839 I communicated my paper on the classification of the Marsupialia³,

¹ Trans. Zool. Soc. vol. iii. (1845), p. 306.

² Proc. Zool. Soc. 1838, p. 149.

³ Trans. Zool. Soc. vol. ii. p. 315.

which contained the generalized expression of observations on the dentition and other systems, carried out through all the materials then at my command. This was chiefly in relation to the actual phase of Mammalian taxonomy in reference to Cuvier's order "Marsupiaux"¹. W. S. Macleay and others opposed such ordinal group or union of the pouched quadrupeds. The learned Vice-Secretary of the Zoological Society had published reasons for rejecting the Marsupialia as a distinct group, and for distributing them among different placental orders according to their supposed closer affinities. The contrary views set forth by Cuvier and De Blainville² were defective in that kind of evidence which could alone render them convincing; accordingly Mr. Bennett asks, in 1831, "What is there of importance in the structure of the Wombat, except this solitary character of the marsupium, to separate it from the Rodent order?"

Amongst the structures shown to be both common and peculiar to the Marsupialia, I adduced the number of the true molar teeth, as characterized by size and shape, remarking that "in the dental system itself, the varieties of which have been chiefly appealed to as sanctioning the dispartition of the Marsupial order, we find an important peculiarity, by which the carnivorous, omnivorous, and strictly vegetable-feeding genera alike agree with each other, and differ from the corresponding placental *Mammalia*. In the ordinary *Feræ*, for example, in the *Quadrumana* and in the *Rodentia*, as likewise in the *Pachydermata* and *Ruminantia*, the number of grinders developed on each side of each jaw, which are not subject to vertical displacement and succession, is never more than *three*, while in the corresponding groups of *Marsupialia* it is always *four*"³.

Since the date of this paper (1839) the associated group of Marsupialia has not been sought to be dissevered. It received the valuable sanction of Mr. Waterhouse in his 'Natural History of the Mammalia;' and the generalization as to the number of true molars is given amongst the characters of the order in Part I. of that work, which was issued in 1845.

¹ Règne Animal, vol. i. p. 172 (ed. 1829).

² Although De Blainville was able to anticipate the appearance of the concluding volume of the 'Règne Animal,' by a few months, in the issue of his Tabular Sheets of Classification, the priority of the proposition of a Marsupial series distinct from, but paralleling, the higher Mammalian orders, is due to Cuvier ("Préface de la première édition, Octobre 1816").

³ Trans. Zool. Soc. vol. ii. p. 332. I noted here the exception, previously pointed out by Mr. Waterhouse, in *Petaurus (Acrobates) pygmeus*, also that of the similarly minute *Phalangista gliriformis*, pp. 325-333.

DESCRIPTION OF THE PLATES.

PLATE I.

- Fig. 1. Side view of the skull of *Phascolomys platyrrhinus*.
 Fig. 2. Back view of ditto ditto.
 Fig. 3. Back view of ditto of *Phascolomys vombatus*.
 Fig. 4. Ditto ditto of *Phascolomys latifrons*.
 Fig. 5. Foramen ovale, var. of *Phascolomys platyrrhinus*.
 Fig. 6. Ditto and part of occiput, var. of *Phascolomys vombatus*.
 Fig. 7. Ditto and part of occiput of *Phascolomys latifrons*.

PLATE II.

- Fig. 1. Top view of skull of *Phascolomys platyrrhinus*.
 Fig. 2. Fore end of cranium of *Phascolomys platyrrhinus*.
 Fig. 3. Nasal bones, var. of *Phascolomys vombatus*.
 Fig. 4. Ditto, var. 2, of ditto.
 Fig. 5. Ditto of *Phascolomys latifrons*.

PLATE LII.

- Fig. 1. Base view of skull of *Phascolomys platyrrhinus*.
 Fig. 2. Upper incisor, side view; and 2', section, ditto.
 Fig. 3. First and second upper molars, magnified 2 diameters, ditto.
 Fig. 4. Palate, var. of *Phascolomys vombatus*.
 Fig. 5. Ditto, var. of *Phascolomys latifrons*.

PLATE LIII.

- Fig. 1. Base view of skull, *Phascolomys latifrons*.
 Fig. 2. Upper incisor, side view; and 2', section *c—e*, ditto.
 Fig. 3. First and second upper molars, magnified 2 diameters.
 Fig. 4. Supratympanic cells and tympano-squamosal gomphosis, ditto.
 Fig. 5. Vertical longitudinal section of the skull, ditto.
 Fig. 6. Supratympanic cells and tympano-squamosal suture, *Phascolomys platyrrhinus*.

PLATE LIV.

- Fig. 1. Outside view of mandibular ramus, *Phascolomys vombatus*.
 Fig. 2. Ditto ditto, *Phascolomys platyrrhinus*.
 Fig. 3. Ditto ditto, *Phascolomys latifrons*.
 Fig. 4. Hind view of ascending branch of ditto, *Phascolomys platyrrhinus*.
 Fig. 5. Ditto ditto *Phascolomys latifrons*.

PLATE LV.

- Fig. 1. Inside view of mandibular ramus, *Phascolomys vombatus*.
 Fig. 2. Ditto ditto, *Phascolomys platyrhinus*.
 Fig. 3. Ditto ditto, *Phascolomys latifrons*.
 Fig. 4. Outside view of ascending branch of ditto, var. of *Phascolomys latifrons*.
 Fig. 5. Hind view of ascending branch of ditto, *Phascolomys vombatus*.

PLATE LVI.

- Fig. 1. Under view of mandible, *Phascolomys platyrhinus*.
 Fig. 2. Ditto ditto, *Phascolomys vombatus*.
 Fig. 3. Ditto ditto, *Phascolomys latifrons*.
 Fig. 4. Right maxillary with front pier of zygoma, *Phascolomys platyrhinus*.
 Fig. 5. Ditto ditto, *Phascolomys latifrons*.

PLATE LVII.

- Fig. 1. Upper view of mandible and mandibular dentition, *Phascolomys platyrhinus*.
 Fig. 2. Ditto ditto, *Phascolomys vombatus*.
 Fig. 3. Ditto ditto, *Phascolomys latifrons*.
 Fig. 4. Section of lower incisor, *Phascolomys platyrhinus*.
 Fig. 5. Ditto ditto, *Phascolomys latifrons*.
 Fig. 6. First and second lower molars, right side, magn., *Phascolomys platyrhinus*,
 showing the partial coat of enamel (the outer lobes of *d* 4 ought to be more
 angular).
 Fig. 7. First and second lower molars, ib., magn., *Phascolomys latifrons*.

All the figures are of the natural size where not otherwise expressed.

Fig. 1

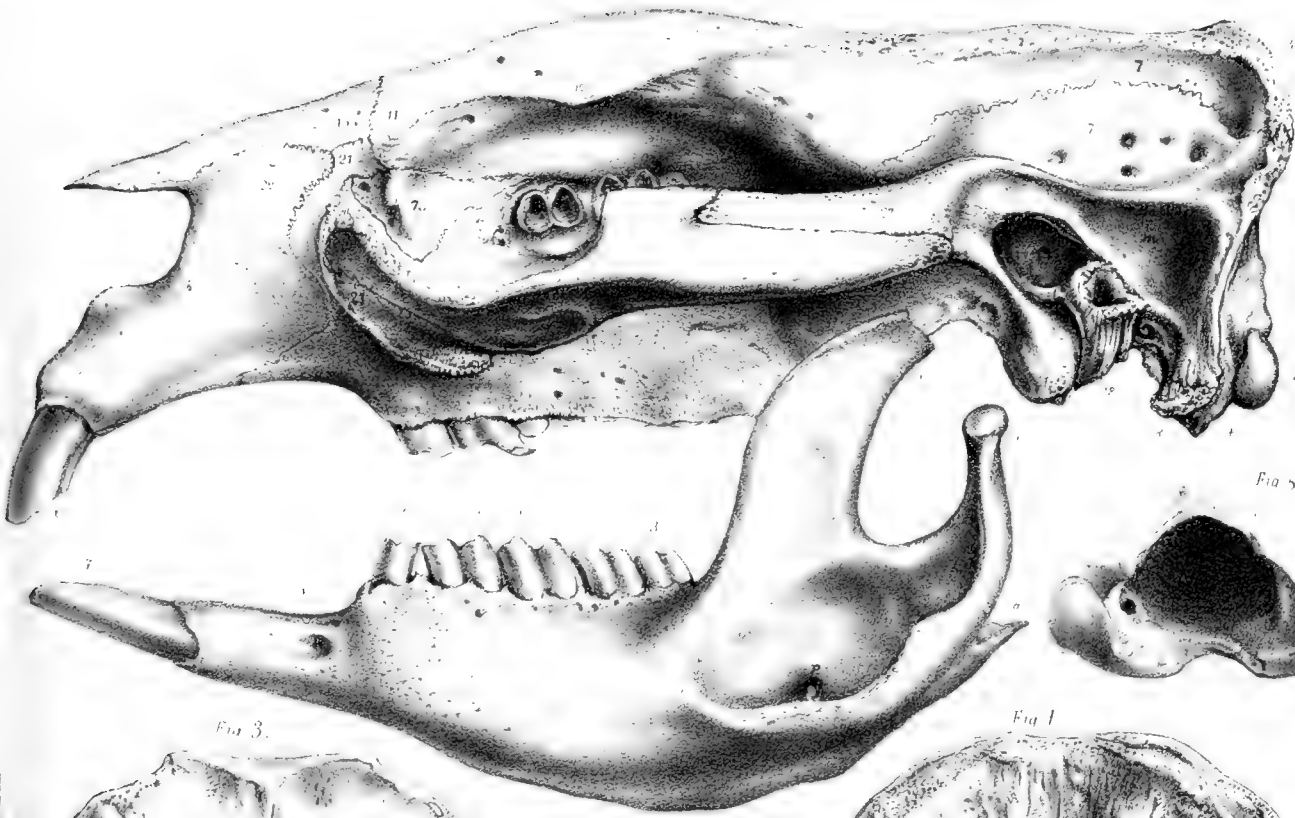


Fig. 5

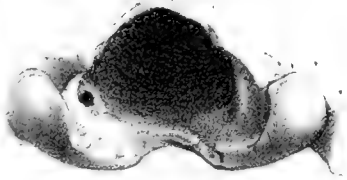


Fig. 3.

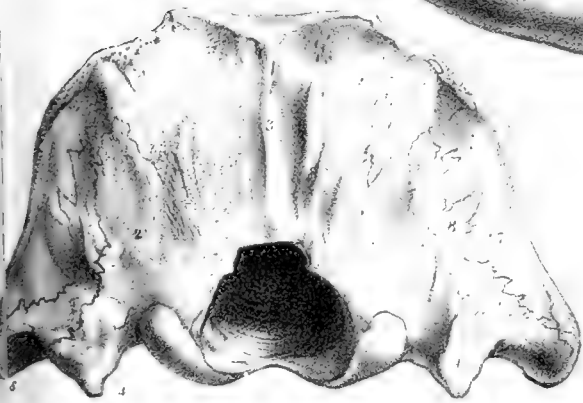


Fig. 1

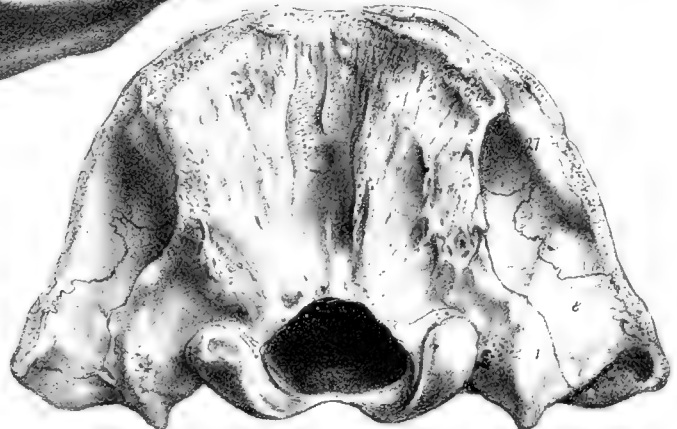


Fig. 2

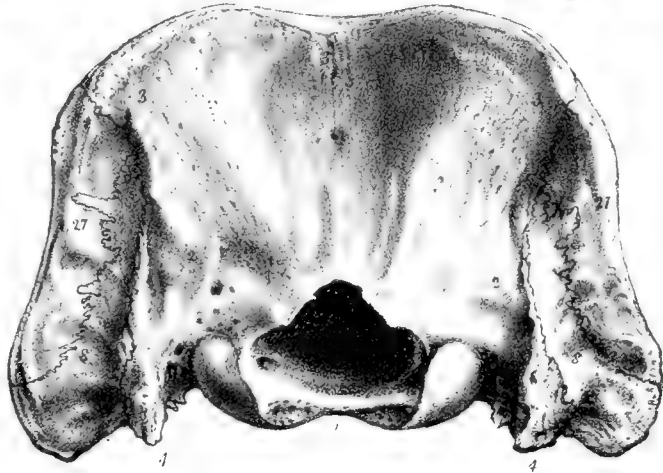


Fig. 6



Fig. 7



and lith

M & N Hamhart sculp

Figs 1 2 5 PHASCOLOMYS PLATYRHINUS. Figs 3 6 PHASC VOMBATUS Figs 4 7 PHASC. LATIFRONS



Fig 1



Fig 2



Fig 3



Fig 4



Fig 5

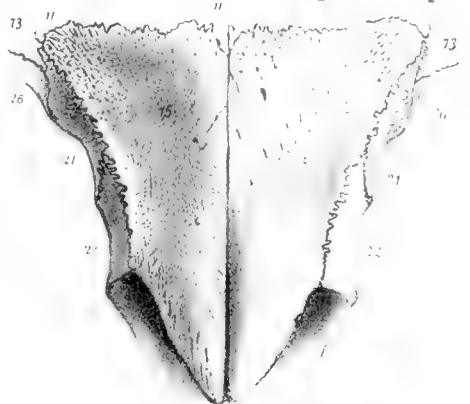
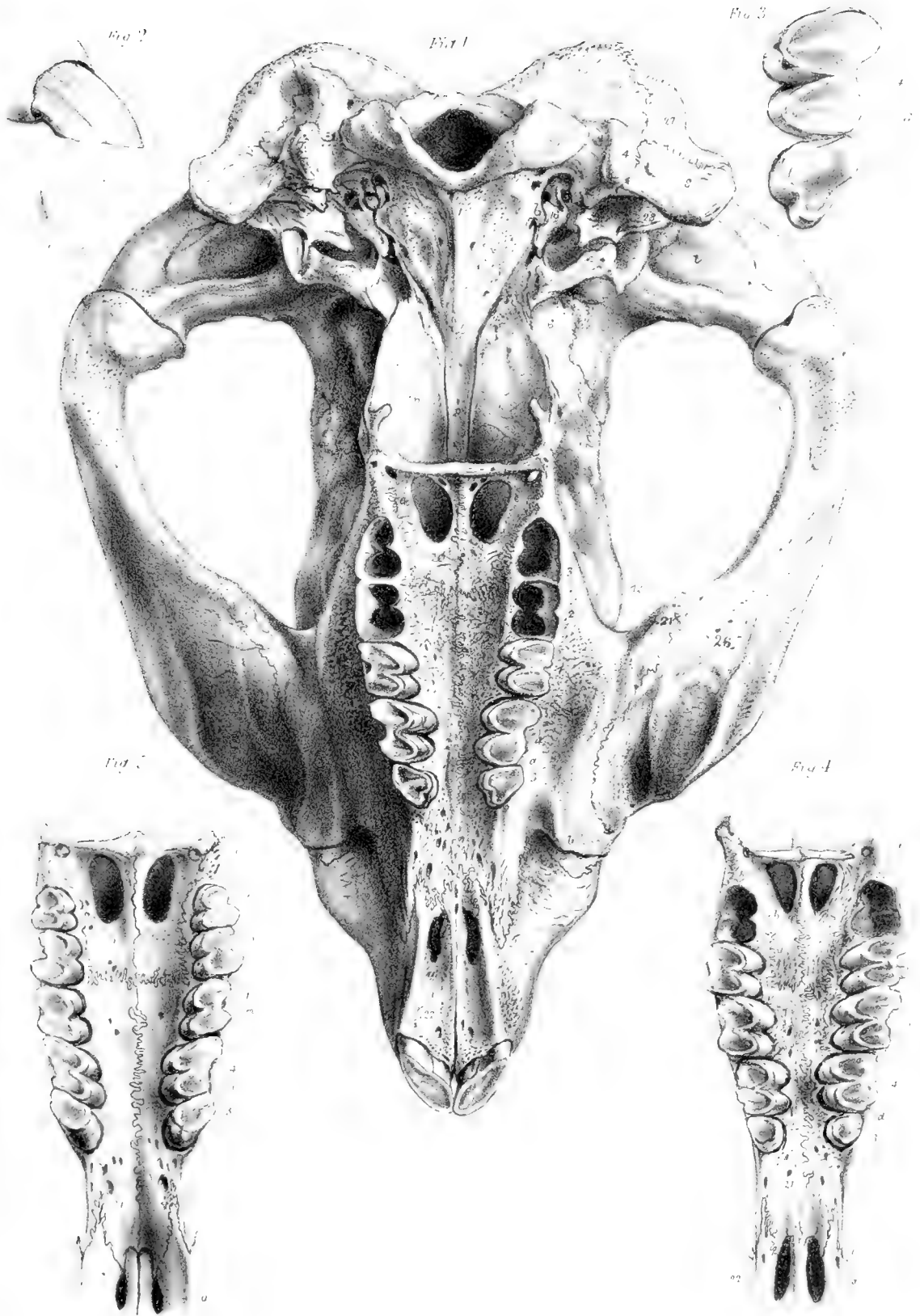
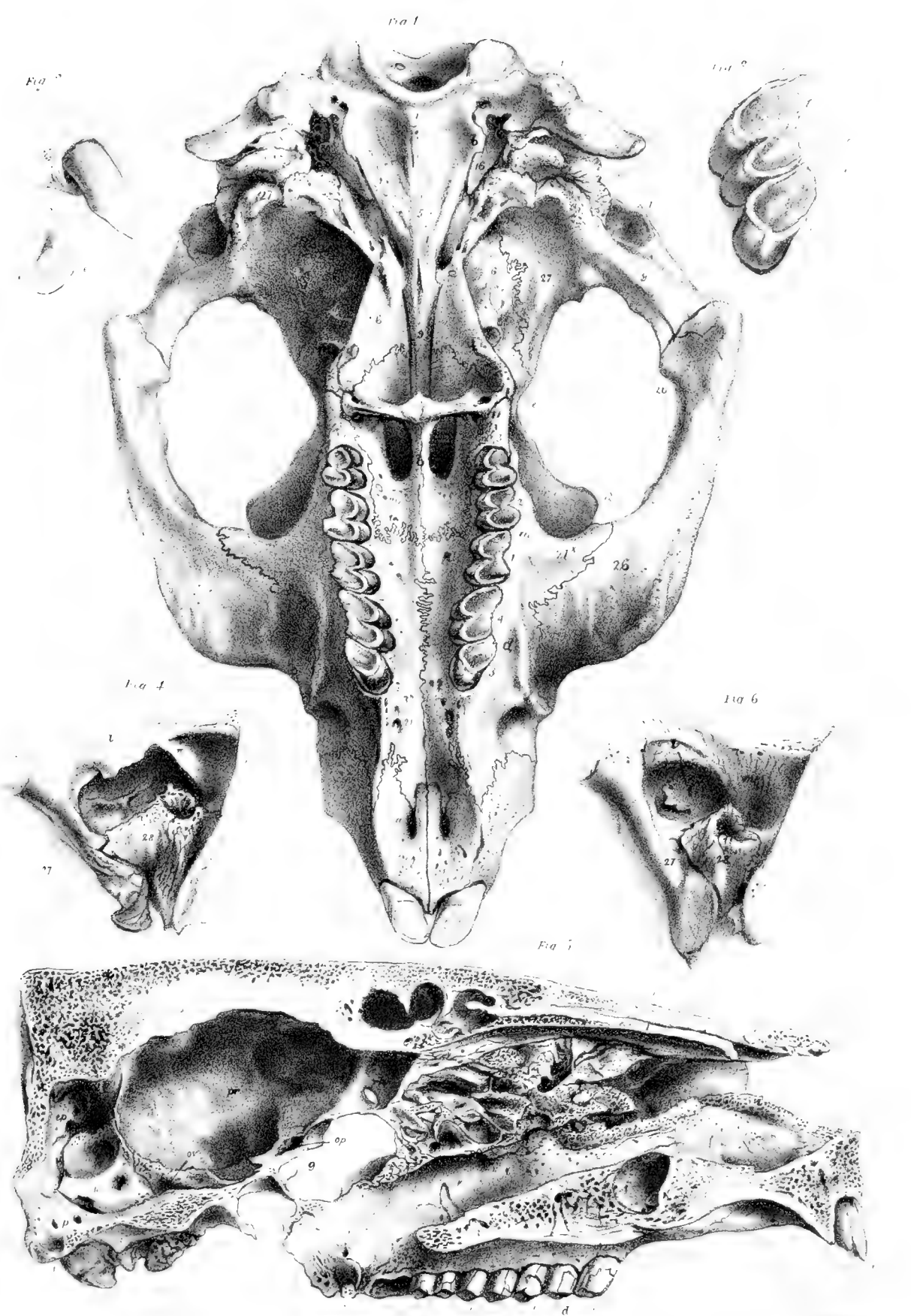


Fig 1. & 2 PHASC. PLATYRRHINUS. 3 & 4. PHASC. VOMBATUS 5 PHASC. LATIFRONS.









na 1

Fig 2

Fig 3

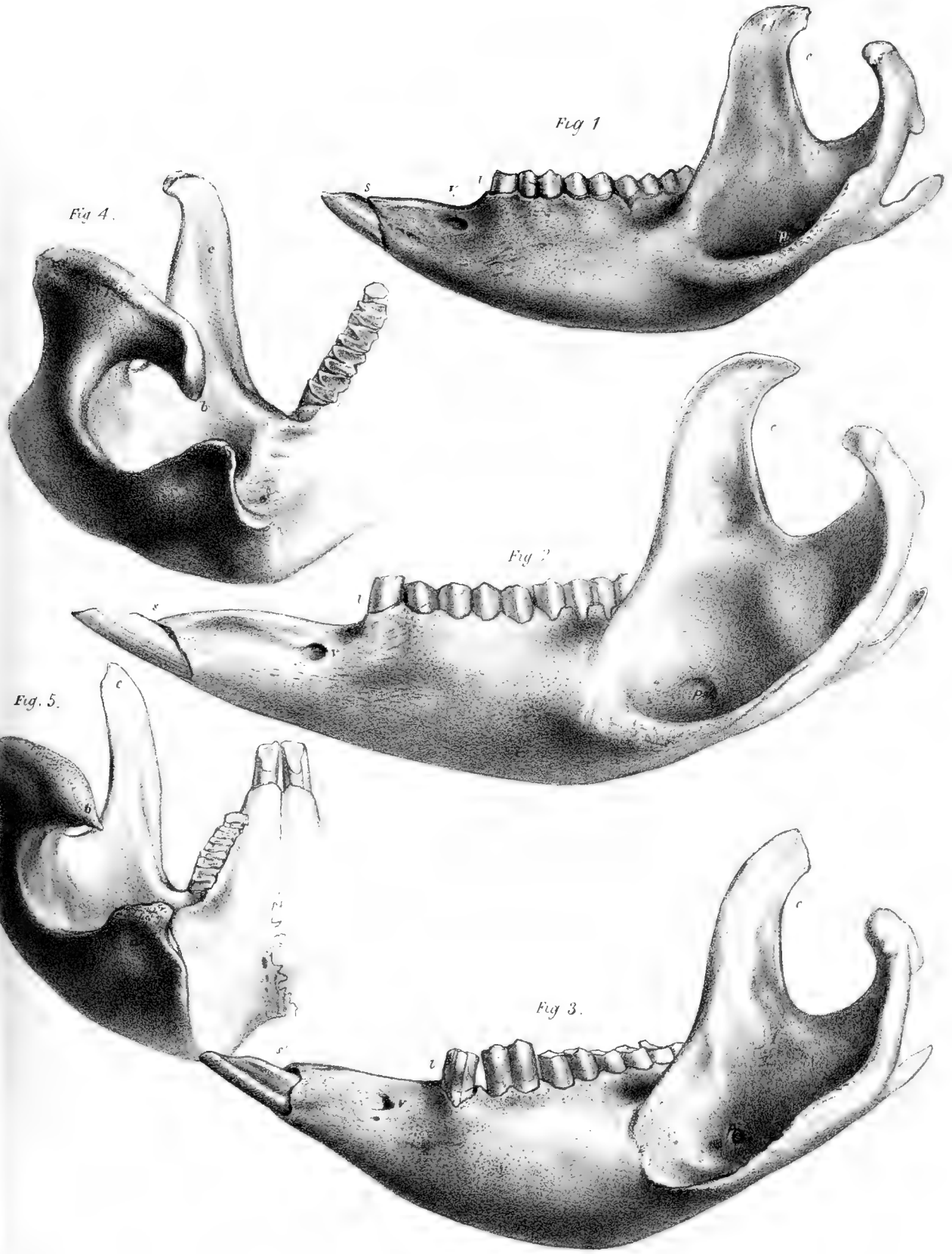
Fig 4

Fig 5

Fig 6

Figs 1-5. PHASCOLOMYS LATIFRONS Fig 6 PHASC. PLATYRHINUS



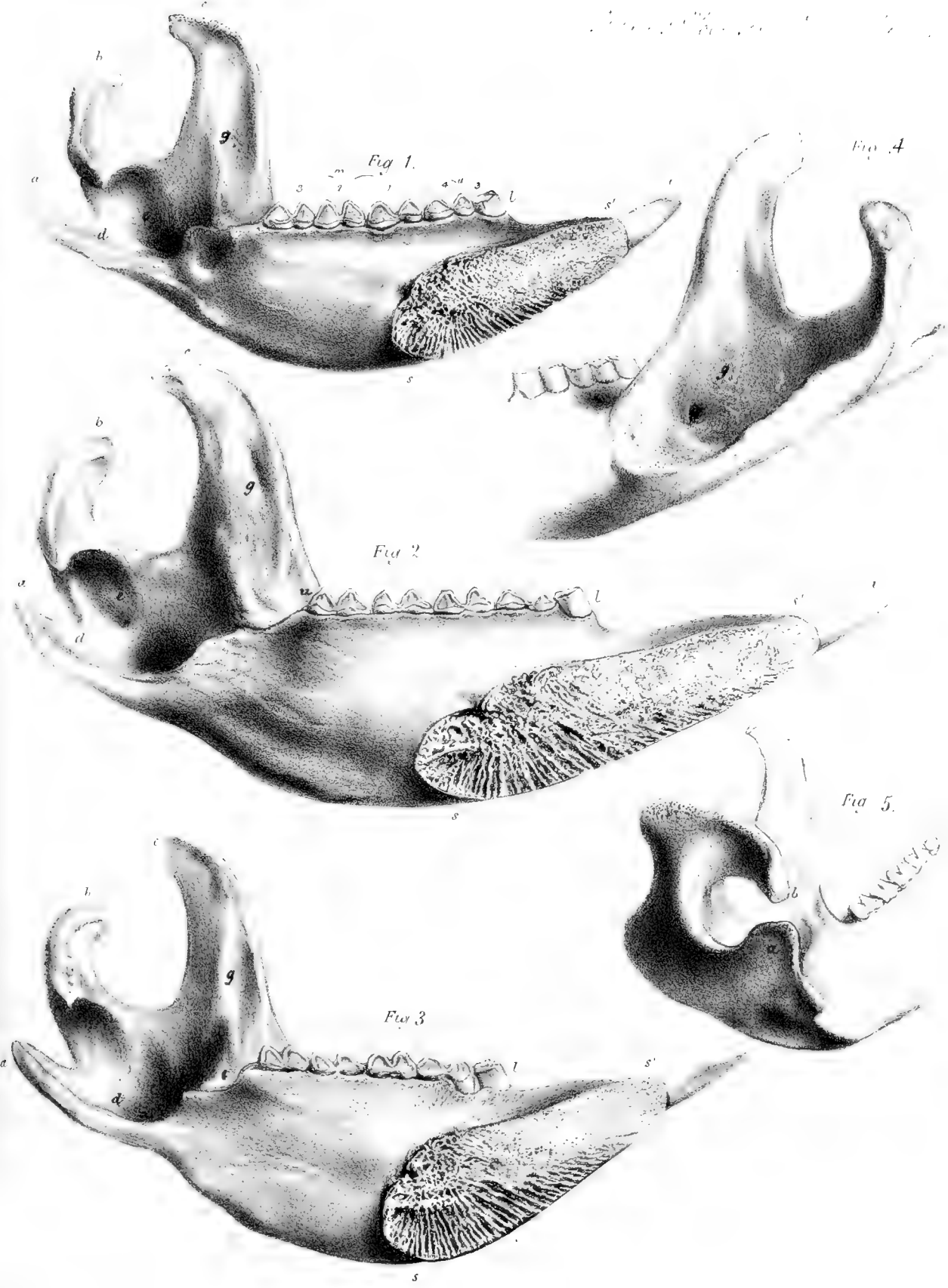


J. Smit lith

M&N Hanhart imp

PHASCOLOMYS VOMBATUS Figs 2 & 4 PHASC. PLATYRHINUS Figs 3 & 5 PHASC. LATIFRONS





Figs 1 & 5 PHASCOLOMYS VOMBATUS Fig 2 PHASC. PLATYRHINUS Fig 3 & 4 PHASC. LATIFRONS Fig 5



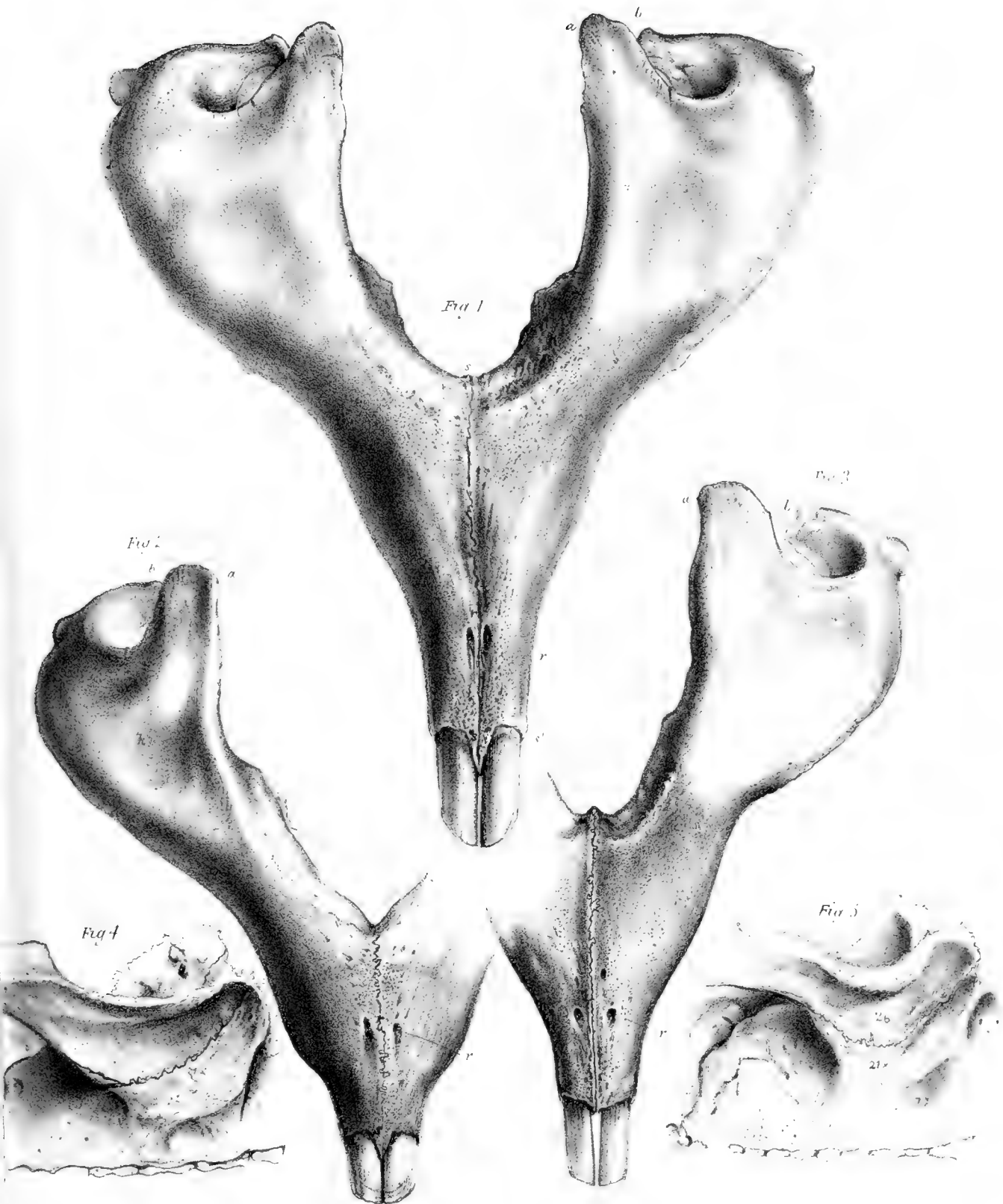
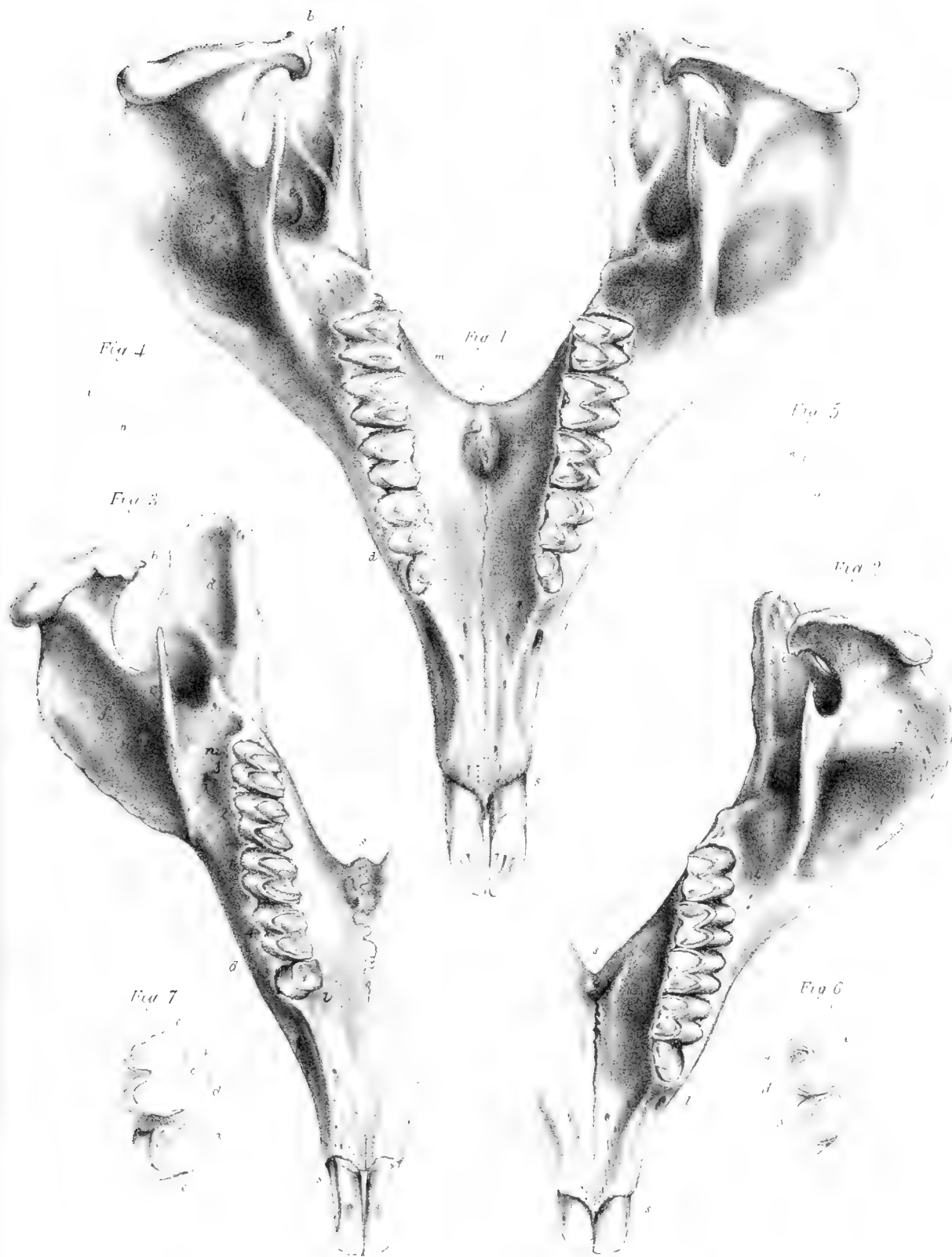


Fig 1.4 PHASCOLOMYS PLATYRHINUS. Fig 2. PHASCOLOMYS VOMBATUS.
 Fig 3. 5. PHASCOLOMYS LATIFRONS.





J. Smit del.

M. & N. Harmer imp.

Fig 1.46 PHASCOLOMYS PLATYRHIUNUS. Fig 2. PHASC. VOMBATUS Fig 3. 57 PHASC. LAMPYRONS.



X. On DINORNIS (Part XVIII.): containing a Description of the Pelvis and Bones of the Leg of *Dinornis gravis*. By Professor OWEN, F.R.S., F.Z.S., &c.

Read May 7th, 1872.

[PLATES LVIII. to LXI.]

IT is with feelings akin to compunction that I come again before the Society with claims to place the record of a fifteenth species of *Dinornis* in a volume of its Transactions. I have hesitated for some years in completing this step, tentatively ventured in 1869¹. But I have no alternative; for I do not see my way, on present experience of the value of characters from leg-bones, to attach thereto other interpretation of those about to be described than that which has led me, in the British-Museum Lists, to refer them to a *Dinornis gravis*.

The fourteen extinct species of terrestrial or wingless birds proposed in preceding Memoirs being characterized by bones only, and chiefly, or mostly, by those of the hind limbs, might well be deemed by ornithologists to require subsequent confirmation before they received general acceptance. Remarks by some esteemed friends, eminent in that branch of natural history, significant of their reticence or expectant attitude, have not surprised me, and ought not.

I look forward with equal interest, at least, to the result of further acquisitions of these remarkable and unexpected evidences of avian life in the old times of New Zealand; and I believe myself ready and willing to yield up any of my species, should intermediate sizes of femur, tibia, and metatarsus, without distinct and well-marked modifications of form or proportion, prove the *Dinornis struthioides*, e. g., to be an immature *Dinornis ingens*, or this to show merely a stage of growth of *Dinornis giganteus*.

I can only say that I prepared myself to grapple with the problem of these bones by a comparison of all accessible materials showing age-characters in the femur, tibia, and metatarsus of the known existing struthious birds, and have noted² and represented³ some of the characters by which the leg-bones, say of an immature Ostrich, might be detected and discriminated from bones of the same size of the Emu, Rhea, or Cassowary.

It was not until I had satisfied myself that characters as distinctive as those observable in the leg-bones of the existing large species of *Cursores* or *Struthionidæ* were present

¹ Trans. Zool. Soc. vol. vii. part 2, p. 141.

² Ib. vol. iii. p. 243 (1843).

³ Ib. vol. iii. pl. 28. figs. 1 & 2.

in the bones of the six kinds of New-Zealand wingless birds defined in my first Memoir¹, that I presumed to express such conclusion in the usual way of specific denominations. On the same grounds were defined four other species in the second Memoir².

As I have already noted, I had had the satisfaction of seeing the characters repeated in more than one specimen of femur, tibia, and metatarsus of eight out of those ten species, in most of them by several bones. Of *Dinornis casuarinus*, for example, in the year 1846, I had had under inspection ten femora, eleven tibiæ, and six metatarsi. I had thus been able, in acquisitions received subsequently to the date of the above-cited Memoirs, to refer bones to species therein characterized and figured.

If in time to come other observers and collectors of avian remains in New Zealand be able to match the bones with those which I have described and figured as the types of extinct species of *Dinornis*, in the way and degree, *e. g.*, in which it has been done by the acute and experienced naturalist and Government Geologist of Canterbury Province in the case of the rich depository of dinornithic remains in Glenmark Swamp³, all reasonable scepticism will in the end give way.

But I work strongly impressed with the duty of making due and suitable return for the opportunities liberally afforded me of examining and comparing the specimens collected in New Zealand, by giving figures of the natural size of all such as typify species. This is the essential foundation of the work of recognizing the already defined species, and of differentiating additional kinds of the extinct birds of New Zealand.

On this ground I proceed to describe a pelvis, femur, tibia, and metatarsus of a *Dinornis* which comes under the latter category, and to ascribe it to a *Dinornis gravis*, from the weight of the bird relatively to its bulk, as indicated by the proportions of the bones of the hind limbs.

I begin with the metatarsus (Pl. LVIII.), as this bone usually yields the best characteristics of the kind of Moa to which it belonged.

In length it comes nearest to the metatarsus of *Dinornis cassuarinus*⁴, in breadth to that of *Dinornis crassus*⁵; it is, however, shorter by half an inch than the former, and broader by five lines than the latter; and as *Dinornis crassus* was differentiated from *Din. casuarinus* by the greater relative breadth of the metatarsus, this differential character applies still more strongly to the present species, inasmuch as the entire bone is shorter than that of *Dinornis casuarinus*, instead of being longer as is the metatarsus of *Dinornis crassus*.

The length of the metatarsus in *Dinornis gravis* is 7 inches 9 lines, the least breadth of the shaft is 2 inches 1 line, the breadth of the proximal end is 3 inches 2 lines or 3 inches 3 lines, that of the distal end is 4 inches 2 lines, the thickness or antero-posterior diameter of the middle of the shaft is 1 inch, its circumference is 5 inches.

¹ Trans. Zool. Soc. vol. iii. p. 235.

² *Tom. cit.* p. 344 (1846).

³ Haast, "On the Measurements of *Dinornis* Bones from a Swamp at Glenmark," in Transactions of the New-Zealand Institute, p. 80. 8vo. Wellington, 1869.

⁴ Trans. Zool. Soc. vol. iii. pl. 48. fig. 3.

⁵ *Tom. cit.* pl. 48. fig. 4.

A comparison of these dimensions with those of the two species of *Dinornis* to which the present comes nearest, in the Table of Admeasurements, p. 371, will exemplify the chief metatarsal characteristics of *Dinornis gravis*.

In general configuration, as in robustness of proportion, though exceeding in the latter respect, the present metatarsus most resembles that of *Dinornis crassus*. I note the following differences, which are repeated in specimens of the metatarsus from two individuals of *Din. gravis* from remote localities in the South Island of New Zealand. The intercondylar rising (Pl. LVIII. figs. 1, 3, *c*) is but slightly developed anteriorly in any *Dinornis*, but it has more claims to be considered a "process" in *Din. gravis* than in *Din. crassus*; the entometatarsal tuberosity (ib. figs. 1 & 3, *e*) is more prominent, and is longer.

In the antinterosseal depression (ib. fig. 1, *i*) the upper common anterior orifice (ib. *n*) of the interosseal canals is less speedily divided into the entinterosseal (ib. fig. 2, *l*) and ectinterosseal (ib. *m*) canals than in *Dinornis crassus*; the rough depression below for the *tibialis anticus* (ib. fig. 1, *o*) is deeper and better-defined for its size in *Dinornis gravis*.

The calcaneal groove (ib. figs. 2, 3, *u*) is narrower and deeper in *Din. gravis*; and the entocalcaneal process (ib. *r*) is rather less prominent. The outer depression on the ectocalcaneal process (ib. *s*) is better marked, and in one metatarsal specimen of *Din. gravis* appears as a shallow longitudinal groove.

The posterior orifice of the entinterosseal canal (*l*) does not open into a depression of the bone; that into which the ectinterosseal canal (*m*) opens, is wide and shallow. The interval between these two orifices in one of the specimens is greater in *Din. gravis* than in the longer metatarsus of *Dinornis crassus*; in the other it is as great.

As in *Dinornis crassus*, the places of insertion of the strong ligamentous aponeurosis formed by the confluence of the tendons of the *gastrocnemius internus* and *gastrocnemius externus* are less longitudinally extended, less ridge-like, and are more concentrated, broader, and better marked than in *Apteryx australis*¹.

The entogastrocnemial surface (Pl. LVIII. fig. 2, *g*) begins behind the entometatarsal tuberosity, and runs downward and backward to near the mid length of the bone; it becomes more defined as it descends, retaining a breadth of about 3 lines, before it suddenly expands into a rough tract of a semioval shape, about 2 inches long by 6 or 7 lines in extreme breadth. This surface terminates about an inch and a half above the hind end of the articular surface of the inner condyle (*ii*). The lower part of this surface indicates the position (ib. fig. 2, *i*) of the ligaments which would attach the metatarsal rudiment of a back toe to the main bone, if such toe existed in *Dinornis gravis*.

The ectogastrocnemial tract (Pl. LVIII. fig. 2, *x*) is at the outer part of the hind surface, and on the lower or distal half of the shaft, of the metatarsal. It is of a semi-

¹ Trans. Zool. Soc. vol. iii. p. 277, plates 31 & 32, R.

oval form, 1 inch 9 lines in length, 7 lines in extreme breadth, and is divided from the back part of the articular surface of the outer trochlea (iv) by a smooth tract about 4 lines in breadth. A narrow, oblong, rough tract at the proximal part of the shaft behind the ectometatarsal ridge (ib. fig. 2, *k*) may serve also for gastrocnemial insertion; but it is divided from the lower ectogastrocnemial tract by a smooth surface of the mid part of the metatarsal, about an inch and a half in extent in one instance, and two inches in the specimen figured in Pl. LVIII. The narrow tract from the entogastrocnemial tuberosity (*g*) is more feebly marked, if it be discernible, in *Dinornis crassus*. The ectogastrocnemial surface is also less defined, and is continued upwards as a more or less conspicuous ridge to within a few lines of the ectometatarsal rough surface in *Dinornis crassus*.

The fore part of the entotrochlea (fig. 1, *ii*) is broader relatively to the hind part in *Dinornis gravis* than it is in *Dinornis crassus*. The outer side of the fore part of the ectotrochlea (iv) is more convex or tuberos, and is less defined from the ectotrochlear fossa than in *Dinornis crassus*.

The interspaces of the trochleæ are narrower in *Dinornis gravis*; and this character is the more easily seized, inasmuch as the breadth of the three trochleæ is almost the same in the two species, notwithstanding the difference in the length of the metatarsi.

Dinornis gravis had a stronger and stouter foot, relatively, than *Dinornis crassus*; and the muscular force working it was more powerful, as is indicated by the insertional ridges and tracts (*g, y, x*).

In a metatarsus of *Dinornis crassus*, 8 inches 6 lines in length, the greatest breadth of the mid trochlea is 1 inch 8 lines; in a metatarsus of *Dinornis gravis* 7 inches 9 lines in length the greatest breadth of the mid trochlea is 1 inch 10 lines.

The general characters of the bone, with the disposition and aspects of the distal trochlea, are much alike in the two species; but the differences above defined impress me with the conviction that ornithologists would find the birds to which the metatarsi of *Din. crassus* and *Din. gravis* belonged, if they had them entire to compare, to be distinct species.

The number of the living species of *Casuaris* which have of late years been discovered in detached remnants of the great Australasian continent, show much more striking differences in plumage and dermal appendages than could have been suspected from any differences which are discernible in the bones of the legs; and these differences, when most distinct, are less marked than those above demonstrated in the metatarsals of the species of *Dinornis* which least differ in general size.

The tibia of *Dinornis gravis* (Pl. LIX.), in comparison with that of *Dinornis crassus*, which it most resembles, has a stronger or thicker shaft in proportion to its length¹. The character of the metatarsal bone of *Dinornis gravis* is here repeated, but in a minor

¹ See Table of Admeasurements, p. 371.

degree. For the rest, the modifications of the dinornithic character of the tibia which the stouter-legged species (*D. robustus*, *D. elephantopus*, *D. crassus*) present, are closely repeated in the tibia of *D. gravis*.

The articular surface (Pl. LIX. fig. 3, *a*), adapted to that of the inner condyle of the femur, is large, shallow, semioval in shape, with the small end turned forward. The ectocondylar surface of the tibia (ib. *b*) is comparatively small, in the form of a tuberosity, the outer and hinder half of which is applied to the inner side of the ectocondylar ridge which divides the tibial from the fibular part of the articular surface at the distal expansion of the femur. The intercondylar channel (*c*) is wide and shallow, and slightly expands as it curves from behind, forward and outward, to the ectocnemial cavity. Anteriorly it is bounded by the low, rough, intercondylar eminence (ib. *d*) for the attachment of the crucial ligaments. The epicnemial channel (*f*) is smooth, broad and shallow.

The rotular or epicnemial ridge (*e*) bounds the anterior and outer half of the proximal expansion of the tibia. The upper end of the procnemial ridge (ib. fig. 1, *g*) forms the low obtuse angle of the epicnemial ridge; the outer continuation of this ridge forms the upper border of the ectocnemial process (*h*).

The suprafibular facet (ib. fig. 2, *l*) is triangular, rough, almost flat. A smooth tract, one inch in extent, divides it from the fibular ridge (*m*), which is four inches in extent and terminates nearly eight inches below the summit of the epicnemial ridge.

The procnemial ridge (ib. fig. 1, *g*) is continued uninterruptedly down the fore part of the shaft with as much inward inclination as makes it, at the lower third of the bone, the inner boundary (*g'*) of the "extensor groove" (ib. *p*). The ectocnemial process or ridge (ib. *h*) is much shorter and thicker, subsiding four inches below the summit of the epicnemial ridge, but extending outward two inches from the suprafibular facet (fig. 2, *l*), and having a thick, smooth border curving to the shaft below its pointed end. The intercnemial surface (ib. fig. 1, *k*), slightly concave across at its upper part, becomes almost flat below. The ectocnemial surface (ib. fig. 2, *i*) is uniformly and more deeply concave across; it is $1\frac{1}{2}$ inch in width.

There are (pneumatic?) foramina (ib. fig. 2, *j, j*) behind and below the intercondylar surface.

A low longitudinal ridge bounds internally the posterior flat tract of the upper half of the shaft, and opposite the fibular ridge inclines forward and to the inner side of the shaft. The medullararterial orifice (ib. fig. 2, *n*) is on the inner side of the fibular ridge, one inch above its end.

As the shaft descends the flatness of its back part gradually becomes convex across, and loses the rough reticulate shallow markings indicative of muscular origin. The ridge (*g'*) continued from the procnemial process, longitudinally and pretty equally bisects a great part of the anterior surface of the shaft, and gives the three-sided character to that part of the bone. On the inner and anterior part of the tibia,

3 inches from the proximal end, is a rough low ridge and surface (ib. fig. 1, *o*), answering to the stronger prominence in the *Cnemiornis* (marked *g* in fig. 1, pl. 66. Zool. Trans. vol. v.).

The extensor canal (Pl. LIX. fig. 1, *p*), its bridge (*q*), and lower outlet (*r*) repeat or retain the dinornithic characters¹. The tuberosity from the outer pier of the bridge is strongly developed. A flat, rough surface, $3\frac{1}{2}$ inches in extent, pointed above and broadening to 10 lines below, marks the inner side of the distal end of the shaft. On the other side of that part is a rough, narrow surface, suggesting a third attachment of the pointed end of a long and slender fibula. The configuration of the distal trochlear articulation closely adheres to the dinornithic pattern. The shallow pit receiving the ectocondylar convexity (Pl. LIX.) is well defined.

The epicnemial process is developed as an epiphysis; it retains this character in the tibia, 14 inches in length, of a young Emu (*Dromaius novæ-hollandiæ*), and includes the commencement of the procnemial and ectocnemial ridges; it might pass for a distinct bone (the patella), as the distal epiphysis (ib. fig. 4, *a*, *v*) has been conjectured to represent an astragalus; but the cartilaginous homologue of the patella in *Dromaius*, which plays upon the rotular groove of the femur, is ossified in some birds, notably in the Penguins and Loons (*Colymbus*), in which the development of the epicnemial process is in excess², and with which the true patella coexists.

The distal epiphysis (Pl. LIX. fig. 4) has effected a closer union with the shaft of this tibia, agreeably with the law of its relation to the course or direction of the medullary artery; the portion of the shaft developed epiphysially (ib. *a*) with the trochlear articulations (*b*) ascends nearly three inches up the fore part of the diaphysis, and develops the groove and process for the ligamentous bridge of the "tibialis anticus" tendon.

Femur.—In no specimen that has hitherto reached me are the dinornithic modifications of the femur more definitely and strongly marked than in the present example (Pls. LX. & LXI.), in which the effects of the usual posthumous abrasion are limited to the articular prominence of the head, and to parts of the margin of the trochanter and hinder projections of the outer condyle. I propose, therefore, to take the opportunity of noting the characters more in detail than has been done in previously figured, less complete, and commonly larger specimens.

The head (*a*) of the femur, in all the species of *Dinornis*, is less sessile than in birds generally; but the part supporting it has more the character of a neck in the present species than in *Dinornis giganteus*³, in *Dinornis casuarinus*⁴, or in *Dinornis maximus*⁵. The constriction affects the entire circumference, but is deepest, as usual, anteriorly,

¹ These are shown, in contrast with those in the tibia of *Gastornis parisiensis*, in the 'Quarterly Journal of the Geological Society,' 1856, pl. iii. figs. 1 & 2, p. 204.

² Owen, 'Anatomy of Vertebrates,' vol. ii. p. 83. fig. 34, *l*.

³ Trans. Zool. Soc. vol. iii. pl. 44. fig. 1.

⁴ Ib. pl. 46. figs. 1, 2.

⁵ Ib. vol. vi. pl. 89. fig. 1.

the head being turned rather forward as well as projecting inward; the axis of the head and neck also slightly inclines upward. The head forms more than a hemisphere. From the neck (*d*), or constriction, the bone rapidly expands to the great trochanter (*f*) and shaft. The articular surface is continued from the head upon the anterior two thirds of the upper part of the trochanter (Pl. LXI. fig. 2, *c*), and is defined by a linear boundary from the non-articular part. Three surfaces may be noted in the enormous trochanterian enlargement of this femur—the upper (epitrochanterian) subdivided as above, the anterior, and the postero-external.

The anterior, or “pretrochanterian,” surface (Pl. LX. fig. 1, *g*) is bisected by a low linear ridge (*h*), which, rising about an inch below the angular summit, passes downward and inward, and subsides (at *h'*) on the inner side of the shaft above the expansion of the inner condyle.

The pre-meets the post-trochanterian tract at an acute angle (*i*); the latter surface is traversed vertically by a rough, broad tract, commencing about an inch from the summit of the trochanter, and gradually approaching the anterior angle as it descends, below which the ridge bends forward, and terminates in the ectotrochanterian tuberosity (Pl. LX. fig. 1, *l*).

The rough tract defines a narrow ectotrochanterian surface from the broader post-trochanterian surface (Pl. LXI. fig. 1, *m*). On this surface are two rough oval shallow depressions for muscular insertions; the upper one (Pl. LXI. fig. 1, *n*, for the “abductor femoris”) is 10 lines below the epitrochanterian ridge, and measures 15 lines by 10 lines: half an inch below and rather in advance of this is the second depression, of rather smaller size, but with a more irregular surface (ib. *o*, for the “quadratus femoris”). From this surface several longitudinal striæ descend vertically, and are continued by one principal linear ridge down the outer side of the shaft to within an inch of the ectocondylar fossa (ib. *k'*). A rough tract is continued from the lower gluteal surface obliquely downward and backward, contracting to the strongly marked ridge (Pl. LXI. fig. 1, *p*). To this ridge converges an inner less prominent oblique ridge (ib. *q*) commencing at the inner side of the shaft, one inch below the neck. The two oblique ridges are divided by a smooth interspace 4 lines in breadth, below which is the orifice of the medullary artery (ib. *r*). On each side of this orifice the lineæ asperæ are, as it were, resumed, and descend slightly diverging,—the outer one (ib. *p'*) gradually subsiding near the ectocondylar pit (*k*); the inner one (ib. *q'*) descends an inch and a half below the arterial orifice to form the tuberosity, *q'*. Internal to this rises a second rough tuberosity (ib. *q''*), continued by a ridge to within an inch of the hind angle of the inner condyle (ib. *u*).

From the ectotrochanterian tuberosity (Pl. LX. fig. 1, *l*) the strong ridge bisecting the fore part of the mid third of the shaft is continued down near the mid line of that surface. Six inches below the upper end of the femur this ridge, which divided the attachments of the “vastus externus” and “vastus internus” muscles, bifurcates, its

divisions diverging to the upper end of the condylar risings (ib. *u, y*), but subsiding before attaining these.

At the lower part of the pretrochanterian surface, midway between the head and the ectotrochanterian tuberosity, is the rough surface, partly prominent, partly depressed (Pl. LX. fig. 1, *s*), which seems to represent the small trochanter in Mammals.

The rotular cavity or channel (ib. fig. 1, *t*), 2 inches across and $1\frac{1}{4}$ inch in depth, shows no trace of the rising marked in that part of the femur of *Dinornis giganteus*¹. The anterior intercondylar ridge dividing the rotular fossa (*t*) from the intercondylar one (Pl. LXI. fig. 1, *v, v'*) is sharp. The intercondylar fossa is partially divided into two depressions, the inner one (ib. *v*) being the deepest, the outer one (*v'*) the largest. These are divided from the popliteal cavity (Pl. LXI. fig. 1, *z*) by the post-intercondylar ridge (ib. *w*), which is well marked, but shorter, thicker, and more rounded than the anterior one (Pl. LX. fig. 2, *t'*).

The entocondylar articular surface (ib. *u'*) has the usual relative size and shape².

The ectocondylar surface for the tibia (ib. *x*) is comparatively small, measuring 1 inch 9 lines by 1 inch in extent; it is continued over the ridge-like posterior projection of this part of the condyle to that on the concavity or groove for the head of the fibula (Pl. LXI. fig. 1, *y*), which groove is feebly divided into an upper (*y'*) and lower (*y''*) tract.

The popliteal space (Pl. LXI. fig. 1, *z*) has the usual dinornithic depth, shape, size, and oblique direction. It is rugous; and some small foramina at its deepest part are the sole representatives of a pneumatic system, though probably related only to the transmission of vessels.

The contrast is striking, in placing by the side of the above-described bone the femur of any of the species of large existing Struthious birds, in regard to every indication of the strength and vigour of application of the hind limbs. The chief results of the comparison of the femur of *Dinornis* with that of *Struthio* were recorded in the original Memoir on the first received bones from New Zealand³. But the femur of the Emu (*Dromaius*), though still smaller than that of the Ostrich in comparison with the gigantic species of *Dinornis*, is less different in shape. The shaft of the bone is rounder than in the Ostrich; but the antero-posterior diameter of that part is less than in *Dinornis*. There is no trace of the bifurcate ridge on the fore part of the shaft, and very feeble indications of "lineæ asperæ" on the back part; of the tuberosities there developed in *Dinornis* no rudiment even is present in existing Struthionidæ. The medullararterial canal is very minute in *Dromaius*, as in other pneumatic femora; and the associated large air-hole at the back part of the upper end of the femur significantly differentiates *Dromaius*, as it does the other large existing Struthionidæ, from *Dinornis*. The head is sessile; one cannot predicate a cervix in the

¹ Trans. Zool. Soc. vol. iii. pl. 44. fig. 2, *r*.

² Ib. ib. pl. 46. fig. 3, *t* (*Dinornis casuarinus*),

³ Ib. ib. (1843) p. 249.

femur of *Dromaius*; the trochanter hardly rises above the level of the head; the back of the trochanter is scarcely at all accentuated, chiefly shows a smooth, feeble concavity; there are no gluteal rugosities, no trace of a lesser trochanterian place of muscular attachment. The popliteal cavity is a shallow groove, not bounded by any post-intercondylar ridge from the intercondylar space. The distal expansion is relatively much less than in *Dinornis*; the inner condyle is much narrower. The tibial part of the outer condyle has relatively more longitudinal extent in *Dromaius* than in *Dinornis*; it rises well above the fibular division, which is relatively shorter than in *Dinornis*, where it equals in that dimension the tibial prominence. But the fibular division projects more outwardly in *Dromaius*, is broader in proportion to its length, and more generally convex. There is no trace of the rough pit for ligamentous or muscular attachment above the fibular division of the outer condyle which so markedly distinguishes the femur of *Dinornis*.

The antero-posterior extent of the outer condyle is much greater than that of the inner condyle in *Dromaius*; the difference is less in *Dinornis giganteus*¹, *Din. casuarinus*², and *Din. didiformis*³. The antero-posterior dimension of the outer and of the inner condyle are nearly the same in *Dinornis gravis*.

The pelvis of *Dinornis gravis* is characteristically massive and ponderous, and accords in shape with those figured in plates 19 & 20 of the first Memoir⁴.

The upper and outer bony wall of the hinder expansion, beyond the gluteal ridges⁵, is better preserved than in figure 3, plate 20⁶.

Eight coalesced vertebræ with combined par- and pleur-apophyses precede the three interacetabular vertebræ, in which those processes are wanting. The bodies of these are broader and flatter below than in the subject of figure 2, pl. 19. vol. iii. Trans. Zool. Soc. After the above eleven sacrals follow six vertebræ with par- and pleur-apophyses again abutting against the iliac walls.

The first sacral has, on each side the centrum, a circular cup for the head of a free rib, behind which cup is a large pneumatic foramen. The ribs of the seven succeeding sacrals are anchylosed and short, abutting against and coalescing with the closely grasping plates of the antacetabular parts of the ilia. The interpleural vacuities of the eight anterior sacrals rapidly decrease in size to the fifth, and again slightly expand in the last two. The first three pairs of anchylosed ribs incline forward; the next three pairs are transverse; the last of this series curves slightly backward, commencing that curve which is carried out by the proximal ends of the ischia. Both ischia and pubes in the present specimen are broken away from their origins at the acetabulum. The following are the dimensions of this pelvis:—

¹ Trans. Zool. Soc. vol. iv. pl. 44. fig. 2.

² Ib. ib. pl. 46. fig. 3.

³ Ib. ib. pl. 24. fig. 3.

⁴ Zool. Trans. tom. cit. (1843).

⁵ Ib. vol. vii. p. 367.

⁶ Ib. vol. iii.

| | in. | lin. |
|--|-----|------|
| Length (fore ends and hind ends of ilia broken off) | 14 | 0 |
| Breadth (behind acetabula, where the prominences are abraded) . . . | 8 | 6 |
| Height of first sacral (summit of spine broken off) | 5 | 0 |
| Breadth of first sacral | 4 | 0 |
| Diameter of circular orifice of neural canal of first sacral | 0 | 4 |
| From fore part of first sacral to postacetabular angle of ilium . . . | 9 | 4 |
| Breadth of "pelvic disk" ¹ | 7 | 0 |
| Vertical diameter of acetabulum | 2 | 3 |
| Length of first eight sacral vertebræ | 6 | 4 |
| Length of last nine sacral vertebræ | 7 | 0 |

It may be convenient for future comparers of the hind-limb bones of *Dinornis* to have, in a tabular form, the principal dimensions of the femur, tibia, and metatarsus of the species now named. In this table are given references to the figures of the type specimens affording the dimensions; and there are added remarks and dimensions of bones obtained by Dr. Haast, F.R.S., from the swamp of Glenmark, and which are referable to the above species of *Dinornis*.

¹ Trans. Zool. Soc. vol. vii. p. 368.

TABLE OF ADMEASUREMENTS OF THE BONES OF THE LEG OF THE KNOWN SPECIES OF *DINORNIS*.

The letter H. refers to the admeasurements given by Dr. Haast in the "Memoir" cited, note 2, p. 362.

Dimensions of the Femur.

| | Din. curtus. | | Din. geranoides. | Din. didiformis. | | | Din. dromioides. | | Din. rheidis. | Din. gracilis. | | Din. gravis. | | | Din. casuarinus. | |
|--------------------------------------|----------------|----------------|------------------|------------------|-----------------|------------------|-----------------------|-----------------------|---------------|----------------|----------------|----------------------|----------------|------------------|-----------------------|--|
| | f3 in. lin. | f4 in. lin. | 4 in. lin. | 6 in. lin. | f7. in. lin. | f17. in. lin. | 9 f16. in. lin. | f Taylor. in. lin. | in. lin. | 13 in. lin. | H. in. lin. | 15 H. in. lin. | H. in. lin. | f13. in. lin. | 18 fE. in. lin. | |
| Length of proximal end (in the neck) | 6 0 | 5 6 | 6 3 | 8 0 | 8 0 | 8 1 | 9 6 | 9 7 | 9 0 | 11 6 | 11 4 | 11 0 | 10 8 | 9 3 | 10 4 | |
| Length of distal end (transverse) | 2 3 | 2 0 | 2 3 | 2 10 | 3 0 | 3 3 | 3 6 | 3 6 | 3 0 | 3 8 | ..... | 4 3 | ... | 3 5* | 3 11 | |
| Distance of middle | 2 5 | 2 2 | 2 9 | 3 3 | 3 2 | 3 6 | 3 7 | 3 8 | 3 6 | 4 0 | ..... | 4 7 | ... | 3 9 | 4 4 | |
| Distance of middle | 2 9 | 2 7 | 3 2 | 4 0 | 4 0 | 4 3 | 4 0 | 3 10½ | 3 9 | 4 8 | ..... | 5 8 | 6 0 | 5 3 | 4 9 | |

* Perhaps not quite enough allowed for mutilated extremities.

Dimensions of the Tibia.

| | 1 t3. | t4. | 14 0 | 7 t3. | t8. | t9. | 10 t. | 17 0 | 14 H. | 16 H. | 19 | | | | | |
|------------------------|----------|------|-------|----------|-------|-------|----------|-------|----------|----------|-------|------|-------|-------|------|-------|
| Length of proximal end | 11 3 | 11 0 | 14 0 | 15 6 | 15 4 | 15 4 | 21 0 | ..... | 17 0 | 23 6 | 23 0 | 17 3 | 16 7 | 15 7 | 18 7 | ..... |
| Length of distal end | 3 3 | 3 1 | 3 0 | 4 5 | ..... | ..... | 4 8 | ..... | 4 6 | 5 0 | ..... | 5 4 | ..... | ..... | 5 6 | ..... |
| Distance of middle | 2 0 | 1 10 | 2 9 | 2 4 | ..... | ..... | 2 8 | ..... | 2 6 | 2 10 | ..... | 3 2 | ..... | ..... | 2 11 | ..... |
| Distance of middle | 2 9 | 2 7 | ..... | 4 0 | ..... | ..... | 4 0 | ..... | 4 0 | 4 6 | ..... | 4 9 | 5 0 | 4 4 | 4 9 | ..... |
| Distance of middle | 4 9 | 4 7 | ..... | 6 10 | ..... | ..... | 9 0 | ..... | 8 0 | 9 6 | ..... | 6 6 | ..... | ..... | 8 6 | ..... |

Dimensions of the Metatarsus.

| | 2 m3. | 3 m4. | 5 | 8 | 11 | 12 H. | 17 | 20 | | | | | | | | |
|-----------------------------------|----------|----------|-------|-------|------|----------|------|-------|------|------|-------|-----|-------|-------|------|-------|
| Length at the middle of the shaft | 5 0 | 4 6 | 6 0 | 7 0 | 6 10 | ..... | 10 5 | ..... | 9 0 | 13 0 | 12 6 | 7 9 | 7 9 | 7 4 | 8 0 | ..... |
| Length of distal end (transverse) | 2 10 | 2 6 | ..... | 3 3 | 3 3 | ..... | 3 9 | ..... | 4 6 | 4 3 | ..... | 5 0 | 9 8 | 4 5 | 4 2 | ..... |
| Distance of middle of shaft | 2 5 | 2 1 | 3 0 | ..... | 3 0 | ..... | 3 4 | ..... | 3 9 | 4 3 | ..... | 4 2 | ..... | ..... | 3 10 | ..... |
| Distance of middle of shaft | 1 1 | 1 0 | 1 5 | 1 5 | 1 3 | ..... | 1 4 | ..... | 1 10 | 1 7 | ..... | 2 0 | ..... | ..... | 1 7 | ..... |
| Distance of middle of shaft | 0 7 | 0 6 | ..... | 0 9 | 0 9 | ..... | 0 10 | ..... | 1 0 | 1 2 | ..... | 1 0 | ..... | ..... | 0 10 | ..... |
| Distance of proximal end | 1 11 | 1 9 | 2 3 | ..... | 2 3 | ..... | 2 10 | ..... | 3 9 | 3 4 | ..... | 3 1 | ..... | ..... | 3 0 | ..... |

Dimensions of the Femur.

| | Din. crassus. | Din. elephantopus. | | Din. struthoides. | | Din. ingens. | | Din. giganteus. | | | Din. robustus. | | Din. maximus. | |
|--------------------------------------|---------------|--------------------|----------------|-------------------|------------------------|----------------|-----------------|-----------------|----------------|----------|----------------|----------------|----------------|----------------|
| | in. lin. | 22 in. lin. | H. in. lin. | f12. in. lin. | f Colenso. in. lin. | 28 in. lin. | f2. in. lin. | 31 in. lin. | H. in. lin. | in. lin. | in. lin. | H. in. lin. | 33 in. lin. | H. in. lin. |
| Length of proximal end (in the neck) | 12 0 | 13 0 | 12 8 | 11 6* | 12 0 | 13 9 | 13 0 | 16 0 | 16 5 | ..... | 14 2 | 14 6 | 18 3 | 18 4 |
| Length of distal end (transverse) | 5 0 | 5 10 | ..... | 4 2 | 4 2 | 5 5 | 4 10 | 6 0 | ..... | ..... | 6 0 | ..... | 6 6 | ..... |
| Distance of middle | 5 3 | 5 11 | ..... | 4 3 | 4 4 | 5 10 | 5 2 | 6 3 | ..... | ..... | 6 0 | ..... | 7 6 | ..... |
| Distance of middle | 6 8 | 7 9 | ..... | 5 6 | 5 6 | 7 1 | 6 1 | 7 9 | ..... | ..... | 7 10 | ..... | 9 6 | 9 6 |

* Perhaps not quite enough allowed for mutilated extremities.

Dimensions of the Tibia.

| | 19 0 | 23 | | 26 | | t2. | tE1. | t1. | tE. | H. | 32 3 | H. 30 4 | 34 39 0 | H. 39 2 |
|------------------------|------|------|------|------|------|------|------|------|------|-------|------|------------|------------|------------|
| Length of proximal end | 6 2 | 7 5 | 7 0 | 5 6 | 5 4 | 6 2 | 6 6 | 7 6 | 7 0 | ..... | 7 6 | ..... | 8 6 | ..... |
| Length of distal end | 3 3 | 4 2 | 4 0 | 3 2 | 3 1 | 3 7 | 4 0 | 4 6 | 4 8 | ..... | 4 4 | ..... | 5 0 | ..... |
| Distance of middle | 4 5 | 6 5 | 6 5 | 5 0 | 4 8 | 5 3 | 6 3 | 6 6 | 6 6 | ..... | 6 9 | ..... | 8 6 | 8 7 |
| Distance of middle | 10 0 | 11 6 | 11 0 | 10 0 | 10 0 | 12 0 | 12 0 | 13 0 | 13 0 | ..... | 12 0 | ..... | 20 0 | ..... |

Dimensions of the Metatarsus.

| | 21 | 24 | | m3. | 27 mE. | mE. | 30 Colenso. | m1. | 31 mE. | H. | 32 H. | 35 | | |
|-----------------------------------|------|-------|-------|-------|-----------|------|----------------|------|-----------|-------|----------|-------|-------|-------|
| Length at the middle of the shaft | 8 6 | 9 8 | 9 3 | 12 0 | 11 6 | 14 6 | 13 9 | 18 6 | 18 0 | 18 9 | 15 9 | 16 2 | 20 0 | 21 6 |
| Length of distal end (transverse) | 4 8 | 4 8 | 4 6 | 4 3 | 4 2 | 5 6 | 4 6 | 5 6 | 6 0 | ..... | 5 3 | ..... | 8 4 | 6 4 |
| Distance of middle of shaft | 4 0 | 5 6 | 5 4 | 4 0* | 4 5 | 5 6 | 4 6 | 5 1 | 6 0 | ..... | 5 3 | ..... | 6 9 | 7 3 |
| Distance of middle of shaft | 1 10 | 2 8 | 2 5 | 1 6 | 1 6 | 1 10 | 1 7 | 1 11 | 2 2 | ..... | 2 0 | ..... | 3 0 | 2 7 |
| Distance of middle of shaft | 1 2 | ..... | ..... | 1 1 | 1 1 | 1 5 | 1 3 | 1 6 | 1 6 | ..... | ..... | ..... | ..... | ..... |
| Distance of proximal end | 3 3½ | 4 8 | 4 5 | ..... | 3 5 | 4 3† | 3 6 | 0 0 | 4 6 | ..... | 4 6 | ..... | 5 6 | 5 3 |

Perhaps not enough allowed for water-worn margins of trochleae.

† With a ridge at the middle of inner condyle at proximal end.

- | | | | | |
|-----------------------------------|----------------------------------|-------------------------------------|-----------------------------------|-----------------------------------|
| of which a side view | 3 Trans. Zool. Soc. vii. pl. 44. | 13 Trans. Zool. Soc. iv. pl. 41. | 21 Trans. Zool. Soc. iii. pl. 48. | 29 Trans. Zool. Soc. iii. pl. 25. |
| en in pl. 20. a, and there | fig. 7. | fig. 1. | figs. 4 & 5. | fig. 1, pl. 26. fig. 1. |
| ed) <i>Din. didiformis</i> , is a | 4 Ibid. v. pl. 65. figs. 5, 6. | 14 Ibid. pl. 42. fig. 2. | 22 Ibid. iv. pl. 43. fig. 1. | 30 Ibid. pl. 48. fig. 1. |
| rs of <i>Din. casuarinus</i> . | 5 Ibid. pl. 67. figs. 5, 6. | 15 Ibid. viii. pl. 58. | 23 Ibid. figs. 4 & 5. | 31 Ibid. pl. 27. fig. 1. |
| ra. Zool. Soc. iii. pl. 47. | 6 Ibid. iii. pl. 24. | 16 Ibid. pl. 50. | 24 Ibid. pl. 44. fig. 1. | 32 Ibid. iv. pl. 1. fig. 1. |
| 4, 5. | 7 Ibid. pl. 26. figs. 3, 4. | 17 Ibid. pls. 60, 61. | 25 Ibid. pl. 41. fig. 2. | 33 Ibid. vi. pl. 89. fig. 1. |
| Mem. | 8 Ibid. pl. 27. fig. 3. | 18 Ibid. iii. pl. 46. | 26 Ibid. pl. 42. fig. 1. | 34 Ibid. pl. 90. |
| big vii. pl. 44. fig. 8 (com- | 9 Ibid. pl. 22. | 19 Ibid. pl. 47. | 27 Ibid. pl. 41. fig. 4. | 35 Ibid. pl. 89. fig. 3. |
| vit the first indication of | 10 Ibid. pl. 47. fig. 1. | 20 Ibid. pl. 48. fig. 3. (See also | 28 Ibid. iii. pl. 21. fig. 1. | |
| ces, Trans. Zool. Soc. iii. | 11 Ibid. pl. 48. fig. 2. | pl. 20. a, fig. 2, wrongly ascribed | | |
| 1. 6). | 12 Ibid. iv. pl. 3. | to <i>Din. didiformis</i> .) | | |

Addition to Note 5, p. 371.

The dimensions of the tibia and metatars of the "smallest size" of *Dinornis didiformis* in Dr. Haast's list of bones from Glenmark swamp agree with those of the present species (*D. geranoïdes*); but the femur therewith associated has the length (9 inches) of a large variety of *D. didiformis*.—*Trans. New-Zealand Institute*, vol. i. 1869, p. 83.

Addition to Note 8, p. 371.

Tibiæ and metatarsi identical, or nearly so, in size and shape with those of the present species are referred thereto by Dr. Haast (*loc. cit.*); but the femur associated therewith in the list of specimens from the Glenmark swamp is an inch longer than that of *D. didiformis* from the North Island. Does this indicate an established variety in the South Island?

Addition to Note 9, p. 371.

Unless the femur, 9 inches 6 lines in length, referred to "No. 4, *Din. didiformis*, largest size," in Dr. Haast's list (*loc. cit.* p. 83), belongs to a *Dinornis dromioides*, that species has not yet been met with out of the North Island. The tibia, 15 inches 6 lines in length, and the metatarsus, 7 inches 5 lines in length, which Dr. Haast associates with this femur, would rightly come under the head of *Din. didiformis*.

Addition to Note 14, p. 371.

"No. 10. *Dinornis gracilis*, Owen. Of this elegant species three more or less complete specimens were found amongst the exhumed bones, which agree in every respect with Professor Owen's figures. For comparison, I shall give the measurements of the best-preserved specimen:—

| "No. 10. | Length of bone. | Girth of proximal end. | Girth of shaft, thinnest part. | Girth of distal end. |
|-------------------|-----------------|------------------------|--------------------------------|----------------------|
| | inches. | inches. | inches. | inches. |
| "Metatarsus | 12·6 | 10·3 | 4·6 | 12·0 |
| Tibia | 23·0 | 13·9 | 4·7 | 11·3 |
| Femur | 11·4 | 11·3 | 5·4 | 12·7" |

HAAST, *loc. cit.* p. 84.

Addition to Note 17, p. 371.

To this species I refer "No. 17, *Dinornis* (?)," in Dr. Haast's List (*loc. cit.* p. 87); on which he remarks:—"A species smaller than No. 16, but partaking still of the same character.

"Measurements.

| "No. 17. | Length of bone. | Girth of proximal end. | Girth of shaft, thinnest part. | Girth of distal end. |
|-------------------|-----------------|------------------------|--------------------------------|----------------------|
| | inches. | inches. | inches. | inches. |
| "Metatarsus | 7·4 | 7·5 | 4·5 | 10·3 |
| Tibia | 15·7 | 14·4 | 4·4 | 9·5 |
| Femur | 9·3 | 10·5 | 5·3 | 11·4" |

The specimens from the Glenmark swamp, referred to under "No. 16, *Dinornis crassus*," agree best with *Dinornis gravis*. Dr. Haast remarks:—"Of this species we obtained ten more or less complete specimens, so that I had ample material to assure myself of the correctness of its specific character.

"Measurements.

| "No. 16. | Length of bone. | Girth of proximal end. | Girth of shaft, thinnest part. | Girth of distal end. |
|-------------------|-----------------|------------------------|--------------------------------|----------------------|
| | inches. | inches. | inches. | inches. |
| "Metatarsus | 7·9 | 9·0 | 4·8 | 11·1 |
| Tibia | 16·7 | 14·2 | 5·0 | 10·6 |
| Femur | 10·8 | 12·0 | 6·0 | 15·3 |

“The metatarsus is shorter than Professor Owen’s *crassus*, the circumference larger, but the proximal end is somewhat smaller.

“The tibia is smaller, but again thicker than Professor Owen’s *crassus*.

“The femur is also shorter, whilst the circumference is the same as Professor Owen’s species. An examination of the general character shows that it is a somewhat smaller but stouter bird than Professor Owen’s *crassus*.”—*Loc. cit.* p. 86.

Addition to Note 21, p. 371.

To this species I should refer the specimens of which Dr. Haast gives the following average size of the leg-bones of fifteen specimens obtained from the Glenmark swamp:—

| “No. 11. | Length of bone. | Girth of proximal end. | Girth of shaft, thinnest part. | Girth of distal end. |
|-------------------|-----------------|------------------------|--------------------------------|----------------------|
| | inches. | inches. | inches. | inches. |
| “Metatarsus | 8·8 | 9·2 | 5·1 | 10·8 |
| Tibia | 18·7 | 14·9 | 4·8 | 10·5 |
| Femur | 11·0 | 12·4 | 5·6 | 13·0” |

And on which he remarks:—“When examining the metatarsus of this subdivision, I found that it corresponded best with one figured by Professor Owen as *crassus* (pl. 48, p. 324, vol. iii. Trans. Zool. Soc.), although the measurements of *crassus* given by Professor Owen further on in his excellent Memoirs differ slightly from the specimen in question, and, as it appears to me, from his own figured metatarsus.”—*Loc. cit.* p. 82.

This difference applies to figure 3 in plate 48 of the Memoir cited, but not to figure 4 in that plate.

Addition to Note 24, p. 371.

“*Dinornis elephantopus*, Owen. Of this remarkable species bones of at least nine, more or less complete, individuals were exhumed, of which four were of the same size as those figured by Professor Owen, while the five others decrease gradually to the size of No. 13, without my being able to find any line of demarcation between them. Of one of these large specimens, which were found together in their natural position, I give here the measurements; they represent, at the same time, the character of the three large specimens excavated.

“Among the Glenmark bones the metatarsus is generally of larger dimensions than Professor Owen’s, according to his measurements; the tibia between the two measurements he gives; the femur is also slightly smaller than the one Professor Owen figures:—

| “No. 12. | Length of bone. | Girth of proximal end. | Girth of shaft, thinnest part. | Girth of distal end. |
|-------------------|-----------------|------------------------|--------------------------------|----------------------|
| | inches. | inches. | inches. | inches. |
| “Metatarsus | 9·8 | 12·3 | 6·8 | 15·2 |
| Tibia | 22·8 | 18·7 | 6·3 | 14·5 |
| Femur | 12·8 | 15·5 | 7·7 | 17·4 |

“There is, then, a distinct break between No. 13 (*Din. elephantopus*, smaller size) and the next size, No. 16, *Dinornis crassus* (?)”.—HAAST, *loc. cit.* p. 85.

Addition to Note 27, p. 371.

This species appears to be represented by a somewhat stronger variety in the South Island, and to have been rare there. In the series of bones obtained from the Glenmark swamp, Dr. Haast remarks:—

“No. 7. *Dinornis*, sp. We possess only the three principal bones of one leg, and odd bones of two other specimens; they are larger, and slightly thicker, than those of *Dinornis struthioides*.

“On the other hand they are much smaller than those of *Palapteryx ingens*. There is no dent or depression

on the back of the metatarsus for the attachment of the back metatarsal trochlea. This bird was bow-legged, and resembled most *Dinornis struthioides* in its principal characteristics, although of larger dimensions.

| "No. 7. | Length of bone. | Girth of proximal end. | Girth of shaft, thinnest part. | Girth of distal end. |
|-------------------|-----------------|------------------------|--------------------------------|----------------------|
| | inches. | inches. | inches. | inches. |
| "Metatarsus | 12·9 | 10·8 | 4·7 | 13·2 |
| Tibia | 24·8 | 14·8 | 5·2 | 12·7 |
| Femur | 12·3 | 14·3 | 6·4 | 14·8 |

"The bones belong evidently to adult birds (three specimens)."—*Loc. cit.* p. 84.

Addition to Note 30, p. 371.

This species, common in the North Island, seems to have been rare in the South Island. Dr. Haast remarks:—

"No. 8. *Palapteryx ingens*, Owen. We obtained only portions of one single specimen from Glenmark, which agree closely with the figures and measurements given by Professor Owen. It is remarkable that there were no more, considering the large quantities of bones of other species dug out.

"Well-preserved parts of another of the same were obtained at Heathcote, near the foot of Banks's peninsula, from a drain five or six feet deep, cut in sandy loam (silt); the bones are a little smaller than Professor Owen's figure, but they are larger than those found in a cave in the province of Nelson, and from which Dr. Jaeger, in Vienna, constructed his cast.

"For comparison I append the measurement of the Heathcote specimen:—

| "No. 8. | Length of bone. | Girth of proximal end. | Girth of shaft, thinnest part. | Girth of distal end. |
|-------------------|-----------------|------------------------|--------------------------------|----------------------|
| | inches. | inches. | inches. | inches. |
| "Metatarsus | 15·1 | 11·5 | 5·7 | 13·6 |
| Tibia | 29·5 | 17·6 | 6·0 | 15·0 |
| Femur | 14·2 | 12·5 | 7·6 | 17·0 |

"The metatarsus has the hollow for the attachment of the back *trochlea* well marked; and the general character of the bones shows clearly that they belonged to a well-developed strong (male?) bird."—*Loc. cit.* p. 48.

Addition to Note 31, p. 371.

This species is represented in the South Island by a variety with rather thicker limb-bones, as indicated by the third of Dr. Haast's admeasurements.

"No. 20. *Dinornis giganteus*. Bones were obtained belonging to six distinct birds of this species, one of the most perfect of which, when articulated, measured 9 feet 10 inches.

"The character of its bones is identical with those given by Professor Owen, except in some small details.

| "No. 9. | Length of bone. | Girth of proximal end. | Girth of shaft, thinnest part. | Girth of distal end. |
|-------------------|-----------------|------------------------|--------------------------------|----------------------|
| | inches. | inches. | inches. | inches. |
| "Metatarsus | 18·9 | 13·1 | 6·8 | 16·6 |
| Tibia | 34·0 | 21·0 | 6·9 | 17·5 |
| Femur | 16·5 | 16·1 | 8·7 | 18·6" |

Loc. cit. p. 88.

Addition to Note 32, p. 371.

"No. 21. *Dinornis robustus*, Owen. The measurements given are those of the specimen articulated for the

Canterbury Museum. Besides which we obtained a few bones belonging to another bird very little inferior in size. Both correspond well with the figures and descriptions of Professor Owen:—

| "No. 21. | Length of bone. | Girth of proximal end. | Girth of shaft, thinnest part. | Girth of distal end. |
|-------------------|-----------------|------------------------|--------------------------------|----------------------|
| | inches. | inches. | inches. | inches. |
| "Metatarsus | 16·2 | 12·6 | 6·2 | 15·2 |
| Tibia | 30·4 | 19·1 | 6·8 | 14·5 |
| Femur | 14·6 | 15·5 | 7·7 | 17·5 " |

Loc. cit. p. 88.

Addition to Note 35, p. 371.

The confirmation and acceptance of this species by the accomplished geologist and naturalist in charge of the Canterbury Museum gave me much satisfaction. Dr. Haast writes:—

"No. 18. *Dinornis maximus*, Owen? Of this species we obtained the perfect pelvis, the right femur, tibia, and fibula, and the first two dorsal vertebræ, lying still in their original position. We dug all round these bones, but our researches were not rewarded by finding any more remains belonging to the same specimen. A fragment of a metatarsus, however, which was lying in a drain not far from the spot, seemed, from its size, to have belonged to this or to a similar bird.

"I may here observe that, judging from the size of the two dorsal vertebræ, still larger specimens of *Dinornis* are entombed in the same swamp, because we obtained a nearly complete neck of one of still larger dimensions than that belonging to No. 18, the other portions of which have not yet been found.

"Measurements.

| "No. 18. | Length of bone. | Girth of proximal end. | Girth of shaft, thinnest part. | Girth of distal end. |
|-------------------|-----------------|------------------------|--------------------------------|----------------------|
| | inches. | inches. | inches. | inches. |
| "Metatarsus ..... | ..... | ..... | 8·1 | ..... |
| Tibia | 39·2 | 22·5 | 8·7 | 17·6 |
| Femur | 18·4 | 19·0 | 9·6 | 21·7 |

"The metatarsus, of which, as before observed, we have only a fragment, is remarkably flat and broad, and does not narrow towards the middle, as in *Din. giganteus*; when restored according to the metatarsus belonging to No. 19, it would be about 23 inches long. We obtained also parts of a specimen of No. 19, which have all the characteristics of this species, but somewhat smaller in all dimensions. The tibia is remarkably thick round the shaft, and presents altogether a very different appearance from that of *Din. giganteus*."—*Loc. cit.* p. 87.

In the preceding Table five species have leg-bones proportionally thick; these strong-limbed Moas are represented by *Dinornis gravis*, *Din. casuarinus*, *Din. crassus*, *Din. elephantopus*, and *Din. robustus*. Six species have leg-bones proportionally thin; these are:—*Dinornis didiformis*, *Din. dromioides*, *Din. gracilis*, *Din. struthioides*, *Din. ingens*, and *Din. giganteus*.

Dinornis rheides is intermediate in the strength or thickness of the limb-bones.

Two species are notable for their small size, viz. *Dinornis geranoïdes* and *Din. curtus*; one species for its great size, even in a genus of giants, viz. *Dinornis maximus*. Of the

bones referable by length to this species, two varieties are indicated by metatarsals¹; the longer and more slender form, contributed by Dr. Lillie (*tom. cit. infra*, p. 500), may prove to be a variety so well established and so characterized by concomitant modifications in other parts of the skeleton as to need, for convenient reference, a distinct name, for which that of *Dinornis altus* may be accepted.

In comparing the skulls, indicative of eight or nine of the fifteen species of *Dinornis* characterized by limb-bones, we see that they differ in the relative length of the beak², and in that of the terminal osseous part of the upper mandible³ to the rest of the skull, in the sharper or more obtuse termination of both mandibles⁴, in the relative antero-posterior extent of the temporal fossæ⁵, in the relative flatness or transverse convexity of the cranium⁶, in the longitudinal contour of the upper part of the skull⁷, and in a few such minor particulars as the breadth and direction of the postorbital process.

The sternum of *Dinornis*, whilst conforming to the apterygian type⁸, shows two well-marked modifications thereof—in the proportions of breadth to length, and in the degree of divergence of the lateral processes⁹.

The back toe (*hallux, i*) was a small functionless appendage to the foot in the best-developed condition in which it has been found¹⁰. The trace of the ligamentous attachment to the functionally developed metatarsus is feeble in the species in which the existence of this toe is most certain. It cannot be inferred to have been wholly absent in the cases in which the connecting ligaments have left a less definite trace or where such is undistinguishable. I have therefore felt obliged to abandon this ground of generic distinction¹¹.

One is naturally disposed to group together the thick-legged or strong-limbed species of the South Island represented by the five above cited. It would seem that the broader type of sternum was associated with such proportions of the limb-bones in those species. If such association should be proved and found to be constant, and if

¹ Trans. Zool. Soc. vol. vi. pl. 89. figs. 4 & 5.

² Compare Trans. Zool. Soc. vol. v. pl. 55. fig. 1 (*Dinornis robustus*), with *op. cit.* vol. vii. pl. 13. fig. 1 (*Dinornis casuarinus*).

³ Compare *op. cit.* vol. vii. pl. 15. fig. 1 (*Dinornis ingens*), with *op. cit.* vol. vii. pl. 11. fig. 1 (*Dinornis crassus*).

⁴ Compare *op. cit.* vol. vii. pl. 11. figs. 2, 3, 8, & 9 (*Dinornis crassus*), with *op. cit.* vol. vii. pl. 10. figs. 6-9 (*Dinornis elephantopus*).

⁵ Compare *op. cit.* vol. v. pl. 53. fig. 1 (*Dinornis robustus*), with Jaeger, Paläontologie der Novara Expedition, art. vi. Bericht über einen fast vollständigen Schädel von *Palapteryx ingens*, Taf. xxvi. fig. 2.

⁶ Compare *op. cit.* vol. vii. pl. 10. fig. 2 (*Dinornis elephantopus*), with *op. cit.* vol. iv. pl. 24. fig. 1 (*Dinornis giganteus*).

⁷ Compare *op. cit.* vol. v. pl. 55. fig. 1 (*Dinornis robustus*), with *op. cit.* vol. vii. pl. 11. fig. 1 (*Dinornis crassus*), or with *op. cit.* vol. vii. pl. 13. fig. 1 (*Dinornis casuarinus*).

⁸ Trans. Zool. Soc. vol. ii. p. 290, pl. 55. figs. 2 & 3, vol. vii. p. 118.

⁹ Compare *op. cit.* vol. vii. pl. 7. fig. 1 (*Dinornis elephantopus*), with *op. cit.* vol. vii. pl. 8. fig. 1 (*Dinornis rheides*).

¹⁰ *Op. cit.* vol. iv. pl. 1. figs. 4 & 5 (*Dinornis robustus*).

¹¹ Trans. Zool. Soc. vol. vii. p. 119.

in like manner the narrower form of sternum shown in *Dinornis rheides* should be found to prevail in the six slender-limbed species, we shall have the same ground for restricting to them the old generic term. If it could be shown that *Palapteryx*, as above defined, had the hallux, and that *Dinornis*, as above restricted, had it not, the grounds of the generic or subgeneric division would be strengthened.

But when we come to consider the species manifesting the cranial modifications above specified, we find what would otherwise afford the most satisfactory generic character failing us. *Dinornis robustus* resembles most *Dinornis ingens* in the form and proportions of skull and beak. *Dinornis elephantopus*, which most closely resembles in limb-characters and sternum *Dinornis crassus*, most differs from that species in the form and proportions of the mandibles.

But much yet remains to be recognized as to the cranial characters of the species of *Dinornis* indicated by other parts of the skeleton. No skull of any of the species represented by remains in the North Island has yet been found at all comparable in the state of its preservation or entireness to those discovered in the South Island. The North-Island Moa-bones, as I have before had occasion to remark, are more mineralized, or more changed from their recent state, than those from the swamps and turbaries of the South Island. The least incomplete of the crania from the North Island is that figured in pl. 54 of vol. iii. of the Transactions of this Society, where it is provisionally referred to *Dinornis geranoïdes*.

Many years may elapse before examples of the skeleton of the slender-limbed species of the North Island are found in such proportion and juxtaposition as to warrant confidence in the ascription to each of its cranial characteristics. The inferential restorations of some of the South-Island Moa-skeletons, in respect at least of the skulls, may need rectification as the result of more fortunate discoveries.

In the present condition therefore of my information respecting the extinct Moas, I deem the means of imparting it to be satisfied by the use of one generic term, with a grouping together of the species on the ground of well-marked differences of thickness in relation to length of femur, tibia, and metatarsus, and more especially as shown by the last-named bone.

DESCRIPTION OF THE PLATES.

PLATE LVIII.

Left Metatarsal. Nat. size.

Fig. 1. Front view.

Fig. 3. Upper or condylar end.

- a.* Entocondylar cavity.
- b.* Ectocondylar cavity.
- c.* Intercondylar process.
- d.* Intercondylar tract.
- e.* Entometatarsal ridge or tuberosity.
- f.* Ectocondylar ridge.
- g.* Entogastrocnemial ridge.
- h.* Antero-superior ridge.
- i.* Antinterosseal depression.
- k.* Ectometatarsal tuberosity.
- l.* Entinterosseal canal.
- m.* Ectinterosseal canal.
- n.* Antinterosseal canal.

Fig. 2. Back view.

Fig. 4. Lower, or trochlear end.

- o.* Fossa of tibialis anticus tendon.
- p.* Entotrochlear ridge.
- r.* Entocalcaneal process.
- s.* Ectocalcaneal process.
- u.* Calcaneal groove.
- v.* Postinternal surface.
- w.* Postexternal surface.
- x.* Ectogastrocnemial surface.
- I. Hallucial surface.
- II. Entotrochlea.
- III. Mesotrochlea.
- IV. Ectotrochlea.

PLATE LIX.

Right tibia. Nat. size.

Fig. 1. Front view.

Fig. 3. Upper articular end.

- a.* Entocondylar surface.
- b.* Ectocondylar surface.
- c.* Intercondylar canal.
- d.* Intercondylar eminence.
- e.* Rotular (epicnemial) process.
- f.* Epicnemial channel.
- g.* Procnemial ridge.
- h.* Ectocnemial ridge.
- i.* Ectocnemial cavity.
- j.* Pneumatic orifices.
- k.* Interenemial cavity.

Fig. 2. Back view.

Fig. 4. Lower epiphysis of tibia of *Dromaius*.

- l.* Suprafibular surface.
- m.* Fibular ridge.
- n.* Orifice of medullary artery.
- o.* Gastrocnemial surface.
- p.* Extensor groove.
- q.* Extensor bridge.
- r.* Extensor bridge, lower outlet.
- s.* Entocondyle.
- t.* Ectocondyle.
- u.* Intercondylar space.
- v.* Trochlear canal.

Femur of Dinornis gravis. Nat. size.

PLATE LX.

Fig. 1. Front view.

Fig. 2. Lower articular surface.

PLATE LXI.

Fig. 1. Back view.

Fig. 2. Upper articular surface.

In both Plates.

- | | |
|--|---|
| <p><i>a.</i> The head.</p> <p><i>b.</i> The depression for ligament (part of).</p> <p><i>c.</i> The trochanterian articular surface.</p> <p><i>d.</i> The neck.</p> <p><i>e.</i> Non-articular surface.</p> <p><i>f.</i> Epitrochanterian ridge.</p> <p><i>g.</i> Retrochanterian surface.</p> <p><i>h.</i> Retrochanterian ridge.</p> <p><i>i.</i> Angle between trochanterian surfaces.</p> <p><i>j.</i> Ectotrochanterian surface.</p> <p><i>k.</i> Ectotrochanterian ridge.</p> <p><i>l.</i> Ectotrochanterian tuberosity.</p> <p><i>m.</i> Post-trochanterian surface.</p> <p><i>n.</i> Upper gluteal surface.</p> <p><i>o.</i> Lower gluteal surface.</p> <p><i>p.</i> Linea obliqua longitudinalis superior externa; <i>p'</i>, inferior ditto.</p> | <p><i>q.</i> Linea obliqua longitudinalis superior interna; <i>q'</i>, inferior.</p> <p><i>q''.</i> Ectocondylar branch.</p> <p><i>r.</i> Medullararterial orifice.</p> <p><i>r'</i>. Entocondylar branch.</p> <p><i>s.</i> Small trochanterian surface.</p> <p><i>t.</i> Rotular channel.</p> <p><i>t'</i>. Anterior intercondylar ridge.</p> <p><i>u'</i>. Entocondylar surface.</p> <p><i>v.</i> Intercondylar fossa.</p> <p><i>w.</i> Posterior intercondylar ridge.</p> <p><i>x.</i> Ectocondylar surface for tibia.</p> <p><i>y.</i> Fibular surface.</p> <p><i>z.</i> Popliteal space.</p> |
|--|---|

[The specimens of *Dinornis gravis*, above described and figured, were discovered in the bed of the Kakamai river, South Island, by Wm. Fenwick, Esq. I am indebted to the kindness of the Baroness Burdett Coutts for the loan of the specimens.]

Postscript.—Since writing the above I have received from my zealous and accomplished correspondent in New Zealand, Julius Haast, Ph.D., F.R.S., Government Geologist of the Province of Canterbury, the following announcement of the discovery of remains of a bird of prey which may truly be termed gigantic.

These remains were discovered and recognized by Dr. Haast's assistant, Mr. F. Fuller, while directing some excavations in a marsh on the Glenmark estate. They consist of a left femur, two claw-phalanges, a vertebral rib, with its ankylosed epipleural appendage, and a mutilated right humerus, the latter being subsequently discovered in a watercourse, about two miles from Glenmark. Dr. Haast, who has kindly sent me

drawings of these fossils, has communicated a memoir on them to the Philosophical Institute of Canterbury, New Zealand, in which he refers the bird they represent to a genus *Harpagornis*, Haast, with the specific name *moorei*, after the partner of Ker-mode & Co., owners of the property, in which, through their liberality, so many evidences of the extinct birds of New Zealand have been brought to light. *Harpagornis* was twice the size of the great wedge-tailed eagle of Australia (*Aquila audax*, Gould). The characters of the femur and the claw-bones, especially the length and shape of the "flexor process" in the latter, so far as the drawings permit the comparison to be made, agree more closely with those of *Circus* than of *Aquila*. In this I concur with Dr. Haast, who was led to the same conclusion by comparing the bones of *Harpagornis* with those of the New-Zealand Harrier (*Circus assimilis*, Jardine). Dr. Haast conjectures that the gigantic Harrier preyed upon the young or feeble individuals of the genus *Dinornis*, and with them became extinct. He deduces from this discovery additional confirmation of his belief that "the present aborigines of New Zealand do not possess any traditions about the gigantic Moas"¹, and writes, "that if trustworthy traditions about the *Dinornis* had been handed down to us, the still more alarming existence of this gigantic bird of prey, contemporaneous with the former, would most certainly have been recorded."—*Letter* penes me, dated "Canterbury Museum, Christchurch, N. Z., 22nd December, 1871."

I may remark that the individual who, in 1839, submitted to me, with other New-Zealand rarities, the fragment of bone which gave the first evidence of great wingless birds in that island, stated that the natives from whom he obtained it "had a tradition that it belonged to a bird of the eagle kind, which had become extinct, and to which they gave the name of 'Movie.'"² I am now, of course, disposed to attach more weight to this tradition than when it rested on a fossil proved to belong to a bird which could not fly, and which was as large as an Ostrich. We may suppose the great Raptorial species, which we now know to have coexisted with the *Dinornithes*, to have survived, by reason of its greater power of escape, some time after the extinction of its principal prey; and the tradition of the great bird "of the eagle kind" may be a consequence of the knowledge of the *Harpagornis* continuing down to later generations of Maories than those who hunted down the huge herbivorous flightless birds.

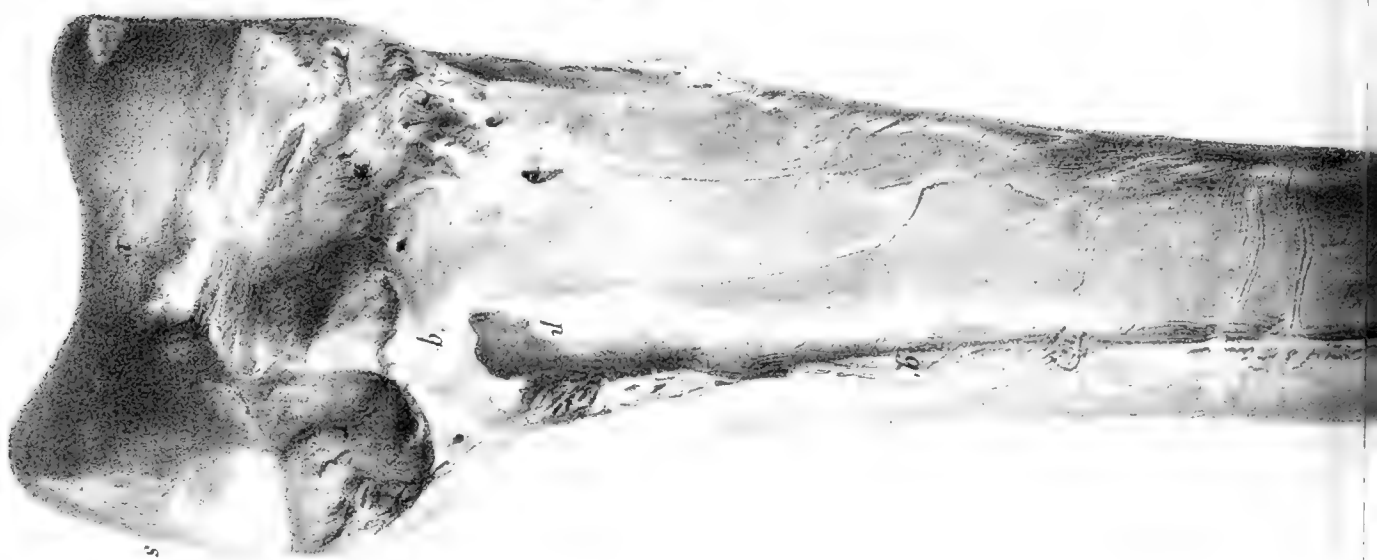
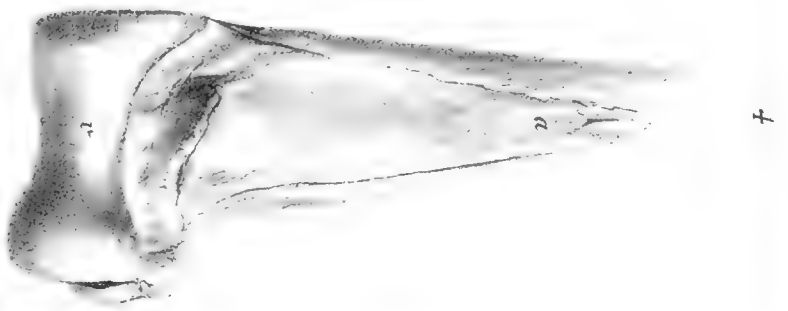
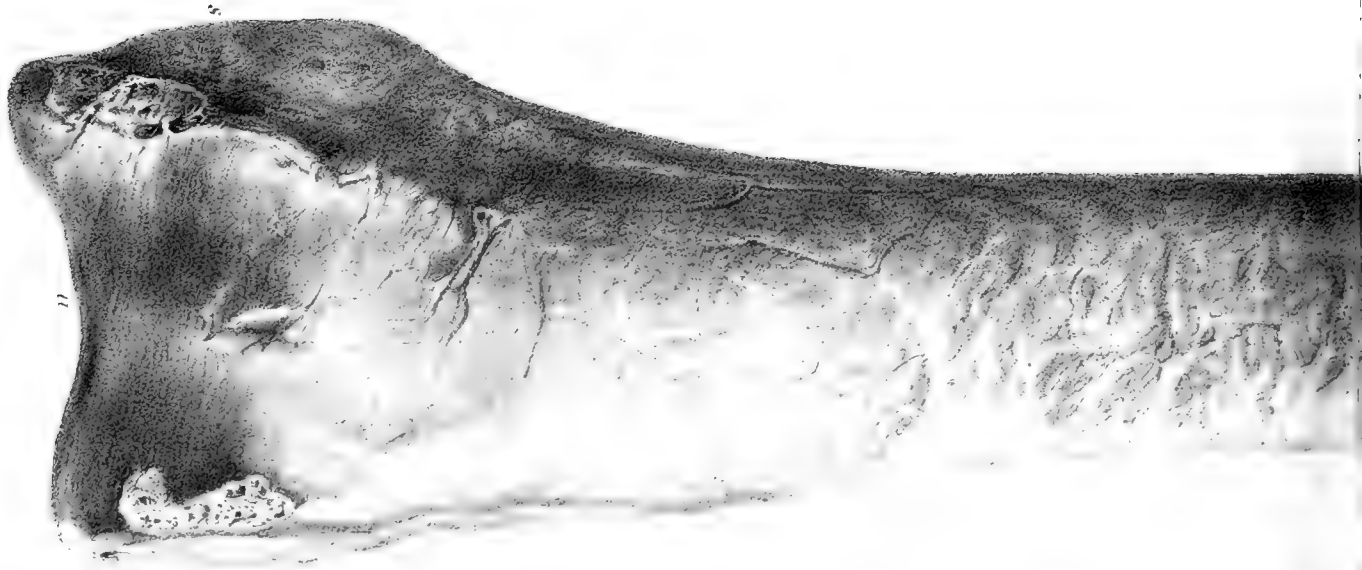
¹ Proceedings of the Zoological Society, 1870, p. 53.

² *Ibid.* 1839, p. 169.

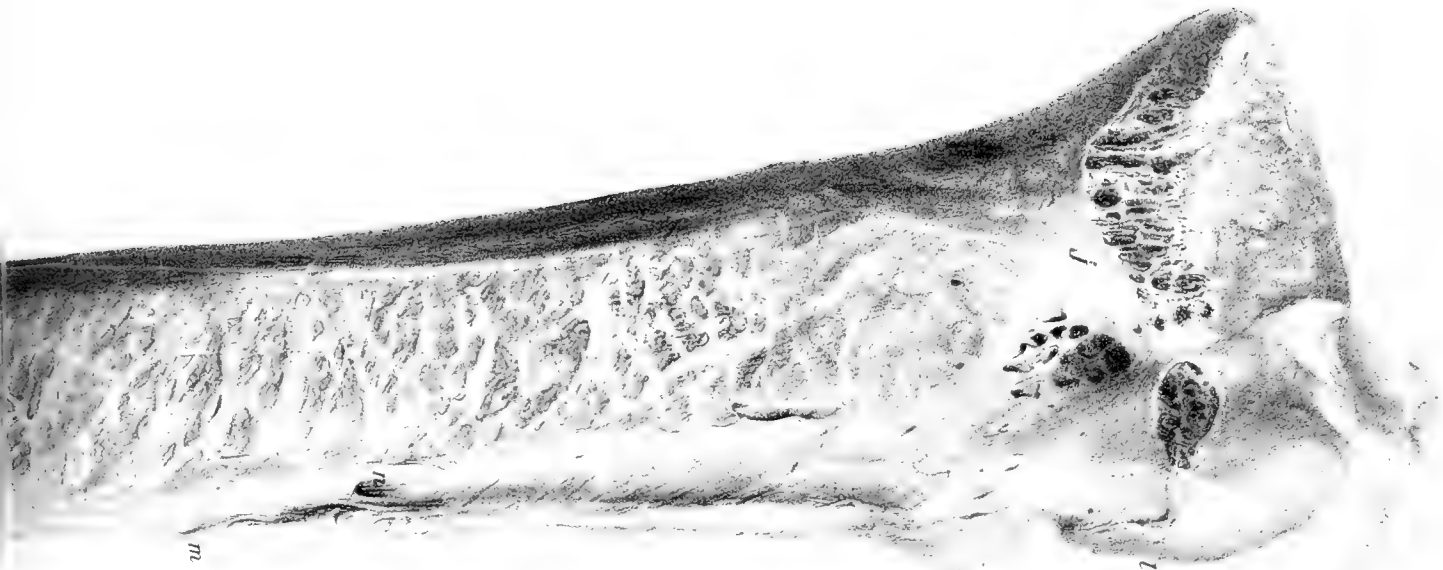








Handwritten text at the top of the page, possibly a title or reference number.



3







from Nature on stone by J. Erxleben

FEMUR GRAVI.

M & N. G. Barthol. imp.



Fig. 1. Dinornis cravis.



from Nel on Stone by J. Erxleben

M. & N. Horbart imp.

DINORNIS CRAVIS



XI. On *DINORNIS* (Part XIX.): containing a Description of a Femur indicative of a new Genus of large Wingless Bird (*Dromornis*¹ *australis*, Owen) from a post-tertiary deposit in Queensland, Australia. By Professor OWEN, F.R.S., F.L.S., &c.

Read June 4th, 1872.

[PLATES LXII. and LXIII.]

IN 1836 Sir Thomas Mitchell, F.G.S., Surveyor-General of Australia, discovered in the breccia-cave of Wellington Valley a femur, wanting the lower end, mutilated and incrustated with the red stalagmite of the cave, which I determined to belong to a large bird, probably, from its size, struthious or brevipennate, but not presenting characters which, at that time, justified me in suggesting closer affinities. Three views of this fossil, of rather less than half the natural size, formed the subject of pl. 32. figs. 12, 13, of my "Palæontological Appendix" to Mitchell's work².

The length of this fossil was 13 inches, the breadth of the middle of the shaft was not quite 3 inches.

In 1869 the Rev. W. B. Clarke, F.G.S., Government Geologist of the Province of New South Wales, made known the interesting discovery of a femur, nearly 12 inches in length, during the digging of a well at Peak Downs, in Queensland³.

The well was sunk through 30 feet of the black trappean alluvial soil common in that part of Australia, and then through 150 feet of drift pebbles and boulders, on one of which boulders ("at that depth," 150 feet?) rested a short, thick femur, so filled with mineral matter (calc spar and iron pyrites) as to give the internal structure more the appearance of a reptilian than an ornithic bone⁴.

Mr. Clarke submitted this fossil to the able Curator of the Australian Museum, Sydney, and states that "Mr. Kreffit has compared it with a collection sent over from New Zealand by Dr. Haast, and has been enabled to determine it to be a bone belonging to *Dinornis*." The communication is accordingly headed "*Dinornis*, an Australian genus."

So exceptional an extension of New-Zealand forms of life to the Australian continent greatly added to my desire of further and more intimate acquaintance with this second evidence of a large extinct Australian bird—more especially as the femora of *Dinornis* received from New Zealand subsequently to the publication of Mitchell's work led me to perceive, from the antero-posterior compression of the shaft and the sessile position of the head in the femur from the Wellington-Valley cavern, that it resembled that bone in the Emu rather than in the *Dinornis*.

My wishes on this point, as on others connected with the palæontology of Australia,

¹ *δρόμος*, cursus, *ὄρνις*, avis. ² Three Expeditions into the Interior of Eastern Australia, vol. ii. 8vo, 1838.

³ "*Dinornis*, an Australian Genus," Geological Magazine, vol. vi. (1869) p. 383.

⁴ *Loc. cit.* p. 383.

met with a prompt and hearty response. The Trustees of the Australian Museum directed the unique bird's bone to be moulded, and they forwarded to me a plaster cast.

Mr. Krefft was so good as to have three photographs taken of the fossil:—one showing the back view of the bone, three fifths the natural size; the two others the front views of the proximal and distal halves of the bone, of very nearly the natural size.

With these evidences a satisfactory comparison can be made of the Australian fossil with the femora of other large wingless birds, both recent and extinct.

The bone is the right femur (Pls. LXII. & LXIII. fig. 1). It measures 11 inches 6 lines; and there may be an inch more of this dimension lost by the abrasion to which both ends have been subject. The middle third of the shaft is entire, and shows its natural form and surface; the breadth of this part is 2 inches 6 lines; the antero-posterior thickness does not exceed 1 inch 7 lines (Pl. LXIII. fig. 2). The extreme breadth of the upper end is 5 inches 3 lines, that of the lower end is 5 inches; but these latter dimensions fall short, probably by half an inch, of those which the un-abraded or entire femur would have yielded.

Of the femora of *Dinornis* I have selected that of *Din. elephantopus*¹, as nearest to the present fossil in regard to length (13 inches); the breadth of the shaft is the same, or, in the largest examples of *D. elephantopus*, exceeds only by 2 lines that of the Australian femur.

But the shaft of the bone in *Dromornis* is compressed from before backward; its transverse section is a narrow oval (Pl. LXIII. fig. 2), while that of the *Dinornis* is a fuller and less regular oval (ib. fig. 3) from the greater proportion of fore-and-aft breadth of the shaft. The back part of the shaft of *Dromornis australis*, besides being less convex transversely, is devoid of the strong ridges and tuberosities which characterize that part in all the species of *Dinornis*; in this respect, as in the shape of the transverse section of the femoral shaft, *Dromornis* resembles more that bone in the Emu (*Dromaius ater*). The bifurcate anterior muscular ("intervastal") ridge which characterizes the fore part of the femoral shaft in *Dinornis elephantopus* (vol. vii. pl. 43. fig. 1), as in other species of that genus, is not defined on that part of the femur of *Dromornis* (Pl. LXII. fig. 1). The longitudinal ridge, descending from the pretrochanterian ridge to the ectocondylar expansion, is traceable in the cast, but is less strongly marked than in *Dinornis*. The mutilation of the prominent parts at the proximal end of the femur begets a reticence in drawing conclusions from apparent differences; but some were evidently inherent in the original when entire. The periphery of the head of the femur (*d*) is not constricted so as give the appearance of a "neck," as it is in *Dinornis*.

The trochanterian part of the articular surface (*c*) is more horizontal, does not ascend as it recedes from the head, in *Dromornis*. So far as the trochanter (*f*) is preserved in the cast, and appears in the photographs, it does not rise above the level of the head (*a*) of the femur, and seems not to have risen, when entire, so much above it as in *Dinornis*; the lay of the trochanterian articular tract agrees with these indications of the remain-

¹ Trans. Zool. Soc. vol. iv. (1856) p. 149, pl. 43. fig. 1.

ing epitrochanterian ridge (*f*). In the above differences *Dromornis* more resembles *Dromaius*.

The ectotrochanterian surface (Pl. LXII. fig. 2) is slightly concave, bounded above by a low arched ridge, from which the rough convex epitrochanterian part of the surface ascended to the crowning ridge. In this character *Dromornis* resembles *Dromaius*, and differs from *Dinornis*.

It resembles *Dinornis*, and differs from *Dromaius*, in the absence of the pneumatic foramen at the hind part of the upper expansion of the femur. This expansion is also relatively greater than in *Dromaius*, and recalls rather that of *Dinornis*; but the breadth of the ectotrochanterian tract (Pl. LXII. fig. 2) is relatively less than in *Dinornis gravis*, and still less than in the exceptionally thick and massive femur of *Dinornis elephantopus*. The fore part of the upper femoral expansion has had its outer wall crushed in; but, in both the cast and the photograph, there is an indication of a rough subcircular tract, answering to that which is conspicuous in *Dinornis* (*loc. cit.* pl. 43. fig. 1, *i*), but which is not present in *Dromaius*.

The outer crust of the femoral wall has been crushed inwards at the distal third of the fore part of the shaft (Pl. LXII. fig. 1, *t*); but the rotular surface seems to have been broad and shallow. In the prominence and thick convexity of the fore part of the expansion of the outer condyle *Dromornis* resembles *Dinornis* rather than *Dromaius*. The transverse extent of the distal end, in proportion to the size of the shaft of the femur, is less than in *Dinornis*, but is greater than in *Dromaius*.

The popliteal cavity (Pl. LXIII. fig. 1, *z*) is oblique, and is deeper and better-defined, especially above, than in *Dinornis*; it is divided from the intercondylar cavity (*v*) by a ridge (*w*) similar to that in *Dinornis*, and which I do not find in *Dromaius*. The intercondylar cavity or pit (*v*) is deep, and smaller than in *Dinornis gravis*; it is deeper, but much smaller, than in *Dinornis elephantopus* (*loc. cit.* pl. 43. fig. 3). There is a rough "gluteal" depression (Pl. LXIII. fig. 1, *x*), less deep than in *Dinornis gravis*, and situated nearer the popliteal cavity, and with a more posterior aspect than in *Dinornis elephantopus*.

The mutilation of the prominent parts of both femoral condyles precludes further profitable comparisons of the fossil under consideration.

But from those for which it affords sufficient grounds, I infer that in its essential characters this femur resembles more that bone in the Emu than in the Moa, and that the characters in which it more resembles *Dinornis* are concomitant with, and related to, the more general strength and robustness of the bone—from which we may infer that the species manifested dinornithic strength and proportions of the hind limbs, combined with characters of closer affinity to the existing smaller, more slender-limbed, and swifter wingless bird peculiar to the Australian continent¹.

¹ I can now, in 1872, repeat with more confidence the remark in my Memoir of 1846:—"No remnant of a *Dinornis* has yet been found in any of the contiguous islands; and I have in vain searched for such in the collections of post-pliocene fossils from Australia."—*Trans. Zool. Soc.* vol. iii. p. 366.

From the proportions of the femur of *Dromornis* I infer also that those of the tibia and metatarsus would be longer and more slender than in *Dinornis elephantopus*, and in a greater degree than is the case with the femur. Consequently the stature of *Dromornis* would be greater in proportion to the solitary bone by which we now know it than is that of the *Dinornis elephantopus*. We may therefore have a comfortable assurance that it indicates the former existence in Australia of a bird nearly of the stature of the Ostrich, but with relatively shorter and stronger hind limbs.

The period at which this large wingless bird trod that singular land was that at which the elephantine Marsupial (*Diprotodon*) flourished. I have received remains of both this genus and the somewhat smaller pachydermal Marsupial (*Nototherium*) from the mass of drift and boulder deposit when this had been reached, at depths equal to that yielding the bird's fossil at Peak Downs, in the sinking of wells in Queensland.

The mineralized condition of these herbivorous mammalian fossils has suggested a comparison of them with the fossil remains of Saurian Reptiles from Oolitic and even older Mesozoic beds in England. Yet the Mollusca which have left their shells with the petrified Australian bones are of the same species as those still living in the fresh waters of the Condamine and its tributary creeks, in the bed of which so many evidences of extinct Marsupial life have been discovered.

From the general analogy, not unfrequently pointed out, between the recent animal and vegetable forms of the Australian continent and the extinct ones of the European Oolitic beds, together with the massive mineralized condition of the ornithic and mammalian fossils found deep in the enormous superficial accumulations of drift and trappean alluvium, we are led to surmise that Australia, or parts of that continent, have not been subject to the frequent movements by which the earth's crust has been modified in the European continent, but that it may have been subject exclusively to the subaerial conditions of change from the period of the Oolitic deposits in our hemisphere. Thus the *Dromornis* of Queensland may have been contemporary with the impressors of the ornithicites of Connecticut.

DESCRIPTION OF THE PLATES.

PLATE LXII.

Dromornis australis. Right femur: nat. size.

Fig. 1. Front view.

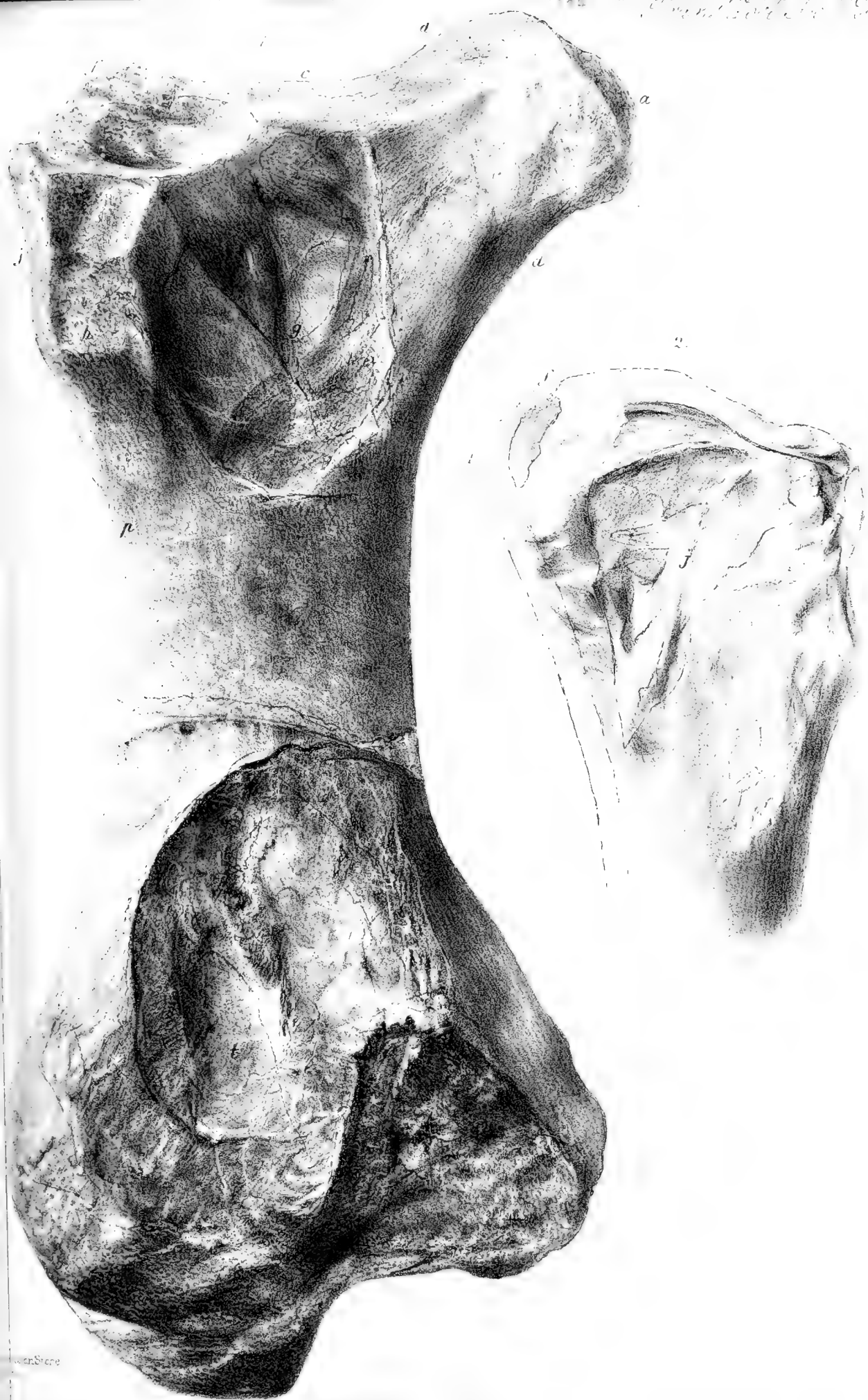
Fig. 2. Ectotrochanterian surface of femur.

PLATE LXIII.

Fig. 1. Back view of the same femur.

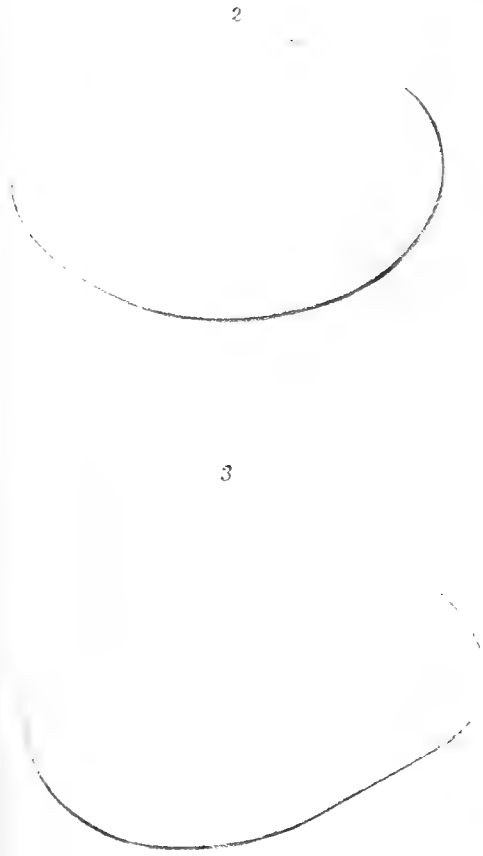
Fig. 2. Form of transverse section of middle of the shaft.

Fig. 3. Form of transverse section of the same part of the femur of *Din. elephantopus*.



FROM THE COLLECTION OF THE





ROMORNIS AUSTRALIS Fig. 1. 2. 3.



XII. *On the Axial Skeleton of the Ostrich (Struthio camelus).*

By ST. GEORGE MIVART, F.R.S.

Received June 18th, 1872.

RECENT investigations having made it probable that the line of affinity between Birds and Reptiles passes through the Struthious members of the first of these classes, I have deemed it advisable to commence a study of the axial skeleton of the *Sauropsida* by a detailed examination of that of the Ostrich, as of the most generalized type.

By kind permission of the authorities of the Royal College of Surgeons, I have been enabled to make use of the rich resources of that institution, not only for examination, but for the purposes of illustration, all the figures being from specimens in that Museum.

Bearing in mind the varying posture which the axial skeleton assumes in different Sauropsidans, I think it better, generally, to employ the term *preaxial* to denote that relation which in a vertical spinal column would be called "superior," and in a horizontal one "anterior." Similarly I use the word *postaxial* for what under the circumstances mentioned would be either "inferior" or "posterior." In the same way the terms *dorsal* and *ventral* stand for "posterior" or "superior," and for "anterior" or "inferior" respectively.

After describing the various vertebræ throughout the spine one after another, I propose to describe the pelvis as a whole, then the vertebral and sternal ribs, and the sternum, concluding with a recapitulation of the serial modifications the several parts and processes undergo as we proceed postaxially from the atlas to the coccyx.

There are seventeen *cervical vertebræ*, which, in the adult, have either no rib-like processes or only styliform and anchylosed ones (fig. 1, c).

The next three vertebræ bear longer ribs, generally articulated movably with their vertebræ and not directly connected with sternal ribs. They may be called *cervico-dorsal vertebræ* (fig. 1, c D).

The next five vertebræ (twenty-first to twenty-fifth inclusive) support long ribs, which unite distally with sternal ribs articulated to the sternum, and are therefore true *dorsal vertebræ*; these vertebræ do not anchylose together or with the sacrum (fig. 1, D). There are two vertebræ after these (twenty-sixth and twenty-seventh) which bear freely-ending ribs or rib-like processes, and which normally anchylose with the sacrum in the adult; these can be distinguished as *dorso-lumbar vertebræ*. Sometimes¹ there may be an extra

¹ As in the mounted skeleton in the Bird Gallery of the British Museum.

Fig. 1.

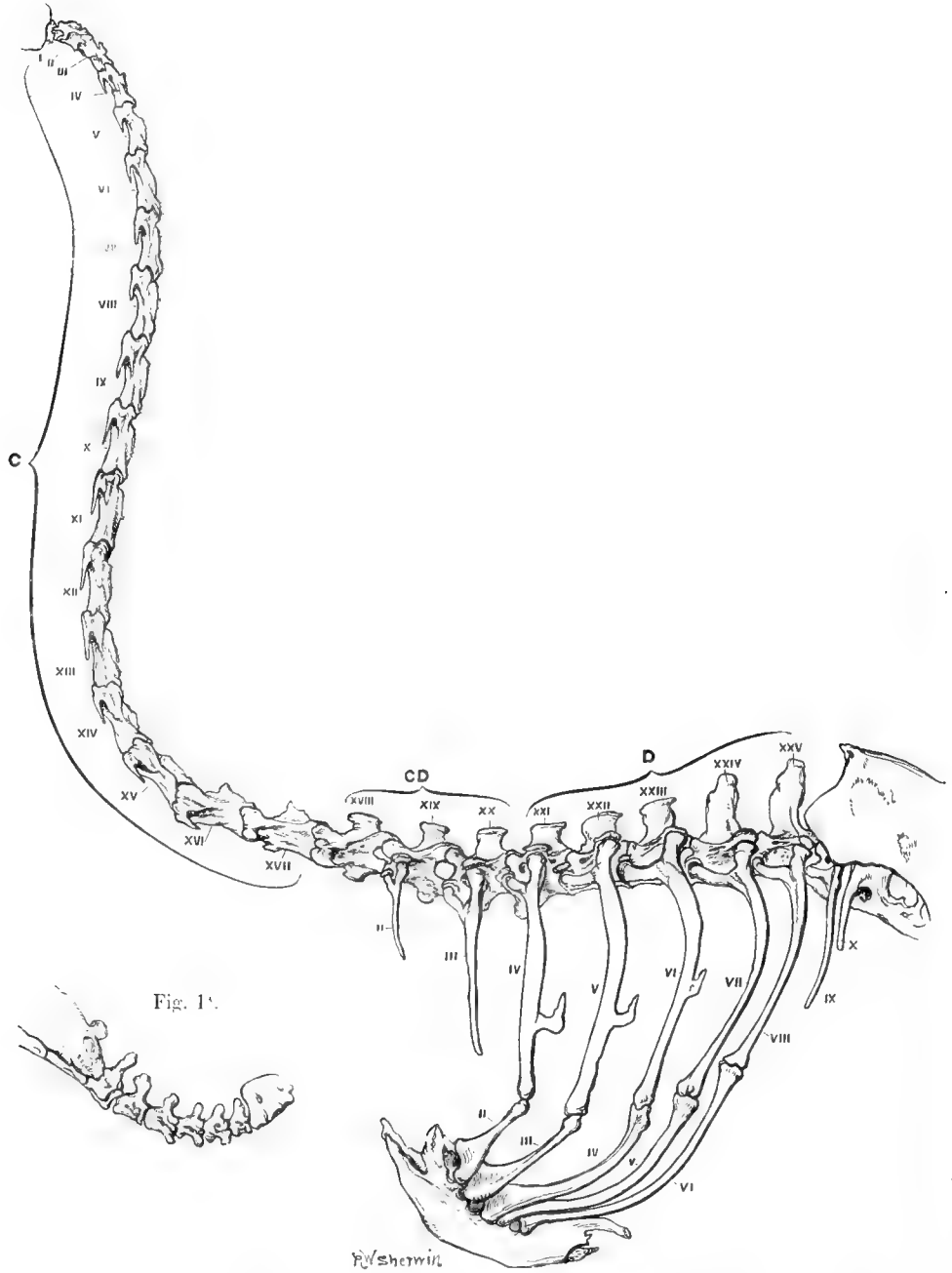


Fig. 1. Presacral part of axial skeleton ; C, cervical vertebræ ; CD, cervico-dorsal vertebræ ; D, dorsal vertebræ.
 Fig. 1'. Coccygeal vertebræ.

dorso-lumbar vertebra, there being three such with ribs, the first of which is connected by a styloform bone with the side of the sternal rib of the last true dorsal vertebra.

The next eight vertebræ (twenty-eighth to thirty-fifth) do not support long rib-like processes and are constantly ankylosed into one mass in adults; they may be called *lumbar vertebræ*.

Next follow three vertebræ with long distally expanded rib-like processes abutting against the ilia. It will be at least convenient to call these *sacral vertebræ*.

At the distal end of the sacral mass we have in the adult eight vertebræ (thirty-ninth to forty-sixth), which may be termed *sacro-caudal vertebræ*.

Finally there are ten postsacral vertebræ normally free in the adult, except the last two; these ten are the true *caudal vertebræ* (fig. 1^A). The number of these vertebræ may sometimes, however, be reduced to eight¹.

There are thus normally fifty-six vertebræ from the atlas to the coccyx inclusively. In some skeletons, however, there may be one or two vertebræ short or a vertebra in excess; and when such divergences exist, the differential characters of all the various vertebræ are correspondingly modified; and this should be borne in mind when the description here given is compared with such skeletons.

THE PRESACRAL VERTEBRÆ.

THE CERVICAL VERTEBRÆ.

THE ATLAS.—The atlas of the Ostrich presents an extreme contrast to the same bone in all mammals, even the lowest, in that it is so small a bone, being little more than an osseous ring, ventrally thickened with three short postaxial projections, and not being more than a quarter the bulk of the axis.

Nevertheless, though this vertebra as a whole is relatively so small compared with the atlas of mammals, yet that part of it which is median and ventral (*i. e.* that hypapophysial ossification which holds the place of a “centrum”) is relatively much larger than in any mammal. This might perhaps be anticipated from the articulation of the vertebral column with the skull being median in birds, through a single condyle, instead of lateral as in mammals through a pair of condyles.

The atlas of the Ostrich consists of this *quasi* body and two neural laminae, which meet together dorsally, but do not develop a neural spine.

The whole vertebra in the adult consists of one bone, no trace remaining of the primitive separation between the neural laminae and the median ventral portion.

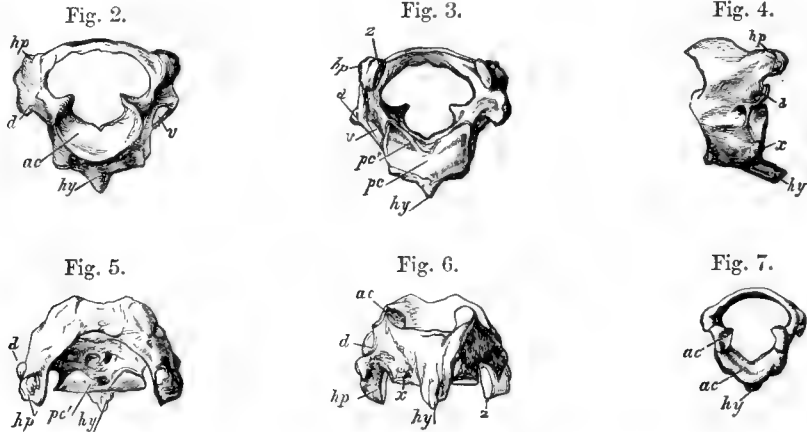
This latter (the *quasi-body*) apart from its junctions with the neural arch, may be said to have four surfaces—one ventral, one dorsal (or neural), one preaxial, and one postaxial; and these four surfaces are divided by four corresponding margins.

The *preaxial surface of the centrum*, which articulates with the occipital condyle.

¹ As in the mounted specimen, No. 1362, in the Museum of the College of Surgeons.

presents a crescentic, transversely extended concavity, as it were a cup, with a considerable median dorsal portion cut away for the reception of the odontoid process of the axis vertebra (fig. 2, *ac*).

ATLAS VERTEBRA (natural size).



Aspects.

Fig. 2, preaxial; 3, postaxial; 4, lateral; 5, dorsal; 6, ventral; 7, preaxial of immature bone.

ac, Preaxial articular surface of centrum; *ac'*, portion of such surface formed by neural lamina; *d*, diapophysis or tubercular process; *hp*, hyperapophysis; *hy*, hypapophysis; *pc*, postaxial articular surface of centrum; *pc'* lateral prolongation of the same surface; *v*, canal for vertebral artery (the spiculum of bone which encloses this is seen to be wanting on one side); *x*, a rounded tubercle representing a lateral hypapophysial process; *z*, postzygapophysis.

The dorsal margin of this preaxial surface forms thus a strongly concave line; and its ventral margin is bounded by a longer line of generally similar curvature (the horns of the crescentic articular surface being as broad as its middle); but the median portion of the ventral margin may occasionally be slightly produced (as in the specimen 1362 B), so as to cause that margin to present a rounded prominence.

The *postaxial surface*, which is applied to the centrum of the axis ventrad of the odontoid process, presents a crescentic transversely extended articular surface (fig. 3, *pc*, *pc'*). This surface is gently convex dorso-ventrally, but straight and flat transversely. Its upper margin is strongly concave, and is produced preaxially on each side, the postaxial articular surface of the quasi-body thus extending on each side somewhat on to the dorsal (neural) surface of the same part, and there articulating with the sides of the ventral surface of the root of the odontoid process.

The ventral margin of the postaxial surface of the atlas is more or less convex, with its median portion drawn out into a postaxially projecting hypapophysial process (figs. 3, 4, & 6, *hy*).

The *neural surface* of the quasi-body is gently concave transversely, with a marked pit (fig. 5) in its midst, no doubt for a ligament proceeding dorsad to the pit at the root of the odontoid process on its ventral aspect.

Its pre- and postaxial margins would be nearly parallel, but that the latter is encroached on by the lateral extensions preaxiad of the postaxial articular surface, as before mentioned.

Its preaxial margin is similarly, though to a less extent, encroached on, on each side, by the postaxiad lateral extensions of the preaxial articular surface. The little lateral facets thus formed on each side of each end of the dorsal (or neural) surface articulate with the sides of the odontoid process of the axis (fig. 5, *p c'*).

The *ventral surface* of the quasi-body is gently convex from side to side, and slightly concave antero-posteriorly in its middle.

Its preaxial margin is generally slightly concave, though it may be (as in specimen 1362 B) slightly convex; its postaxial margin is nearly straight, except for the sudden production postaxiad of the median hypapophysial process before referred to (fig. 6, *hy*).

This process has a width equal to about a third of that of the postaxial surface of the quasi-centrum; and the length of its free projection may nearly equal or may slightly exceed its breadth.

A small rounded tubercle or lateral hypapophysial process (figs. 4, 6, *x*) may be developed on each side of the root of the median hypapophysial process, close to the postaxial margin of the ventral surface of the quasi-body; and a slight ridge may run obliquely outwards and preaxially from each of these tubercles nearly to the preaxial margin of such ventral surface.

The hypapophysial process is directed postaxiad, and but slightly ventrad; indeed its free extremity (as in specimen 1362 B) may have a slightly dorsal curvature.

The dorsal surface of this process articulates with the middle of the front part of the ventral surface of the centrum of the axis vertebra.

The *neural arch* may be considered as consisting of two lateral halves dorsally united in the middle line.

Each lateral half springs from the side of the quasi-centrum by a narrow portion or *pedicle*, expanding dorsally into a neural lamina.

A narrow band or a mere spiculum of bone (figs. 2 & 3) may spring from the more postaxial part of the side of the quasi-centrum, and may fuse above with the posterior part of the pedicle, forming a foramen or short bony canal for the vertebral artery. The preaxial margin of the pedicle is strongly concave, but develops no process of any kind.

Its postaxial margin is also strongly concave, and ends above in a decided postzygapophysis; but before reaching that postzygapophysis it develops a more or less marked rounded prominence, which is a rudimentary tubercular process or *diapophysis*¹ (figs. 2, 3, & 5, *d*).

The little band or spiculum of bone before noticed, wherever it is developed, fuses

¹ I use the word diapophysis to denote all parts which are homotypes of the process articulating with the tubercle of the rib when this exists. Similarly I employ the term parapophysis to denote the part with which the head of the rib articulates.

dorsally with this diapophysial tubercle. It is thus essentially the "neck" of an undeveloped rib; and its ventral junction with the quasi-centrum is essentially a *parapophysis* or capitular process.

Sometimes the postaxial margin of this diapophysial tubercle is slightly produced postaxially, thus affording a faint indication of a prominence much more developed in succeeding vertebræ.

The *postzygapophysis* projects strongly postaxiad, and has on its inner side a small rounded articular surface, which looks inwards and also slightly ventrad (figs. 3, 6, *z*). This surface is slightly concave dorso-ventrally, and nearly straight antero-posteriorly.

On its dorsal surface each postzygapophysis bears a more or less marked rounded tubercle, which is a *hyperapophysis*¹ (figs. 3, 4, & 5, *hp*).

From each postzygapophysis the neural lamina extends preaxially and somewhat dorsad, meeting its fellow of the opposite side without (as before said) developing any neural spine. The conjoined neural laminæ thus form a low flat arch of bone, the preaxial margin (fig. 5) of which is slightly convex, but the postaxial margin very strongly concave, on account of the strong postaxiad projection of the two postzygapophyses (fig. 3, 6, *z*).

No foramina are developed, other than those for the vertebral arteries before described.

The immature condition of the atlas vertebra (as seen in the specimen 1397 A of the College-of-Surgeons Museum) shows that the neural arches meet together dorsally, so as to form a straight, though short, antero-posteriorly directed line of junction.

Similarly each pedicle joins the quasi-centrum by a line of junction which is nearly straight or slightly concave dorsally.

The ventral ends of the neural laminæ furnish the dorsal ends of the crescentic articular surface for the occipital condyle, also the articular facets for the side of the odontoid process and for the ventral surface of its root (fig. 7, *ac'*).

THE AXIS.

The axis of the Ostrich exceeds the atlas in size far more than is the case in the axial skeleton of any mammal. It also differs from a mammalian axis in that it is, for all its predominance over the atlas, insignificant in size when compared with the more posterior cervical vertebræ.

In the small size of the odontoid process when compared with the centrum, the Ostrich's axis vertebra also differs from that of the highest vertebrate class.

As compared with the atlas of the Ostrich, the axis differs most markedly in the great excess of its antero-posterior development over that in other directions.

The axis consists of a centrum, odontoid process, and neural arch, with zygapophyses and other outgrowths or annexations.

¹ This process is well seen in the cervical vertebræ of the Dingo, where it was first described. See Proc. Zool Soc. 1865, pp. 574 & 579, figs. 5, 7, & 9, *h*.

AXIS VERTEBRA (natural size).

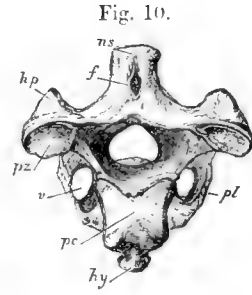
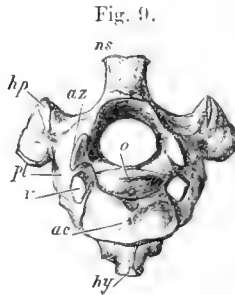
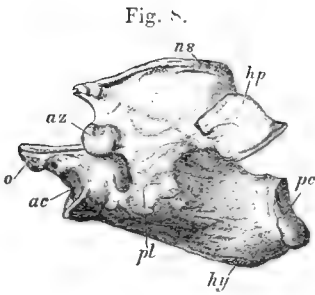


Fig. 11.

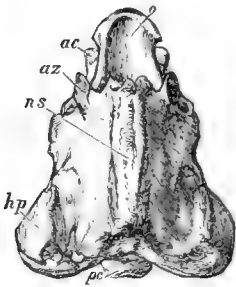


Fig. 12.

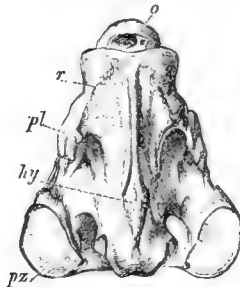


Fig. 13.



Fig. 14.



Aspects.

Fig. 8, lateral; 9, preaxial; 10, postaxial; 11, dorsal; 12, ventral; 13, preaxial; 14, lateral of immature bone.

Letters as before, except *az*, prezygapophysis; *ns*, neural spine; *o*, odontoid process; *pl*, rib-like or pleurapophysial lamella; *pz*, postzygapophysis; *r*, running backwards and outwards to parapophysis; *f*, fossa (for ligament) on postaxial aspect of neural spine.

The whole vertebra in the adult consists of one bone.

The *centrum* may be considered as regards its four surfaces:—

The *preaxial surface*, which joins the postaxial surface of the quasi-body of the atlas, presents a crescentic, transversely extended articular surface, more or less strongly concave dorso-ventrally, but nearly straight transversely.

Its ventral margin is slightly convex, generally flattened, and never produced medianly.

Its dorsal margin is not easily defined, as the preaxial articular surface of the centrum is prolonged dorsally on to each side of the ventral aspect of the root of the odontoid process. Its dorsal margin, however, if we count such prolongations as belonging to the preaxial surface of the centrum, must be described as strongly concave (figs. 8, 9, *ac*).

The *postaxial surface* differs greatly in shape from the preaxial surface. Its ventral part is prolonged ventrad into a hypapophysial process; but apart from this it exhibits an articular surface the outline of which approximates slightly to that of an hour-glass (fig. 10, *pc*). This articular surface is strongly concave dorso-ventrally and strongly convex transversely. Its dorsal and ventral margins are both very decidedly concave,

and its two outer margins very slightly so; the transverse extent of the dorsal margin of this surface considerably exceeds that of its ventral margin. The ventral margin of the whole centrum is of course not only convex, but much produced ventrad by reason of the hypapophysial process. The extreme width of the articular surface of the postaxial side of the centrum exceeds its dorso-ventral extent only slightly. The ventral lip of the articular surface extends much further postaxially than does its dorsal margin (fig. 8, *pc*); but this extension is actually less, and relatively very far less, than the postaxial extension of the hypapophysial process of the atlas.

The *neural surface*, even apart from the dorsal surface of the odontoid process, which continues it on preaxiad, is exceedingly prolonged compared with that of the atlas. Nearly straight antero-posteriorly, it is slightly concave transversely.

Certain small irregular foramina may lead into the substance of the centrum from nearly the postaxial extremity of this neural surface, the postaxial margin of which is slightly convex.

The *ventral surface* of the centrum is nowhere concave, but is greatly produced ventrad medianly, except at and towards its preaxial end. Its preaxial margin is nearly straight, but may be very slightly convex or very slightly concave; its postaxial margin is narrower, but is very strongly convex (fig. 12).

The median production before referred to is a strong hypapophysial (figs. 8, 12, *hy*) ridge, which, beginning a little preaxiad of the antero-posterior middle of the ventral surface of the centrum, rapidly increases in prominence postaxially till near the postaxial margin, when it yet more suddenly subsides. Its ventral margin is nowhere pointed, but presents a curve, the preaxial slope of which is more gradual than the postaxial one.

As the hypapophysial ridge increases and decreases in dorso-ventral extent, it also, but more gradually, increases and decreases in its transverse dimension. Its ventral surface, however, is not flattened out.

Two ridges (fig. 12, *r*) traverse obliquely the preaxial part of the ventral surface of the centrum, diverging postaxially from a little behind its preaxial margin to the parapophysial part hereafter to be noticed. These ridges seem to be the homotypes of those which run preaxiad from the lateral hypapophysial tubercles on the ventral surface of the atlas vertebra.

The *odontoid process* is between three and four times the size of the hypapophysial process of the atlas vertebra. Its preaxial margin is rounded; its upper surface is flat or slightly concave, continuing on preaxially the dorsal (or neural) surface of the centrum. Its ventral aspect presents three surfaces. The most postaxial of these three is the continuation preaxiad of the preaxial articular surface of the centrum; and it is this part which articulates with the little articular surfaces prolonged preaxiad on to the postaxial part of the dorsal surface of the quasi-centrum of the atlas.

The median surface of the three is irregularly excavated and probably gives attach-

ment to a ligament going ventrad to the pit on the middle of the dorsal surface of the quasi-centrum of the atlas.

The most preaxial of the three surfaces is smooth and articular, and in part joins with the preaxial articular facets of the dorsal surface of the quasi-centrum of the atlas; in part it joins the occipital condyle (fig. 9, *o*). It completes, as it were, the cup mainly formed by the preaxial concavity of that quasi-centrum, the dorsal excavation of which it fills up, occupying as it does the space between the horns of the preaxial articular surface of the atlas.

The *neural arch* is very much more extended antero-posteriorly, more solid, and furnished with more annexed processes than is the neural arch of the axis.

The pedicle, or part ventral to the zygapophyses, is so little extended dorsally as to be insignificant. The postaxial margin of the pedicle is very concave (fig. 8).

A flat band of bone ascends obliquely on each side (figs. 8, 9, *pl*) from the antero-lateral side of the centrum (where the transverse oblique ridge runs into the parapophysis) to between the prezygapophysis and the postzygapophysis, the band expanding dorsally and forming a sort of antero-posterior ridge or plate, connecting these zygapophyses.

This band shelters beneath it the vertebral artery.

On the side of the centrum and neural arch, within the band, are irregular foramina leading into the substance of the vertebra.

The oblique band of bone is essentially the neck of a rib, and corresponds with the spiculum before noticed as sometimes existing beside the atlas.

The dorsal expansion of the band is the diapophysis; its inferior origin is the parapophysis.

The preaxial margin of the oblique band of bone is more or less concave. A slight angular process projects postaxially from its postaxial margin (fig. 8, *pl*).

Each *prezygapophysis* is small and rounded, looks outwards and slightly dorsad, is a little convex dorso-ventrally, and nearly straight antero-posteriorly (figs. 8, 9 & 11, *az*).

The *postzygapophysis* is between two and four times the size of the prezygapophysis; its antero-posterior decidedly exceeds its transverse diameter. It looks mainly ventrad, but slightly postaxially also (figs. 10 & 12, *pz*).

On its dorsal surface each postzygapophysis bears a very prominent and conspicuous hyperapophysis (figs. 8, 10, & 12, *hp*).

The neural laminæ at their point of union dorsally, develop a low but strong and stout *neural spine* or, rather, ridge (figs. 8, 9, 10, & 11, *ns*).

This neural spine gradually rises as we proceed from the preaxial margin of the neural arch postaxially. It attains its greatest elevation at the postaxial end of the middle third of the neural arch. From that point it descends rather sharply to the postaxial border of the neural arch, presenting a margin which is slightly concave postaxially.

The neural spine is excavated by a fossa (for a ligament) on its postaxial surface (fig. 10, *f'*); but preaxially it dips gradually to the preaxial border of the neural arch, without either excavation or process of any kind.

The neural arch encloses a space which is smaller than that enclosed by the neural arch of the atlas; and the transverse diameter of this space is especially diminished, the arch thus appearing less low relatively.

When viewed in its dorsal aspect (fig. 11), the neural arch is seen to expand greatly postaxiad, its transverse diameter between the postzygapophyses being double that between the prezygapophyses. Its preaxial margin is concave, with a median preaxial projection; its postaxial margin is generally more or less slightly concave.

No foramina are developed other than those already noted.

The immature condition of the axis vertebra (as seen in the specimen 1397 A of the College-of-Surgeons Museum) shows that the neural laminae become perfectly ankylosed together and to the centrum at a time when the neural laminae of the atlas remain altogether distinct, as also the odontoid process (or rather "bone") itself.

The odontoid bone forms a very large part of the so-called centrum of the axis, as well as the whole of the odontoid process itself (fig. 14, *ac*). All the articular surfaces of the axis for the quasi-body of the atlas are formed by this odontoid bone, except the little surfaces at the sides of the ventral surface of the root of the apparent odontoid process of the adult. These are seen to be formed by the preaxial ventral ends of the neural laminae themselves (fig. 13, *ac'*).

At this early stage, the lateral perforations of the vertebra (one just postaxial to the diapophysis, and one at the side of the centrum and placed more ventrally) are relatively larger and much more conspicuous.

THE THIRD VERTEBRA.

The third vertebra exceeds the axis in size very much less indeed than the axis exceeds the atlas.

Its most striking difference in appearance from the axis depends on the absence of the odontoid process and the larger development of the prezygapophyses, which give the bone a quadrate appearance when viewed dorsally, instead of that preaxial tapering which marks the axis (fig. 15).

The vertebra consists of the same parts as the axis, except the odontoid process; and these are similarly fused into one solid and complex bone.

As to the *centrum*, its *preaxial surface*, which joins the postaxial surface of the centrum of the axis, presents a transversely extended articular surface, very concave from side to side and convex dorso-ventrally; both the dorsal and ventral margins of this surface are strongly concave, while its lateral margins are slightly convex. The whole articular surface looks more ventrad than preaxiad (figs. 16, 17, *ac*).

The *postaxial surface* does not differ from its preaxial surface in shape nearly so

THIRD VERTEBRA (natural size).

Fig. 15.

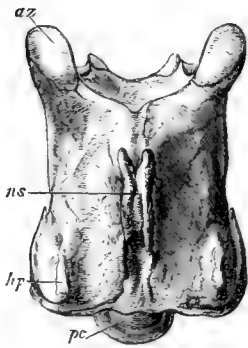


Fig. 16.

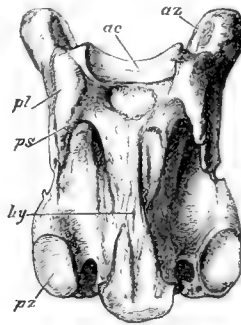


Fig. 17.

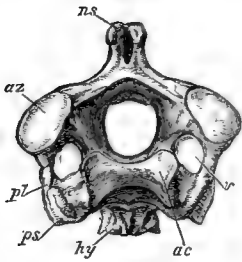


Fig. 18.

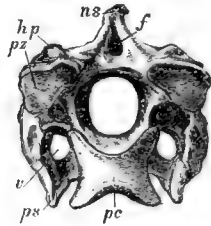
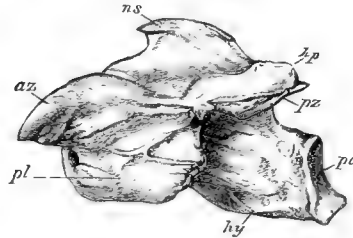


Fig. 19.



Aspects.

Fig. 15, dorsal; 16, ventral; 17, preaxial; 18, postaxial; 19, lateral.

Letters as before; and besides:—*m*, metapophysis; and *ps*, parapophysial root of pleurapophysial lamella.

much, nor in the same way, as the postaxial surface of the centrum of the axis differs from that vertebra's preaxial surface (fig. 18, *pc*).

The postaxial surface of the body of the third vertebra closely resembles the corresponding surface of the axis, while it presents a corresponding but inverted relation to its own preaxial central surface, being strongly convex transversely and concave dorso-ventrally, the whole surface looking dorsad as well as postaxiad (figs. 15 & 19, *pc*).

This surface differs from the corresponding surface of the axis in that its ventral part is not prolonged ventrad into a hypapophysial process, in that its extreme dorso-ventral diameter is less in proportion to its extreme transverse dimension, and in that the transverse extent of the dorsal margin exceeds that of the ventral margin to a less degree. Still its ventral margin is sometimes convex (not coinciding with the ventral margin of the central articular surface); but its dorsal and lateral margins seem always concave.

The *neural surface* of the centrum, but for its greater length, is very like that of the axis, abstraction being made of the (here absent) odontoid process.

The preaxial margin of the neural surface is strongly concave; its postaxial margin is slightly convex (fig. 15).

The *ventral surface* of the centrum is strongly concave from side to side at its most preaxial fourth; and its preaxial margin is concave. A little preaxial of the middle of the ventral surface a median hypapophysial process (figs. 16 & 19, *hy*) arises, which, for a little, gradually increases in depth postaxial, and then proceeds directly postaxial, coinciding with the ventral surface of the centrum—the postaxial part of the hypapophysial process being flattened on its ventral surface, so that this may be said to have two lateral margins which diverge postaxially. The hinder margin of the hypapophysis is at the same time the hinder margin of the centrum and is strongly convex.

The hypapophysis does not extend nearly so suddenly and prominently ventrad as does the hypapophysis of the axis.

No oblique ridges diverge postaxially from near the preaxial margin of the third vertebra, as they do in that of the axis; but there is a great prominence on each side near the preaxial margin, and it is their projection ventrad which makes the preaxial part of the ventral surface concave.

The *neural arch* is much like that of the axis, except that its prezygapophysial and pleurapophysial parts (fig. 19, *az* & *pl*) are much more developed, while its neural spine is less so.

The pedicle is similarly low, with a concave postaxial margin. Its preaxial margin is more extended dorso-ventrally and more concave than is that of the pedicle of the axis vertebra.

The flat pleurapophysial band of bone (for the vertebral artery) has greatly increased in antero-posterior extent, compared with that of the axis vertebra, being about equal to half the extent of the centrum in this dimension. It extends oblique dorsad from the parapophysis and expands till it merges into, or, rather, comes to constitute an interzygapophysial ridge, the anterior end of which may appear as a slight prominence (*metapophysial*) outside and beneath the prezygapophysis (as in specimen 1362 B on the left side).

The preaxial margin of the pleurapophysial lamella is concave. Its postaxial margin is irregular from defective ossification; but it may (as in 1362 A, right side) develop a slight median, postaxial, bluntly pointed prominence (fig. 19).

At the middle of the side of the neural arch, near the dorsal postaxial end of the plurapophysial lamella, is a depression with irregular foramina, leading into the substance of the bone.

Each *prezygapophysis* presents an oblong articular surface, which looks preaxially and dorsally, and is nearly, if not quite, twice as long antero-posteriorly as it is broad. It is slightly convex in both directions, but more so antero-posteriorly (figs. 15, 17, & 19, *az*).

Each *postzygapophysis* (figs. 16, 18, & 19, *pz*) is about the same size as the prezygapophysis, but is slightly less developed in the antero-posterior direction. Its antero-posterior diameter very much exceeds its transverse diameter, as much as, or more so, than in the axis vertebra. The articular surface is slightly concave transversely and nearly flat antero-posteriorly.

It looks mainly ventrad, but slightly postaxiad also.

On its dorsal surface each postzygapophysis bears a prominent *hyperapophysis*, which, however, is considerably smaller than in the axis vertebra (figs. 15 & 19 *hp*).

The neural laminae develop a low neural spine, which, however, extends less both dorsally and antero-posteriorly than does the neurapophysis of the axis. Instead of rising gradually from the preaxial margin of the neural arch, it springs up suddenly, at some distance postaxiad from that preaxial margin (figs. 15 & 19, *ns*). It subsides less suddenly, at about the same distance from the postaxial margin of the neural arch as its origin is distant from the preaxial margin of that arch. It occupies rather less than the middle three fifths of the dorsal surface of the neural arch.

The neural spine is excavated medianly on its postaxial surface (a fossa for a ligament thus being formed) in the same way that the same part of the axis is excavated (fig. 18, *f*).

The preaxial surface of the neural spine of this third vertebra, however, is also excavated, and in such a way as to cause that spine to bifurcate preaxially (figs. 15, 17, & 19, *ns*), the two preaxial margins of the depression projecting preaxiad at their dorsal ends, and making the short preaxial margin of the neural spine concave.

The neural arch encloses a space of very little different width from that enclosed by the neural arch of the axis (fig. 17).

When viewed above, the neural arch is subquadrate, the transverse diameter of the prezygapophyses about equalling that of the postzygapophyses. Its preaxial margin is much more strongly concave than is the corresponding margin of the axis; its posterior margin may be slightly concave or nearly straight (fig. 15).

THE FOURTH VERTEBRA.

The fourth vertebra exceeds the third about as much as the third exceeds the second (counting the odontoid process); but in general appearance and arrangement and development of parts, the fourth vertebra very much more nearly agrees with the third than does the third with the second.

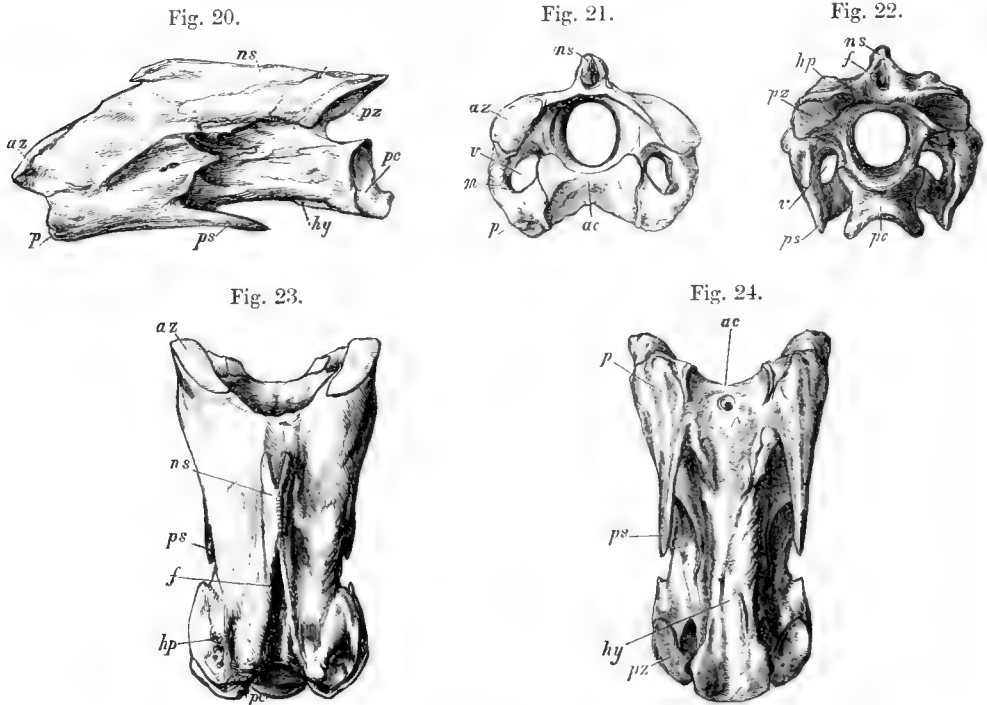
As to the *centrum*, its *preaxial surface* is quite like that of the third vertebra, except that it is rather more extended transversely and looks slightly less ventrad (figs. 21 & 24, *ac*).

The *postaxial surface* only differs from the preaxial surface in the same antithetical way that the two corresponding surfaces of the third vertebra differ from each other (figs. 20 & 22, *pc*). It differs from the postaxial surface of the third in that its ventral margin is more strongly concave and nearly coincides with the concave ventral margin of the articular surface, and in that the transverse extent of the dorsal part of that surface is nearly equalled by the transverse extent of its ventral part.

The *neural surface* of the centrum closely resembles that of the third vertebra, except that, of course, its absolute length is greater.

The *ventral surface* of the centrum agrees with that of the third vertebra, except that the median hypapophysis is much less developed (fig. 20, *hy*), being only in the form of a slight ridge extending antero-posteriorly along the middle third of the centrum.

FOURTH VERTEBRA (natural size).



Aspects.

Fig. 20, lateral; 21, preaxial; 22, postaxial; 23, dorsal; 24, ventral.

Letters as before, except that *p* denotes parapophysis, and *ps* the rib-like, freely projecting, pleurapophysial process.

It also differs from the third vertebra in that its most postaxial part is decidedly, though slightly, concave transversely, and in that the parapophyses, project a little more sharply and strongly ventrad.

The *neural arch* is very like that of the third vertebra, except that its pleurapophysial part is more developed, while its neurapophysis, being actually about the same size, is relatively less.

The pleurapophysial band is rather more extended antero-posteriorly, though it does not quite attain the postzygapophysis as it does in the third vertebra; while from the ventral end of its postaxial margin (*i. e.* from the parapophysis) a long, tapering, styliform, rib-like process projects in nearly a straight line postaxially (fig. 20, *ps*).

The length of the free part of this process is less than half the antero-posterior extent of the centrum, though its extremity may project beyond the antero-posterior median point of the centrum.

The postaxial margin of the pleurapophysial band is irregular, often more or less slightly concave, and proceeds obliquely dorsad and postaxiad.

At the anterior part of this band a slight metapophysial prominence may appear between the preaxial end of the parapophysis and the prezygapophysis.

The *zygapophyses* closely resemble those of the third vertebra.

The *hyperapophyses* on the postzygapophyses are absolutely, and still more relatively, smaller than in the third vertebra, though they are still noticeable prominences (figs. 20, & 23, *hp*).

The neural spine and the neural arch generally agree with those of the third vertebra, except that the latter is less quadrate when viewed from above. This is owing to the transverse diameter of the preaxial part of the vertebra (measured across the prezygapophyses) considerably exceeding that of its postaxial part (measured across the postzygapophyses), instead of these two dimensions being equal as in the third vertebra. The postaxial margin of the neural arch is also always decidedly concave (fig. 23), instead of being nearly straight as sometimes is the case in the third vertebra.

THE FIFTH VERTEBRA.

The fifth vertebra, though again a large bone antero-posteriorly, more closely resembles in shape the fourth vertebra than does the fourth the third (fig. 1, C, v).

The *preaxial surface* of its *centrum* quite agrees with that of the fourth vertebra, while its *postaxial* surface differs only in having its articular surface relatively broader and narrower dorso-ventrally in its middle (the two sides of the hour-glass coming there nearer together), and in having the ventral margin of that surface very considerably more extended than its dorsal margin, and, concomitantly, its lateral margins rather more concave.

The *neural surface* is similar to that of the centrum of the fourth vertebra, except that it is perhaps rather more exposed at its preaxial end, through the slightly greater cutting away, as it were, of the more preaxial part of the neural arch.

The *ventral surface* of the centrum agrees with that of the fourth vertebra, except that its postaxial part is more decidedly and extensively concave transversely, and that the median hypapophysial ridge is still less developed.

The *neural arch* is, of course, longer than that of the fourth vertebra, but is otherwise very like it. The pleurapophysial band more decidedly fails to attain the postzygapophysis; while at the dorsal end of its slightly concave, oblique, postaxial margin a slight pointed process projects postaxiad, which process is the homotype of the slight projection noticed as extending from the postaxial margin of the band in the axis

vertebra. It has here mounted more dorsally. The styliform rib-like process is rather longer in this fifth vertebra, but otherwise like that of the fourth.

The *metapophysis* is rather more swollen and prominent; but the *hyperapophysis* is still more reduced.

The prezygapophysis projects preaxially beyond the parapophysis to a less degree than is the case in the fourth vertebra.

The *neural spine* is relatively less than that of the fourth vertebra, but otherwise resembles it, except that the two margins of the preaxial excavation do not stand out preaxially on processes with near so much distinctness.

The *neural arch* when viewed from above is still less quadrate than in the fourth vertebra, because the transverse extent of the preaxial end of the fifth vertebra exceeds that of the postaxial part of the same vertebra more than the one exceeds the other in the fourth vertebra.

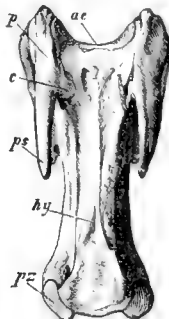
The postaxial margin of the neural arch is also much more decidedly and sharply concave.

THE SIXTH VERTEBRA.

The sixth vertebra, though a larger bone than the fifth, resembles the latter in form and proportions, even more than the fifth vertebra resembles the fourth. Both the

VENTRAL ASPECT OF SIXTH VERTEBRA (natural size).

Fig. 25.



Letters as in last figures, and in addition *c*, catapophysis.

pre- and postaxial surfaces of the *centrum* agree with those of the fifth vertebra respectively; and the neural surface only differs from that of its serial predecessor in being slightly more exposed preaxially.

The ventral surface exhibits no noticeable differences, except that the hypapophysial ridge is still more obsolete, and that the postero-inner part of each parapophysis begins

to exhibit a special though slight prominence (directed medianly inwards and ventrad), which is the beginning of the differentiation of the *catapophysis*¹ (fig. 25, c).

The *metapophysis* may be again slightly more prominent; while the *hyperapophysis* is so reduced that it would perhaps escape notice were it not traced from the more preaxial vertebræ.

The *prezygapophysis* projects beyond the parapophysis still less than in the fifth vertebra, sometimes scarcely or not at all so. Its articular surface is even also relatively longer and narrower than in the bone last described.

The neural spine is excavated, both pre- and postaxially, more obliquely and extensively than in the fifth vertebra; so that its median unexcavated part is relatively, and may be absolutely, shorter. The lateral margins of the preaxial excavation do not at all develop preaxial processes.

Both the pre- and postaxial margins of the neural arch are rather more concave than in the fifth vertebra.

THE SEVENTH VERTEBRA.

The seventh vertebra is rather larger than the sixth vertebra, but in other respects is so complete a repetition of the latter as hardly to need distinct notice except in the following few points.

The *catapophyses* and *metapophyses* are rather more prominent; and the neural spine has (at least sometimes) a greater development dorsad.

The *prezygapophyses* do not project forwards quite so much as do the *parapophyses*. instead of projecting, in a greater or less degree, more preaxially, as has always been the case in the vertebræ hitherto described; their articular surfaces are directed rather more inwards than are those of the sixth vertebra.

THE EIGHTH, NINTH, AND TENTH VERTEBRÆ.

These vertebræ slightly increase in length antero-posteriorly, though the rate of increase diminishes as we proceed postaxially. In these three vertebræ the *catapophysial projection* gradually becomes more marked; and thereby the preaxial part of the ventral surface of the centrum becomes more concave, as also the ventral margin of its preaxial surface.

The *metapophyses* remain as marked (fig. 28, *m*) or become rather more so, while the *hyperapophyses* disappear.

¹ From *κατά*, down. These processes are, as it were, merely transitional processes, sometimes merging with the parapophysis dorsally, and sometimes with the hypapophysis ventrally. By giving them therefore a distinct name I by no means wish to ignore their transition; but as these parts are often so distinct and conspicuous as to require description and distinct reference, it is convenient to be able to speak of them substantively and adjectively by a distinct term. By *catapophyses* I mean parts which are distinguishable from, but intermediate between, parapophyses and hypapophyses, and which are placed on the ventral side of the former.

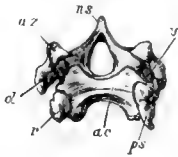
The interval between the pre- and postaxial excavations of the neural spine progressively increases.

In the tenth vertebra the transverse dimension of the postaxial part of the neural arch (measured from outer margin to outer margin of the two postzygapophyses) begins to be slightly less in defect compared with the same dimension of the preaxial part of that arch.

PREAXIAL ASPECT OF EIGHTH VERTEBRA.

Immature condition (natural size).

Fig. 26.

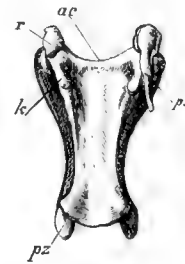


The rib-like part, *ps*, is removed on the left side;
d, diapophysis.

VENTRAL ASPECT OF EIGHTH VERTEBRA.

Immature condition (natural size).

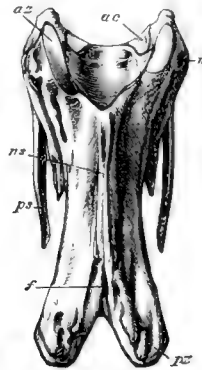
Fig. 27.



Letters as before, except *k*, catapophysis, and
r, parapophysis.

NINTH VERTEBRA (size $\frac{2}{3}$ of nature).

Fig. 28.



Dorsal aspect. Letters as before.

In the tenth vertebra also the prezygapophysis projects about as far preaxially as does the parapophysis.

THE ELEVENTH VERTEBRA.

The eleventh vertebra is of very nearly the same length as the tenth, especially as estimated by the antero-posterior extent between the preaxial end of the prezygapophysis and the postaxial end of the postzygapophysis. This vertebra, however, is very slightly more massive than the preceding one.

The postaxial articular surface of the centrum has the transverse extent of its ventral margin very little in excess of that of its dorsal margin. The articular surfaces of the *prezygapophyses* look more directly dorsad and less inwardly; those of the *postzygapophyses* are broader.

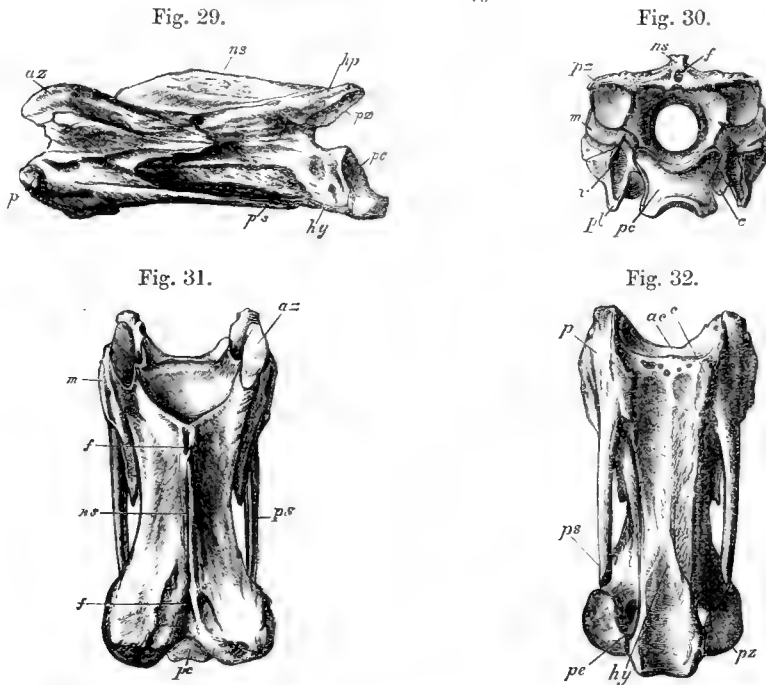
The median unexcavated part of the neural spine is again more or less longer antero-posteriorly. The postaxial part of the neural arch still more nearly approaches in width the preaxial part of that arch than in the tenth vertebra; and its postaxial margin is less concave.

THE TWELFTH VERTEBRA.

The twelfth vertebra carries on the progressive modifications indicated in the eleventh vertebra, and it is slightly longer and more massive than that vertebra.

The *catapophyses* may here first project ventrally as sharply marked processes (figs. 30 & 32, *c*).

TWELFTH VERTEBRA ($\frac{2}{3}$ natural size).



Aspects.
 Fig. 29, lateral; 30, postaxial; 31, dorsal; and 32, ventral.
 Letters as before; *c*, catapophysis.

The transverse extent of the postaxial part of the neural arch nearly equals that of its preaxial part.

The styliform rib here generally attains its maximum of length.

THE THIRTEENTH VERTEBRA.

This vertebra slightly exceeds the twelfth in length, but still more in breadth and stoutness. Here, once more, the dorso-ventral extent of the lateral margin of the postaxial surface of the centrum equals the transverse extent of the dorsal margin of that surface.

The neural arch here attains about its maximum of antero-posterior extent, measured pre- and postaxially in the middle line.

The median unexcavated part of the neural spine is slightly shorter antero-posteriorly than in the twelfth vertebra.

The free projection of the styliiform rib may be for the first time less in extent than in the vertebra next (preaxially) to it; but it is at the same time thicker.

The transverse extent of the postaxial part of the neural arch nearly equals that of its preaxial part; and concomitantly with this greater projection outwards of the postzygapophyses, the lateral margins of the neural laminae (viewed dorsally) become more concave.

The articular surfaces of both zygapophyses, but especially of the postzygapophyses, are broader in proportion to their length.

THE FOURTEENTH VERTEBRA.

The fourteenth vertebra scarcely exceeds the thirteenth in length, though it does so very decidedly in breadth. Indeed the antero-posterior length of the neural arch in the dorsal middle line is absolutely, though very slightly, less than in the thirteenth vertebra.

The styliiform ribs are thicker, the catapophyses more projecting, the zygapophysial articular surfaces broader, while the four margins of the postaxial articular surface of the centrum have become about equal.

The canal for the vertebral artery has also become rather more capacious.

THE FIFTEENTH VERTEBRA.

With this vertebra the absolute antero-posterior dimension has begun slightly to decrease; but the transverse development continues to progress. The styliiform ribs are still stouter, the zygapophysial surfaces still broader, the neural spine thicker and shorter, and the lateral margins of the neural arch more concave. The postaxial excavation of the neural spine is enlarged into a considerable fossa.

The metapophysis is rather prominent beneath a prezygapophysis, which may here once again begin to decidedly project, preaxial, beyond the parapophyses.

THE SIXTEENTH VERTEBRA.

The sixteenth vertebra is, again, like the fifteenth, shorter than its preaxial predecessor; and even the transverse dimension, measured across the postzygapophyses, is scarcely if at all greater, though the preaxial part of the vertebra is enlarged transversely, and therefore relatively to the more postaxial part as well as absolutely. The posterior end

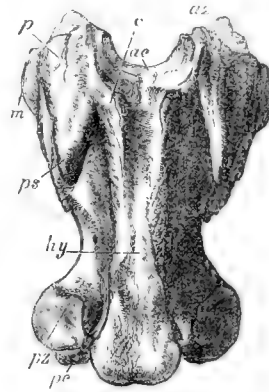
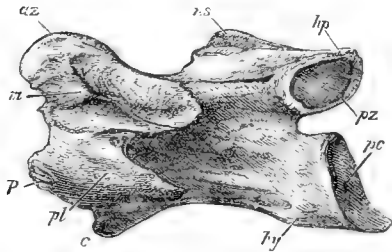
of the ventral surface of the centrum has notably increased in width. The styliform ribs are no longer styliform, but stout obtusely pointed processes, projecting, however, postaxiad and slightly ventrad as usual (fig. 34, *ps*).

The *catapophyses* (figs. 33 & 34, *c*) are very largely developed, projecting not only ventrad but somewhat proximad also; they are so extended inwards that the interval between their ventral ends is decidedly less than the breadth of the middle of the ventral surface of the centrum behind them, a condition which we have not yet met with. The middle of the ventral surface of the centrum may still show a trace of the antero-posteriorly extended hypapophysial ridge (fig. 34, *hy*).

SIXTEENTH VERTEBRA ($\frac{2}{3}$ natural size).

Fig. 33.

Fig. 34.



Aspects.

Fig. 33, lateral; 34, ventral. Letters as before.

The pleurapophysial lamella is beginning decidedly to diminish in antero-posterior extent; but the metapophysis is largely prominent beneath a prezygapophysis, which may project very considerably preaxiad beyond the parapophysis (figs. 33 & 34, *m*).

The low neural spine is as thick as in the fifteenth vertebra and also shorter antero-posteriorly; its posterior excavation is enlarged into a deep conical fossa, the dorso-lateral margins of which diverge to the postzygapophyses—without, however, sheltering it or covering it in, except to a minute extent on each side.

The articular surfaces of the postzygapophyses are nearly as wide transversely as long pre- and postaxially.

THE SEVENTEENTH VERTEBRA.

The seventeenth vertebra differs very considerably from the sixteenth, and more than the latter differs from the fifteenth. It is shorter and at the same time broader, while the breadth of its preaxial part is still more in excess of that of its postaxial part (fig. 38) than was the case in the sixteenth vertebra. Thus we have a return to a predominance which existed in more preaxially situated cervical vertebræ (fig. 25).

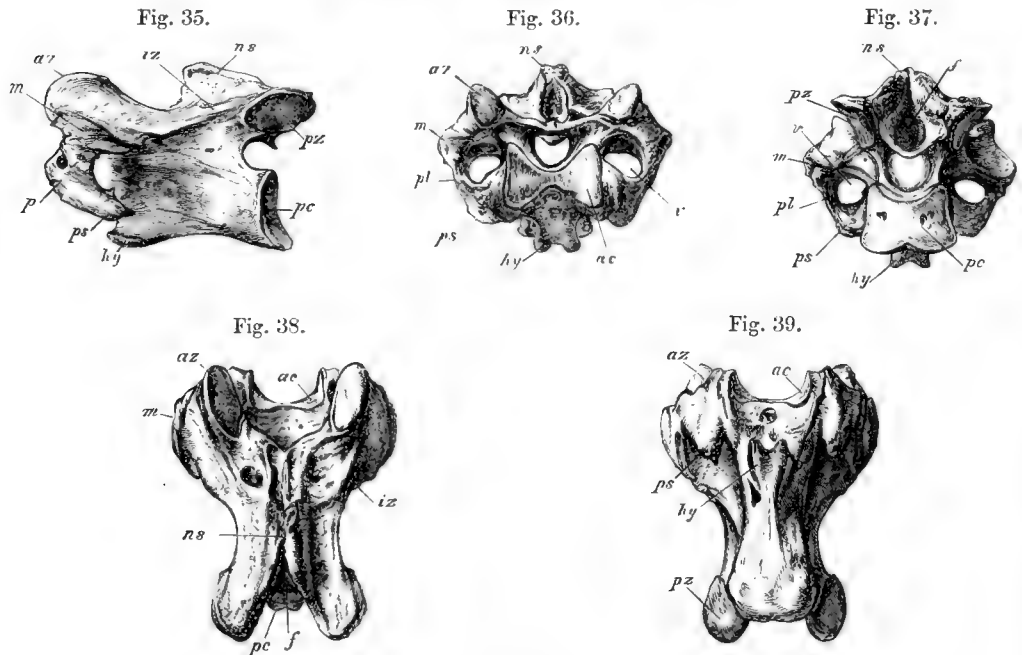
As regards the *centrum*, its *preaxial surface* has the shape of its ventral margin changed by the appearance of two small hypapophysial processes (fig. 36, *hy*).

Its *postaxial surface* is larger both actually and relatively; while its ventral margin has once more become more extended transversely than its dorsal margin, and at the same time is less concave than in the vertebra last described (fig. 37, *pc*).

The *neural surface* of the centrum may be more exposed by the further cutting away, as it were, of the preaxial part of the neural arch.

The *ventral surface* of the centrum presents somewhat of a return to the proportions of the third vertebra, if abstraction is made of the *hypapophyses* (fig. 39).

SEVENTEENTH VERTEBRA ($\frac{1}{2}$ natural size).



Aspects.

Fig. 35, lateral; 36, preaxial; 37, postaxial; 38, dorsal; and 39, ventral. Letters as before.

These latter processes (which may conveniently be said to represent and take the place of absent *catapophyses*) project as a pair of short processes, springing from beneath about the middle (both antero-posteriorly and transversely) of the centrum. They extend ventrally and preaxially, and diverge from each other towards their apices, instead of converging like the catapophyses of the sixteenth vertebra.

The *hypapophyses* may be separated by a notch which extends dorsad to the general level of the ventral surface of the centrum, or may be only imperfectly divided from one another as in the specimen figured.

In front of these hypapophyses the ventral surface of the centrum presents a wide and rather shallow transverse concavity, bounded by two diverging ridges, which proceed respectively from the root of each hypapophysis to the adjacent parapophysis. Behind the hypapophyses there is no trace whatever of a median hypapophysial ridge, but the centrum widens rapidly backwards into a nearly flat slightly concave surface with a rounded postaxial margin.

In the place of styliform ribs there are conical prominences so short and stumpy that their nature would hardly be suspected but for the conditions presented by more preaxial vertebræ; their direction, however, is the same as heretofore (figs. 35 & 36, *ps*).

The pleurapophysial bands of bone are still less extended antero-posteriorly, though they enclose a canal for the vertebral artery, which has now become so large as nearly to equal the neural canal in diameter (fig. 37, *v*).

The *metapophysis* (figs. 35, 36 & 38 *m*) is very largely developed; but the prezygapophysis extends less decidedly preaxial of the parapophysis than in the sixteenth vertebra.

The *postzygapophysis* also projects postaxially a little beyond the centrum.

The prezygapophysial articular surfaces look slightly more inwards, and the postzygapophysial ones decidedly more outwards, than in the sixteenth or preceding vertebræ.

The *neural spine* has become so wide as (it may be for the first time) to exceed in transverse extent the dorsal surface of the neural laminae on either side of it.

The anterior excavation of the neural spine (fig. 36, *ns*) has become a considerable and open fossa, while its posterior excavation (fig. 37, *f*) has assumed very large proportions, with a vertical preaxial wall, and laterally more or less sheltered and overshadowed by the projecting margins of the ridges, which diverge postaxially from the neural spine to the postzygapophyses. The neural spine itself is very little extended antero-posteriorly, less than in any of the nine preceding vertebræ; but it has a greater extension dorsad.

One or two conspicuous foramina lead from the side of the centrum or neural arch into the substance of the bone.

CERVICO-DORSAL VERTEBRÆ.

THE EIGHTEENTH VERTEBRA.

The eighteenth vertebra differs as much from the seventeenth as does the latter from the sixteenth.

It is a larger bone than the seventeenth vertebra, inasmuch as, though the centrum is shorter, the extreme antero-posterior extent of the whole vertebra is not less, while its transverse and its dorso-ventral dimensions are augmented.

The excess of the transverse diameter of its preaxial part over that of its postaxial part is greater than even in the seventeenth vertebra (fig. 41).

This vertebra bears the first rib.

The *centrum* has its *preaxial* articular surface with its dorsal margin more concave and its ventral margin less concave than in the seventeenth vertebra. The outline of the inferior margin of the whole centrum is modified by the hypapophysial process.

The *postaxial* surface of the centrum is relatively more extended transversely, with its ventral margin wider and more in excess of its dorsal margin than in the seventeenth vertebra, while at the same time the ventral margin is still less concave.

EIGHTEENTH VERTEBRA ($\frac{1}{2}$ natural size).

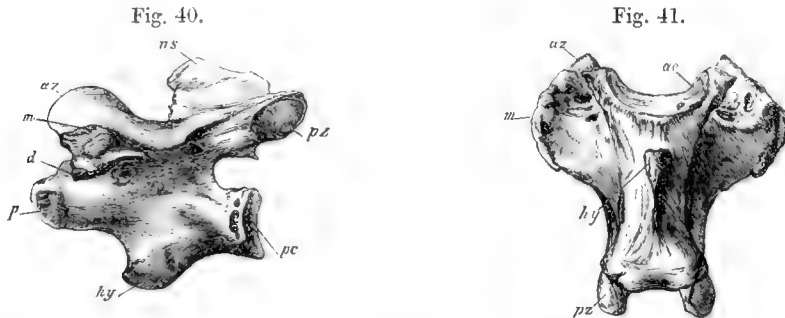


Fig. 40, lateral aspect; 41, ventral aspect. Letters the same, except that *d* denotes the diapophysis.

The *ventral surface* of the centrum is wide and but very slightly concave at either its preaxial or its postaxial part. There is a very thick median hypapophysis extending from the middle of the ventral surface, and more or less bifurcating ventrally into two short, rounded, diverging processes (fig. 41, *hy*).

No diverging or other ridges connect the *hypapophysis* with the parapophyses; but a ridge may run postaxially from each parapophysis to the postaxial margin of the ventral surface of the centrum, the two ridges bounding that surface laterally.

The postaxial margin of the ventral surface is less convex than in the seventeenth vertebra.

If there is no free rib, the pleurapophysial band of bone representing it is extremely short antero-posteriorly. Each margin of it is concave, while from the ventral end of its postaxial margin a triangular blunt prominence (the last rudiment of the styloform rib of more preaxial vertebræ) projects postaxially, but at the same time in a more ventral direction than that taken by any of the styloform ribs before described. Such is its condition in a highly ossified skeleton; but very often the pleurapophysial band appears as a separate rib, and in this free condition it is described below as the first rib (fig. 75, 1).

This osseous band, when it is ankylosed to the vertebra, bounds externally a bony canal for the vertebral artery, which is so large that it exceeds in diameter the neural canal itself.

This arterial canal is bounded internally by the neural lamina and inferiorly by the

great lateral projection of the parapophysis, on to which here, as in the more preaxial vertebræ, the preaxial articular surface of the centrum extends itself.

Superiorly the canal for the artery is bounded by a process of bone, which extends outwards from beside and beneath the prezygapophysis (being in fact a *diapophysis*, or tubercular process)¹, on the outer side of which is to be seen a prominence still representing the *metapophysis* (figs. 40 & 41, *m*).

These parts exist in the same way in preceding vertebræ; but they are most conveniently noticed here on account of the large size they attain on the dorsal and ventral sides respectively of the great canal for the vertebral artery.

The articular surfaces of the prezygapophyses look more inwardly, and those of the postzygapophyses more outwardly, than do the corresponding surfaces of the seventeenth vertebra; and the postzygapophyses also extend postaxially beyond the centrum to a greater degree (fig. 40, *pz*).

The *neural spine* may be longer antero-posteriorly, and is wider transversely as well as more extended dorsad than is the neural spine of the preceding vertebra.

Its anterior excavation is larger and has a nearly vertical postaxial wall, with two prominent ridges, which bound it laterally and proceed preaxially and nearly parallel to near the preaxial margin of the neural arch.

The posterior excavation of the neural spine is at about its maximum of development in this vertebra, and is overshadowed and protected by the postaxial extent of its dorsal lateral margins, which diverge from the neural spine to the postzygapophyses.

The pre- and postaxial margins of the neural arch are strongly concave, though the former is not so much so as is the corresponding part in the seventeenth vertebra.

Sometimes two conspicuous foramina lead into the substance of the bone on either side. One of these is placed a little on the ventral side of the interzygapophysial ridge, rather nearer to the postaxial margin of the pedicle of the neural arch than to its preaxial border; the other may be sometimes found at the side of the middle of the centrum, directly ventrad to the first foramen.

THE NINETEENTH VERTEBRA.

The nineteenth vertebra is very like the eighteenth in size and general shape, although it has never any pleurapophysial osseous band, but always an articulated rib (the second rib) instead.

This absence of course produces a striking difference in the general appearance of the vertebra when it is viewed preaxially.

The *centrum* presents a *preaxial surface* which ends in an obtusely pointed process on each side; and both the dorsal and ventral margins of its articular surface are less concave than are the corresponding margins of the eighteenth vertebra (fig. 43, *ac*).

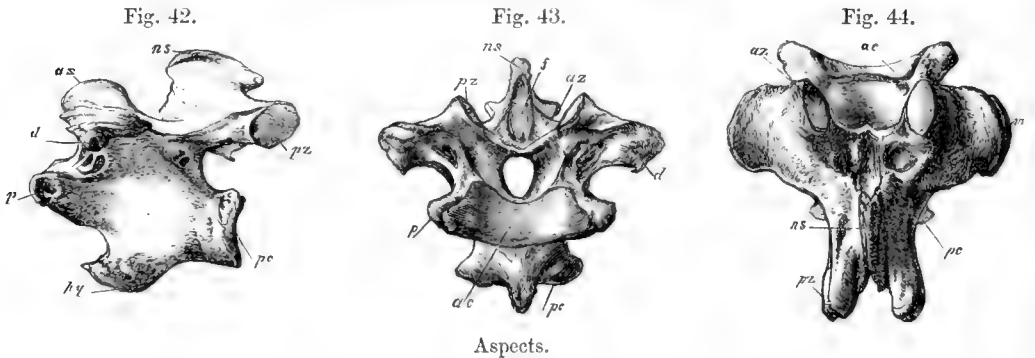
¹ The *diapophysis* is that part to which the tubercle of the rib is attached, while its head joins the *parapophysis*.

The *postaxial aspect* of the centrum shows an articular surface which may be more quadrate, its ventral margin often less preponderating over its dorsal margin than in the preceding vertebra. The latter is also less concave, while the former is nearly straight and may even be very slightly convex.

The ventral surface has its preaxial margin more expanded and less sharply concave, and its postaxial margin often less convex than is the case with the eighteenth vertebra.

The *hypapophysis* is a single rounded, obtuse tubercle. It extends rather more ventrad and sometimes less preaxiad than does that of the preceding vertebra. The under surface of the centrum may be concave antero-posteriorly in the middle line behind the hypapophysis.

NINETEENTH VERTEBRA ($\frac{1}{2}$ natural size).



Aspects.
Fig. 42, lateral; 43, preaxial; 44, dorsal. Letters as before.

The ventral aspect of the hypapophysis exhibits, as it were, a slight lingering tendency to bifurcate.

Behind the hypapophysis the surface of the centrum begins to be slightly convex transversely instead of being concave.

Not only is there, as has been said, no pleurapophysial band of bone, but no ridge runs postaxially from the parapophysis, the side of the centrum being continued uninterruptedly dorsad into the side of the neural arch, the whole forming one concavo-convex expanse.

The *parapophysis* extends preaxially and slightly outwards, and has at the outside of it a small, rather deep, concavity for the head of the rib, and on its inner side the lateral continuation of the preaxial central articular surface (fig. 42, *p*).

The *diapophysis* projects slightly more outwards from the prezygapophysis, is more antero-posteriorly extended; and the dorso-ventral distance between it and the parapophysis is greater than heretofore, extending to the preaxial margin of the neural lamina. From its ventral outer side, near its preaxial end, the diapophysis develops a rounded prominence (fig. 42, *d*) to receive the tubercle of the rib. Beneath it the preaxial surface of the neural lamina is deeply and irregularly excavated, and another

smaller excavation (either several small openings or one large foramen) is placed a little preaxially of the postaxial margin of the neural lamina, on the ventral side of the interzygapophysial ridge.

The *neural spine* has its dorsal margin more antero-posteriorly extended than in the eighteenth vertebra; and consequently the margins of the ridges running from it to the postzygapophyses, instead of sloping gradually, run at first a little preaxially, thus forming a slightly acute angle.

The postaxial excavation of the neural spine is much as in the eighteenth vertebra, though somewhat less deep. The preaxial surface of the neural spine is vertical, but cannot always be said to be medianly excavated; rather there is sometimes a slight depression on each side of it on the neural lamina.

The *prezygapophyses* are broader than in the eighteenth vertebra, and look rather more inwards. The *postzygapophyses* are smaller and look even more outwardly. For the first time their transverse (here actually dorso-ventral) diameter may exceed their antero-posterior development; and they are so produced that their articular surfaces may be altogether postaxial to the postaxial margin of the centrum. The preaxial margin of the neural arch begins to show a little median preaxially directed process (fig. 44).

THE TWENTIETH VERTEBRA.

The twentieth vertebra closely resembles the nineteenth, with the centrum, diapophyses, and neural spines slightly enlarged.

The *centrum* has its *preaxial* articular surface relatively deeper dorso-ventrally; and its lateral parapophysial terminations are not so much laterally produced.

TWENTIETH VERTEBRA ($\frac{1}{2}$ natural size).

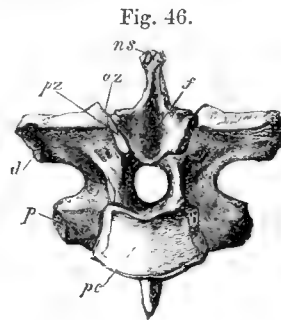
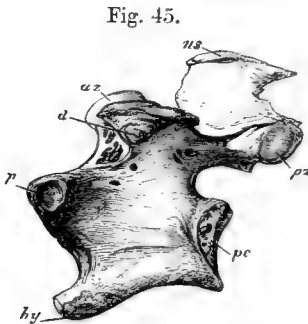


Fig. 45, lateral aspect; 46, postaxial aspect. Letters as before.

The pre- and postaxial diapophysial excavations of the neural lamina are the same as in the nineteenth vertebra; only the postaxial excavation is relatively the more extensive.

The *postaxial* surface has its ventral margin more convex, but relatively shorter compared with its dorsal margin, than in the nineteenth vertebra; the whole articular surface begins also to be less convex transversely and less concave dorso-ventrally.

The *neural* surface of the centrum is still more exposed than heretofore by the cutting away, as it were, of the preaxial part of the neural arch, which has a more marked median process.

The *ventral* surface is nowhere concave transversely, though somewhat so antero-posteriorly; not, however, to the same degree as in the nineteenth vertebra. The preaxial margin is also somewhat less concave, and the postaxial margin less convex.

There is a median *hypapophysis* which may or may not be somewhat expanded laterally towards its tip, and which may or may not project more strongly preaxial than in the nineteenth vertebra, and may have its dorsal surface concave transversely. The ventral surface of its apex may be marked with a short, faint, antero-posterior groove, the last trace of the bifurcation of the process in more preaxial vertebræ.

The side of the centrum is continuous with that of the neural arch, exhibiting an undulating expanse (concavo-convex dorso-ventrally), which is smooth, save that there may be a scarcely perceptible indication of a ridge running obliquely ventrad from the capitular process to the postaxial margin of the centrum.

The *parapophysis* extends less both preaxially and outwards than in the nineteenth vertebra; but the articular fossa for the head of the rib is larger, though nearly, if not quite, as deep (fig. 45, *p*).

The *diapophysis* again projects more outwards, is more extended antero-posteriorly, and more remote from the parapophysis than in the preceding vertebra. It bears on its ventral side, more close to its external margin, a convex articular surface (fig. 45, *d*) for the tubercle of the rib, which surface is rather more elongated and less rounded than it is in the nineteenth vertebra. It is placed about as near to the preaxial margin of the diapophysis as to its postaxial margin, or rather nearer; and therefore more postaxially with relation to the whole, more extended, diapophysis than in the more preaxial vertebra.

Ventral and preaxial to this surface the preaxial aspect of the neural lamina (pedicle) is deeply, widely, and irregularly excavated; and another excavation is placed near the postaxial margin of the pedicle, in the same position as in the nineteenth vertebra, but larger in size.

The *neural spine* is more extended both dorsally and antero-posteriorly, having a straight dorsal margin, which about equals in length its preaxial margin and also the transverse diameter of the postaxial articular surface of the centrum.

The postaxial excavation of the spine extends less dorsally, the dorsal part of the neural spine presenting postaxially a single margin, instead of a flat surface bounded by two ridges as in the nineteenth vertebra.

From the side of the neural spine two laminae of bone proceed postaxially to the postzygapophyses, bounding externally that fossa behind the neural spine which represents the postaxial excavation of that spine, which we have seen to exist in vertebræ nearer the skull.

The dorsal margins of these laminæ form nearly a right angle with the postaxial margin of the neural spine.

The articular surfaces of the zygapophyses are still smaller; and the postaxial ones project still more postaxially beyond the centrum than in the nineteenth vertebra (fig. 45, *pz*).

The twentieth vertebra supports a long rib, which ends freely and does not come into contact with any sternal rib, though it is related to the first of these (fig. 75, III).

THE DORSAL VERTEBRÆ.

THE TWENTY-FIRST VERTEBRA.

The twenty-first vertebra is so much like the twentieth that little need be said in its description.

The preaxial articular surface of the centrum is deeper dorso-ventrally.

The *hypapophysis* is generally smaller, especially narrower from side to side, and its preaxial margin is more concave; it may show a rather more marked tendency to distal bifurcation (fig. 48, *hy*).

No oblique ridge traverses the side of the centrum; but there may be some defects of ossification dorsally, just ventrad of the diapophysis.

The *parapophysis* extends less; but its articular fossa (*p*) is larger.

TWENTY-FIRST VERTEBRA ($\frac{1}{2}$ natural size.)

Fig. 47.

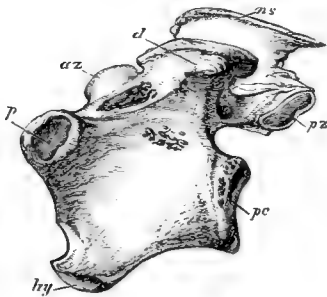


Fig. 48.

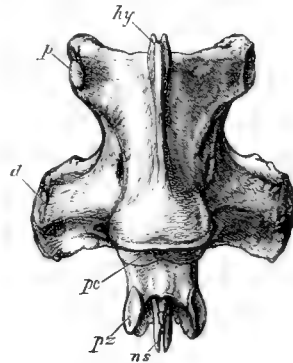


Fig. 47, lateral aspect; 48, ventral surface. Letters as before.

The diapophysial excavations are plainly to be seen; the postaxial one has the form of a single foramen or fossa.

Besides these, there is a defect of ossification in the side of the centrum, just below the middle of the diapophysis.

The *diapophysis* projects obliquely postaxiad and slightly dorsad, as well as outwards, and is much more remote from the parapophysis than in the twentieth vertebra.

The tubercular convexity (*d*) is less marked, and is situated almost as near the postaxial border of the diapophysis as it is near its preaxial margin.

Excavations occur preaxially, as in the preceding vertebra; but postaxially they may exist close to the postaxial margin of the diapophysis, extending inwards to the base of the neural spine.

The *neural spine* is more extended dorsally and slightly so antero-posteriorly; its dorsal margin is rather convex, and bifurcates slightly at each end. That concavity which in the preceding vertebra exists on each side of the preaxial root of the neural spine is here deeper.

The postaxial fossa is smaller; and the margins of the laminae which laterally bound it form rather less than a right angle with the postaxial margin of the neural spine.

The zygapophysial articular surfaces are again slightly diminished. The twenty-first vertebra supports a long rib, which articulates by its distal end with the second sternal rib.

THE TWENTY-SECOND VERTEBRA.

This vertebra is of about the same size as the twenty-first, in some respects less developed, in others more so.

Its *centrum* has its *preaxial* surface entirely occupied by the articular surface, and the ventral margins of both coincide, as there is no hypapophysial production. The surface is deeper dorso-ventrally, is less laterally produced, and may have its dorsal and ventral margins more concave and convex respectively.

TWENTY-SECOND VERTEBRA ($\frac{1}{2}$ natural size).

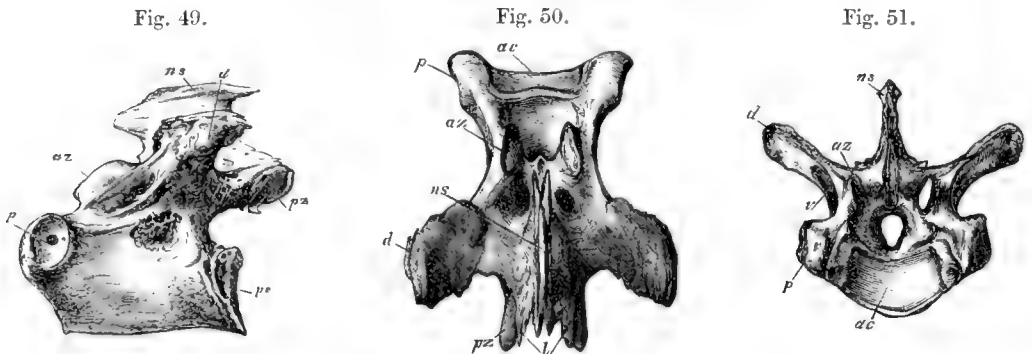


Fig. 49, lateral aspect; 50, dorsal aspect; 51, preaxial aspect. Letters as before, except *v*, excavation on preaxial side of diapophysis.

Excavations are to be seen on the preaxial, postaxial, and ventral aspects of the diapophysis, the preaxial one being very much the larger.

The *postaxial* surface of the centrum is rather larger and flatter, but very similar in figure to that of the twentieth vertebra; its dorsal margin, however, is rather wide and less concave.

The *neural* surface of the centrum is more concave transversely at its preaxial part than in the vertebra last described.

The *ventral* surface is destitute of any hypapophysis; but its nearly straight median portion is in the form of a slightly marked antero-posterior ridge. On each side of this the centrum rounds off, so that its ventral surface is convex transversely throughout; its lateral margins are, when viewed dorsally (fig. 50), strongly concave, owing to the expansion of the pre- and postaxial ends of the centrum. The concavity of the preaxial margin is much as in the twenty-first vertebra; but the postaxial margin is less convex.

The sides of the centrum and neural arch are continuous, without any trace even of a ridge; but there may be defects of ossification beneath the diapophysis.

The *parapophysis* extends out less even than in the twenty-first vertebra; and its articular fossa is larger (especially dorso-ventrally), but shallower.

The *diapophysis* is much longer and very much produced obliquely, postaxiad and slightly dorsad; its remoteness from the parapophysis is again augmented in passing to this vertebra from the twentieth.

The convexity for the tubercle of this rib is, like that of the twenty-first vertebra, smaller and less marked than in the twentieth vertebra, and may be nearer to the postaxial margin of the diapophysis than it is to its preaxial margin.

The distal part of the diapophysis is more antero-posteriorly extended than the more proximal part.

Numerous irregular preaxial diapophysial excavations are placed beneath the ridge running from the prezygapophysis to the diapophysis; and other large excavations appear behind the diapophysis and on each side of the postzygapophysis, extending close to the ventral side of the postaxial margin of the diapophysis, which margin runs inwards to the base of the neural spine.

The *neural spine* is more extended dorsally, but not antero-posteriorly; it has a slightly convex dorsal margin, and bifurcates again at each end (fig. 50, *ns*).

That concavity which in the two preceding vertebræ exists on each side of the preaxial root of the neural spine is here yet further deepened.

The postaxial fossa of the neural spine is smaller; and the margins of the laminae which laterally bound it form an obtuse angle with the postaxial margin of that spine.

The articular surfaces of the zygapophyses are again still smaller, and look almost entirely inwards and outwards respectively. Almost the whole surface of the postzygapophysis projects postaxially beyond the postaxial surface of the centrum.

The twenty-second vertebra supports a long rib, which articulates by its distal end with the third sternal rib.

THE TWENTY-THIRD VERTEBRA.

This vertebra is so like its preaxial predecessor that little need be said in its description.

The postaxial surface of the *centrum* is relatively deeper dorso-ventrally, and its ventral margin is slightly concave.

The parapophysial surface for the head of the rib is much as in the twenty-second vertebra (fig. 52, *p*). The *diapophysis* extends somewhat less postaxially, and is less antero-posteriorly extended at its distal end; and the surface for the tubercle is somewhat less remote from the parapophysis.

The *neural spine* is more extended dorsally, being longer in this direction than antero-posteriorly.

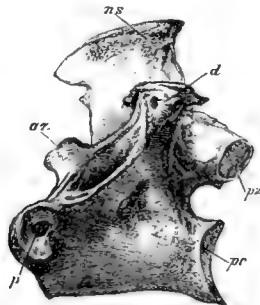
The prezygapophysial articular surfaces are smaller than those of the twenty-second vertebra; but the same cannot be said of the postzygapophysial ones.

Great excavations appear on each side of the vertebra, in front of, ventrad to, and behind the diapophysis.

Thus we have a side fossa, partially filled up with little lamellæ and spicula of bone,

TWENTY-THIRD VERTEBRA ($\frac{1}{2}$ natural size).

Fig. 52.



Lateral aspect. Letters as before.

on the preaxial aspect of the root of the diapophysis. The fossa is bounded dorsally by the ridge running from the dorsal side of the diapophysis to the prezygapophysis, on the ventral side by the ridge running from the ventral side of the diapophysis to the parapophysis. Again, there is a great depression at the side of the neural lamina, just ventrad to the diapophysis; and the same may exist in the two preceding vertebræ.

On the dorsum of the neural arch we see that the lateral depressions on each side of the preaxial part of the neural spine have much extended. The postaxial median excavation of the neural spine is more open, while the margins of the laminae which laterally bound it form a very obtuse angle with the postaxial margin of that spine.

Those postaxial excavations which in the two preceding vertebræ were mentioned as existing on each side immediately ventrad to the postaxial margin of the diapophysis may be here more conspicuous; they may be so, in part, on account of the less development postaxially of the dorsum of the diapophysis, so that these lateral postaxial excavations may appear on the dorsum of the vertebra and as but slightly separated from the preaxial lateral depressions on each side.

The postzygapophyses either do not project at all postaxially beyond the centrum, or but very slightly so (fig. 52, *pz*).

The twenty-third vertebra supports a long rib (the sixth), which articulates at its ventral end with the fourth sternal rib.

THE TWENTY-FOURTH VERTEBRA.

The twenty-fourth vertebra differs from the twenty-third principally in the much greater length (dorsally) of the neural spine.

The *centrum* has its postaxial surface more concave dorso-ventrally, as also is its ventral margin, which at the same time is more everted postaxially.

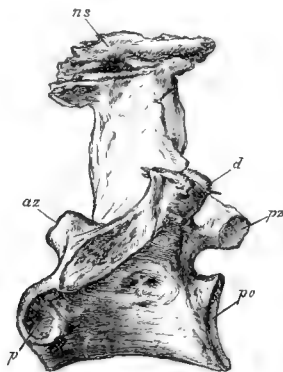
The *ventral* surface is slightly flatter. The neural canal, which has been diminishing in the last few vertebræ, is here decidedly smaller.

The *parapophysis* is much as in the twenty-third vertebra.

The *diapophysis* is somewhat less produced preaxially; and its distal end is more

THE TWENTY-FOURTH VERTEBRA ($\frac{1}{2}$ natural size).

Fig. 53.



Lateral aspect. Letters as before.

rounded. The surface for the tubercle is again less remote from that for the head of the rib (fig. 53, *d*).

The lateral excavation on each preaxial side of the root of the *neural spine* is still larger, and separated only by a vertical lamella of bone from the postaxial lateral excavation, which is here greatly augmented in size.

Thus, when the neural arch is viewed dorsally, five radiating lamellæ are seen to separate five subequal fossæ.

The two preaxial lateral excavations are separated by the preaxial part of the root of the neural spine. The two postaxial lateral excavations are each separated from the adjacent preaxial lateral excavation by a vertical lamella of bone running from the middle of the side of the neural spine outwards and postaxially to the postaxial part of the diapophysis. The two postaxial lateral excavations are separated from the remaining median postaxial excavation by the two lamellæ which laterally bound the median

postaxial excavation, and which diverge from the hinder part of the neural spine to the postzygapophyses.

This fifth fossa (the median postaxial fossa) shows signs of subdivision at its fundus through a slight postaxial projection of the postaxial margin of the root of the neural spine.

The apex of the neural spine is somewhat swollen, and may be much extended antero-posteriorly.

The postzygapophysial surfaces are here, again, somewhat larger, and look much more ventrally and less outwards.

The twenty-fourth vertebra supports a long rib (the seventh), which articulates by its ventral end with the fifth sternal rib.

THE TWENTY-FIFTH VERTEBRA.

This last of the free vertebræ differs greatly from any yet described, and considerably even from the twenty-fourth vertebra, principally in the diminution of the centrum and great augmentation of the neural spine.

The *centrum* has its *preaxial* surface less extended dorso-ventrally, while its ventral margin is concave as well as its dorsal one (fig. 55, *ac*).

The *postaxial* surface of the centrum may be different from any thing we have hitherto seen; its transverse extent may be nearly three times its dorso-ventral dimension. There may be scarcely a trace of dorso-ventral concavity, while the whole surface may be but very feebly convex from side to side¹; on the other hand, there may be little difference between it and the postaxial surface of the twenty-fourth vertebra².

The neural canal is even more contracted, especially in its dorso-ventral extent at its postaxial end, than in the twenty-fourth vertebra.

The *ventral* surface of the centrum presents a quadrangular, subequilateral, much flattened surface, such as we have not yet met with; its lateral margins, however, are still concave, while its pre- and postaxial margins are respectively rather more concave and convex than in the twenty-fourth vertebra.

The *parapophysis* is much as in the twenty-fourth vertebra, but extends less outwards.

The *diapophysis* is more slender, and projects directly outwards and somewhat dorsally; its distal half, at the least, is rather pre- and postaxially compressed than dorso-ventrally depressed. The surface for the tubercle is again less remote from that of the head of the rib.

The prezygapophyses are larger than in the twenty-fourth vertebra, and look more dorsad; the postzygapophysial articular surfaces are still smaller than in the preceding vertebra, and look still more ventrad.

The lateral excavations on the ventral and preaxial sides of the diapophysis have more

¹ As in the specimen 1362A in the College-of-Surgeons Museum.

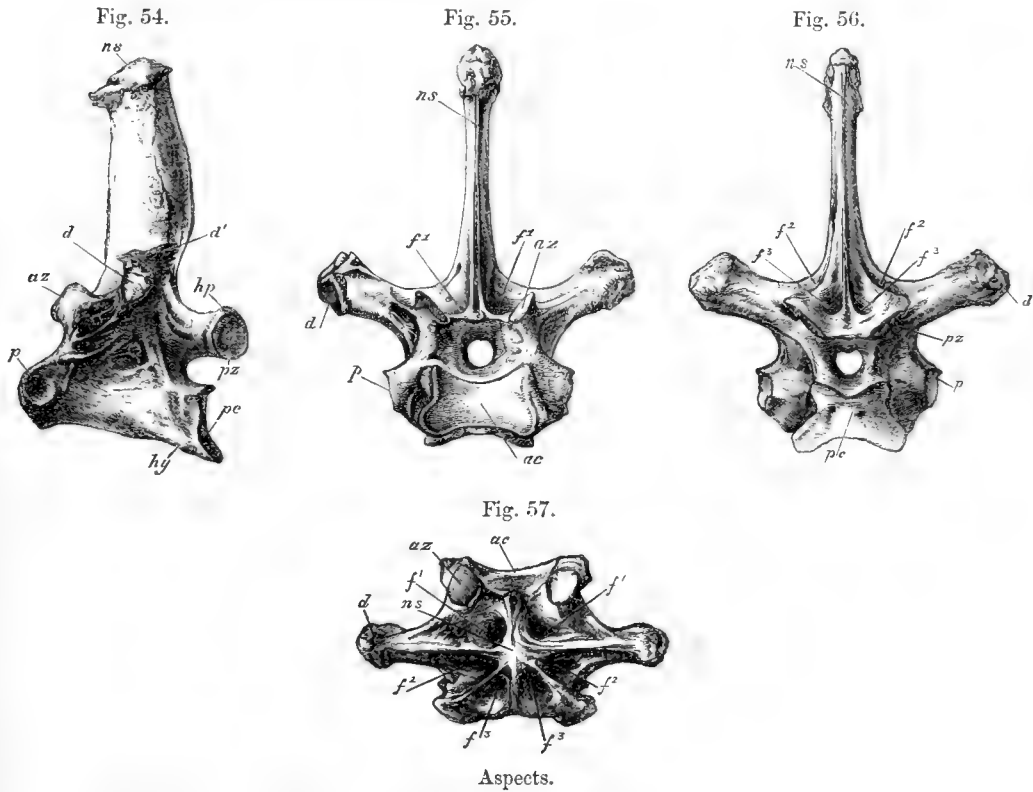
² As in the specimen 1317 in the College-of-Surgeons Museum.

or less coalesced by the abortion of the lamella running from the root of the diapophysis to the parapophysis.

The *neural spine* is swollen at its distal end, and is in length about twice the antero-posterior extent of the whole vertebra.

When the neural arch is viewed from above, there may be sometimes seen six fossæ (fig. 57, f^1, f^2, f^3), owing, when this is the case, to the complete subdivision of the median postaxial fossa into two by the greater postaxial development of the postaxial margin of the neural spine, which may extend to the postaxial margin of the neural arch.

TWENTY-FIFTH VERTEBRA ($\frac{1}{2}$ natural size).



Aspects.

Fig. 54, lateral; 55, preaxial; 56, postaxial; 57, dorsal (the neural spine being cut short off).
Letters as before, except f^1 , antero-lateral fossa; f^2 , lateral fossa; f^3 , posterior fossa of neural arch.

The degree of special development of this vertebra varies, however, with the more or less preaxial extension of the ilia, also with the total number of vertebræ of which the spinal column consists; for there may be one less than the number herein given.

The twenty-fifth vertebra supports a long rib (the eighth), which articulates with the sixth sternal rib.

THE LUMBO-SACRO-CAUDAL VERTEBRÆ.

These vertebræ are normally twenty in number, and are, in the adult, anchylosed together and also with the innominate bones into one great osseous mass (figs. 70-73).

The various individual vertebræ cannot, therefore, be described from the adult; but the Museum of the College of Surgeons fortunately possesses a preparation of the sacral vertebræ (figs. 58, 59, 60, 61, & 62) of a young Ostrich in an unanchylosed condition, which enables the serial description of individual vertebræ to be completed.

THE DORSO-LUMBAR VERTEBRÆ.

THE TWENTY-SIXTH VERTEBRA.

This vertebra has, of course, its preaxial surface formed to correspond with the postaxial surface of the twenty-fifth vertebra. It may be greatly or not quite completely overlapped by the iliac bones.

Its *parapophysis* is smaller than that of the preceding vertebra, with a smaller articular surface for the capitulum.

Its *diapophysis* is shorter, more compressed in an oblique pre- and postaxial direction, so as to have its dorso-ventral diameter widest ventrad and preaxiad; its articular surface is also elongated in the same direction.

Its spinous process is yet higher than in the twenty-fifth vertebra.

This vertebra is mostly, but not always, confluent with the sacrum in the adult. It supports a distinct rib (the ninth), which, however, generally ends freely at its ventral extremity without joining any sternal rib; indeed there is no true sternal rib corresponding to it, though it may be connected by a styliform bone with the sternal rib of the preceding vertebra.

THE TWENTY-SEVENTH VERTEBRA.

This vertebra is always, in the adult, confluent with the sacrum; and its rib (the tenth) is almost always an anchylosed process (but not always so, as *e. g.* in the specimen 1362B).

Its spine is again higher.

Its *diapophysis* is still more compressed, appearing as a lamella, the greatest breadth of which is inclined still more preaxiad and ventrad than in the twenty-sixth vertebra.

The *parapophysis* is much smaller, and is directed as much dorsad as ventrad, if not more so.

The anchylosis of the transverse processes and rib results in the formation of a perforated transverse process, with its greatly produced extremity (the shaft of the rib) extending ventrally, slightly arched convex preaxially, greatly flattened from within outwards, and with sharp, pre- and postaxial margins (figs. 70, 71, 72, & 73, *pl.*).

THE LUMBAR VERTEBRÆ.

THE TWENTY-EIGHTH VERTEBRA.

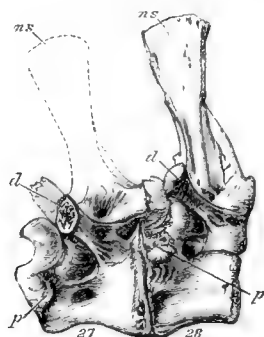
This is hardly to be distinguished in the adult, save by its transverse processes, which are strongly inclined postaxiad and dorsad, and are the first, since the axis, which present no indication of a rib.

The under surface of its centrum is transversely concave (fig. 73).

From the immature condition it may be seen that the spinous process is again higher, that the diapophysis inclines outwards and dorsad and is ventrally continuous with the parapophysis, that there are no postzygapophyses, but that its neural arch joins that of the twenty-ninth vertebra by suture (fig. 58, 28).

LATERAL ASPECT OF TWENTY-SEVENTH AND TWENTY-EIGHTH VERTEBRÆ.

Fig. 58.



Letters as before.

THE TWENTY-NINTH VERTEBRA.

This vertebra (figs. 59, 60, & 61, 1) like the preceding, but with a slightly higher spine, more vertically extended transverse process, and no zygapophyses.

THE THIRTIETH VERTEBRA.

This vertebra (figs. 59, 60, and 61, 2), as indicated by the young condition, has its spinous process yet higher; its diapophysis is also more dorsally produced, so that with the conjoined parapophysis there is presented an elongated vertical surface for the ilium. Without zygapophyses its neural arch is united to its centrum only by suture, and does not extend postaxially so far as the latter, thus leaving a large intervertebral opening between it and the ventral part of the neural arch of the next vertebra (fig. 59).

THE THIRTY-FIRST VERTEBRA.

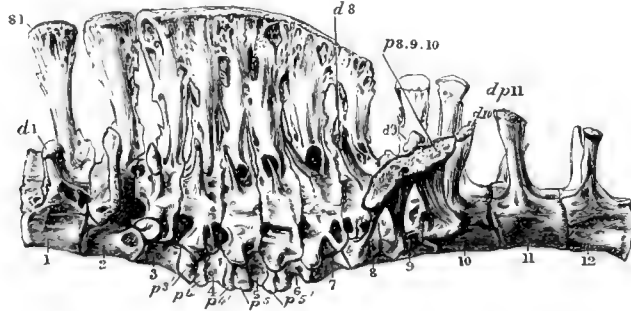
This vertebra (figs. 59, 60, & 61, 3) has a spinous process slightly more elevated, and even in the immature condition (fig. 59, 3) has this process anchylosed with that of the next postaxial vertebra.

Its *neural arch* is united by suture to its fellows and to the centrum, and is antero-posteriorly contracted below, so as to have a large intervertebral opening both pre- and postaxial of it.

The most preaxial part slightly rests on the postaxial extremity of the thirtieth vertebra.

LATERAL ASPECT OF LUMBAR AND SACRAL VERTEBRÆ OF AN IMMATURE SPECIMEN
($\frac{2}{3}$ natural size).

Fig. 59.



1. Twenty-ninth (or second lumbar) vertebra; d^1 , its diapophysis; s^1 , its neural spine. 2. Thirtieth vertebra.
3. Thirty-first vertebra; p^3 , its posterior parapophysial projection, which concurs with the anterior (and smaller) parapophysial projection (p^1) of the next vertebra to form an articular surface for the ilium. 4. Thirty-second vertebra; p^1 and p^4 , anterior (preaxial) and posterior (postaxial) parapophysial projections; the latter concurs with the anterior parapophysial projection (p^3) of the succeeding vertebra to form an articular surface. 5. Thirty-third vertebra; p^5 and p^6 , its parapophysial projections. 6. Thirty-fourth vertebra. 7. Thirty-fifth vertebra. 8. Thirty-sixth (or first sacral) vertebra; d^8 , its diapophysis; $p^{8,9,10}$, its rib or capitulum, which has coalesced distally with the same parts of the two succeeding vertebrae. 9. Thirty-seventh vertebra. 10. Thirty-eighth vertebra. 11. Thirty-ninth (or first sacro-caudal) vertebra; dp^{11} , its conjoined dia- and parapophysis. 12. Fortieth (or second sacro-caudal) vertebra.

The *diapophysis* is inclined like that of the last vertebra, but has a flattened surface at its extremity; it is quite separate from the parapophysis, which is formed by the ventral part of the neural arch, and offers a rounded, flat, articular surface (fig. 59) to the ilium. This surface is very slightly reinforced by minute adjacent portions of the centra of this and the preceding vertebra.

The side of the *centrum* at its postaxial part exhibits a small neural foramen near its dorsal border and in front of a large parapophysial surface (fig. 59, p^3), which this part of the centrum contributes towards the proper parapophysial surface of the next vertebra.

THE THIRTY-SECOND VERTEBRA.

This vertebra (figs. 59, 60, & 61, 4) has a spinous process at its maximum of development and ankylosed to the adjacent spines.

Its *centrum* is shorter pre- and postaxially, and its ventral surface is concave transversely and very strongly so at each lateral margin.

Its *neural arch* rests half on the postaxial part of the preceding centrum, half on the preaxial part of its own centrum; it has a large intervertebral opening both pre- and postaxial of its ventral portion.

The *diapophysis* is elongated and slender, ascends dorsal and slightly preaxial and outwards, with a small external flattened facet at its extremity (fig. 59, 4).

The *parapophysis* is formed in a minute degree by the most ventral point of the neural arch, but mainly and subequally by the adjacent portions of the centra which support the arch (fig. 59, p^3 & p^4).

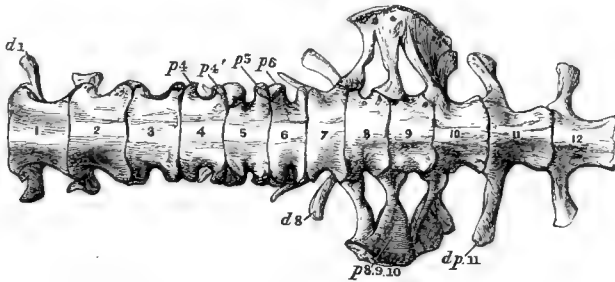
The neural foramen of the centrum is larger.

THE THIRTY-THIRD VERTEBRA.

This vertebra (figs. 59, 60, & 61, 5) is similar to that last described; but the diapophysis is shorter, the neural arch more antero-posteriorly extended at its ventral part, the intervertebral opening postaxial to it being much smaller.

VENTRAL ASPECT OF LUMBAR AND SACRAL VERTEBRÆ OF AN IMMATURE SPECIMEN.
($\frac{2}{3}$ natural size).

Fig. 60.



1-12. Centra of vertebræ from twenty-ninth to fortieth inclusive; d^1 , diapophysis of twenty-ninth vertebra; d^8 , diapophysis of thirty-sixth vertebra; dp^{11} , diapophysis of thirty-ninth vertebra conjoined with its parapophysis; p^4 , anterior parapophysial projection of thirty-second vertebra; $p^{4'}$ posterior parapophysial projection of the same vertebra; p^5 , posterior parapophysial projection of thirty-third vertebra; p^6 , anterior parapophysial projection of thirty-fourth vertebra; $p^{8,9,10}$, conjoined parapophyses of thirty-sixth, thirty-seventh, and thirty-eighth vertebræ. The last of these three is anchylosed to its supporting centrum (10); but each of the two preceding capitula is united by suture, with a pair of slight parapophysial projections contributed by contiguous vertebræ.

There is a considerable defect of ossification in the neural arch (fig. 61, 5) on each side of the spine, oval in shape and extending nearly from the spinous process to the *diapophysis*.

The ventral surface of its *centrum* (fig. 60, 5) is slightly narrower antero-posteriorly,

with each lateral margin extremely concave, through the two parapophysial processes which the centrum throws out. The preaxial one of these is the more considerable.

The neural foramen of the centrum is again rather larger.

THE THIRTY-FOURTH VERTEBRA.

This vertebra (figs. 59, 60, & 61, 6) has again its neural arch supported on two centra; but it rests rather more on its own. It has a larger dorsal defect of ossification (fig. 61, 6) than in the thirty-third vertebra, extending quite from the diapophysis to the neural spine.

The *neural spine* is slightly less extended, though still ankylosed both pre- and postaxially, even in the young.

Its *diapophysis* is rather longer (fig. 61, *d*⁶) than in the last vertebra, and inclined more preaxial. Both the pre- and postaxial intervertebral openings are smaller.

Its *centrum*, the ventral surface of which is exceedingly short antero-posteriorly, forms half of a large parapophysial surface (fig. 60, *p*⁶) at its preaxial part, and the greater part of a very much smaller parapophysial surface at its postaxial part.

The neural foramen of the centrum is again large; it is here almost at its maximum (fig. 61, 6).

THE THIRTY-FIFTH VERTEBRA.

This vertebra (figs. 59, 60, & 61, 7) rests mainly on its own centrum. The postaxial intervertebral opening is bounded below by its neural arch. The defect of ossification of this neural arch is at its maximum (fig. 61, 7), and more dorso-ventrally extended than in the thirty-fourth vertebra.

The *diapophysis* is longer, almost as slender as in the last vertebra, and inclined more preaxially (fig. 61, 7).

The *parapophysial* surface is much smaller, and is formed less by its own centrum than by that of the more preaxial vertebra.

The postvertebral interspace is again rather smaller.

The neural foramen of the centrum is smaller.

THE SACRAL VERTEBRÆ.

THE THIRTY-SIXTH VERTEBRA.

This vertebra (figs. 59, 60, & 61, 8) is distinguishable in the adult as that which furnishes (from the preaxial end of its centrum) the first of those three parapophysial roots which ascend and meet together to form the large bony plate which abuts against the ilium just behind the acetabulum.

In the young it is easily distinguishable as the most preaxial one which develops from the preaxial end of its centrum a suture-united parapophysial process or capitulum of a rib (fig. 60, *p*⁸).

Compared with the thirty-fifth vertebra, its neural arch is more antero-posteriorly extended, and shows a less defect of ossification dorsally (fig. 61, s). Ventrally the neural lamina extends postaxially over the preaxial half of the root of the capitulum of the next vertebra, and thence ascends so as completely to enclose the postvertebral perforation, so that the neural arch may be said to be rather perforated than postaxially notched. The postvertebral interspace or perforation is considerably larger than in the three preceding instances.

The *diapophysis* (figs. 59, 60, & 61, d^8) is remote from the parapophysis, is stouter than that of the preceding vertebra, and extends more outwards and less preaxially.

The *parapophysis* is a scarcely noticeable prominence from the side of the preaxial part of the ventral side of the centrum; and this concurs with a process from the postaxial part of the thirty-fifth vertebra (fig. 60, 7 & 8) to form a surface for the capitulum. This capitulum arises thence by an expanded base with a somewhat hexagonal outline, rapidly contracts, then rapidly expands, ascending dorsally and postaxially to ankylose with the similar expansion of the capitulum next behind, and contributing to form the dorsally and postaxially extended surface (fig. 59, p^{8-9-10}) which abuts against the postacetabular part of the ilium.

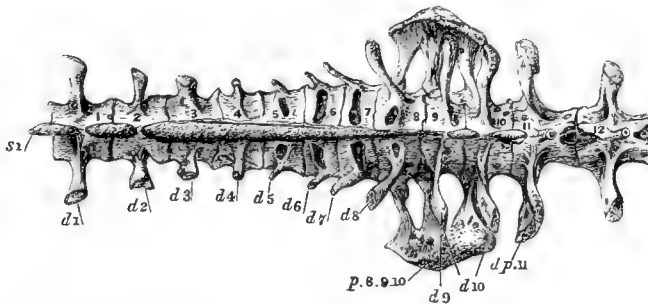
THE THIRTY-SEVENTH VERTEBRA.

This vertebra (figs. 59, 60, & 61, 9) has a lower neural spine, which, in the young, is free both pre- and postaxially.

Its centrum, but not its neural arch, is more extended antero-posteriorly than in the last vertebra.

DORSAL ASPECT OF LUMBAR AND SACRAL VERTEBRÆ OF AN IMMATURE SPECIMEN
($\frac{2}{3}$ natural size).

Fig. 61.



1-12. Neural arches of vertebræ from the twenty-ninth to the fortieth inclusive; d^1-d^{10} , diapophyses of these vertebræ to the thirty-eighth inclusive; dp^{11} , conjoined di- and parapophysis of the thirty-ninth vertebra; p^{8-9-10} , conjoined capitula of sacral vertebræ; s^1 , neural spine of twenty-ninth vertebra. In the neural arches of the vertebræ from the thirty-third to the thirty-sixth, considerable defects of ossification are to be seen.

The defect of ossification in the neural arch is very small and behind the diapophysis (fig. 61, 9).

The *diapophysis* (figs. 59 & 61, d^9) is much larger, more expanded dorso-ventrally, and is connected with the root of the spinous process by a ridge; it projects outwards and dorsad and very slightly postaxiad.

The neural lamina is scarcely notched behind for the spinal nerves; and the post-vertebral interspace is less than in the two preceding vertebræ.

The *capitulum* is again united by suture, but is supported more by the preaxial parapophysial surface of its own centrum than by the postaxial central projection of the thirty-sixth vertebra (fig. 60). The capitulum, though it arises from a similarly expanded base, does not contract so much as in the preceding vertebra; it extends and expands to join its serial predecessor and successor; but it projects slightly preaxially instead of projecting postaxially as does that of the thirty-sixth vertebra.

THE THIRTY-EIGHTH VERTEBRA.

This vertebra (figs. 59, 60, & 61, 10) has its centrum a little more antero-posteriorly extended (fig. 60, 10) and considerably more convex transversely than the centrum of the preceding vertebra.

Its neural spine is quite free, less high, and more slender.

Its *diapophysis* (figs. 59 & 61, d^{10}) closely resembles that of the thirty-seventh vertebra; but its *capitulum* is ankylosed (fig. 60, p^{10}) at a time when the two preceding capitula are still united by suture to the centra. It is almost entirely supported by its own centrum, is still less contracted above its origin, and, projecting decidedly preaxiad as well as dorsad, comes into contact with its own diapophysis, as well as ankyloses with the two capitula preceding.

There is no lateral defect of ossification in the neural arch; but it is slightly excavated in the middle line postaxially to the neural spine.

There is no postvertebral interspace or perforation, except what is quite minute.

THE SACRO-CAUDAL VERTEBRÆ.

THE THIRTY-NINTH VERTEBRA.

This vertebra (figs. 59, 60, & 61, 11) is slightly more antero-posteriorly extended than is the preceding vertebra; its neural spine is lower and more slender; and its neural arch is medianly notched at its postaxial border, very decidedly (fig. 61, 11) and slightly so at the middle of its opposite margin.

Diapophysis, *parapophysis*, and *capitulum* all combine in one ankylosed transverse process, which projects much, as does the diapophysis of the thirty-eighth vertebra, but is never dorso-ventrally extended. Its most ventral point of origin does not extend so far ventrad as does that of the capitulum of the preceding vertebra.

THE FORTIETH VERTEBRA.

This has the transverse and spinous processes less developed, and the former have a rather more dorsal origin (figs. 59, 60, & 61, 12).

The median notch of the neural arch is more marked (fig. 61, 12).

The centrum is more excavated, causing each lateral margin of its ventral surface to be more concave.

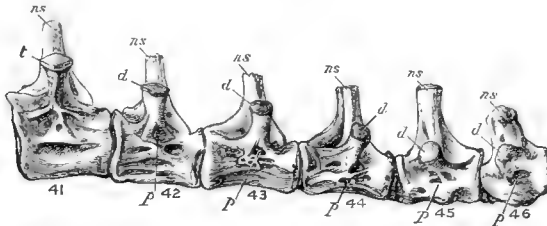
THE FORTY-FIRST VERTEBRA.

The differences just noted are here intensified (fig. 62, 41).

The under surface of the centrum begins to exhibit antero-posteriorly directed excavations of its substance.

LATERAL ASPECT OF THE VERTEBRÆ FROM THE FORTIETH TO THE FORTY-SIXTH INCLUSIVE IN AN IMMATURE CONDITION (natural size).

Fig. 62.



d, diapophyses; *ns*, neural spines; *p*, parapophyses; *t*, transverse processes, including the undifferentiated parapophyses and diapophyses.

THE FORTY-SECOND VERTEBRA.

Again we find an intensification of the same characters; but, in addition, the root of each transverse process sends out a minute process on its ventral origin, *i. e.* a *parapophysis* (fig. 62, 42, *p*).

THE FORTY-THIRD AND FORTY FOURTH VERTEBRÆ.

With progressive diminution of the other process, the *parapophysis* is here rather more prominent (fig. 62, 43 & 44).

The ventral surface of the centrum is more excavated.

THE FORTY-FIFTH AND FORTY-SIXTH VERTEBRÆ.

These vertebrae are like the two last noticed, but are smaller, and have the diapophysis projecting preaxially and more decidedly separated from the more marked parapophyses, which latter project outwards, one from each lateral margin of each centrum, while the ventral surface of each centrum is deeply excavated antero-posteriorly on each side of a median antero-posterior lamella (fig. 62, 45 & 46).

THE CAUDAL VERTEBRÆ.

THE FORTY-SEVENTH VERTEBRA.

This vertebra remains normally unanchylosed with the preceding bone in the adult bird.

It has a massive centrum and a neural arch small in circuit and very little developed antero-posteriorly, with a wide and massive neural spine and a moderate transverse process.

The *centrum* has its *postaxial surface* nearly flat or slightly concave or convex.

Its dorsal margin is slightly concave, its ventral margin very slightly convex.

The *preaxial surface* of its centrum is slightly concave, and its ventral margin nearly straight.

THE FORTY-SEVENTH, OR FIRST CAUDAL VERTEBRA (natural size).

Fig. 63.

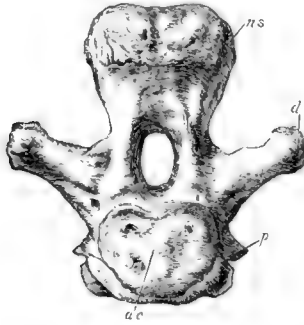


Fig. 64.



Fig. 63, preaxial aspect ; 64, lateral aspect (left side). Letters as before.

The *ventral surface* of the centrum shows the subparallel antero-posterior excavations separated by a considerable interval. The excavations, however, are less extensive than are those in more preaxial vertebræ.

The *diapophysis* (figs. 63 & 64, *d*) projects dorsad, outwards and very slightly postaxiad ; it is subconical, rather flattened pre- and postaxially, and with a somewhat rounded extremity. A very small *parapophysial* process projects from or ventrad of the ventral side of its root, extending slightly outwards from the lateral margin of the ventral surface of the centrum at or postaxiad of the antero-posterior middle point of that margin (figs. 63 & 64, *p*).

The neural lamina of each side has its postaxial margin nearly vertical ; but its preaxial margin is inclined preaxiad and dorsad.

The *neural spine* is much more developed transversely than antero-posteriorly, and shows a tendency to bifurcate, its lateral extremities extending more or less outwards and preaxially.

There are no zygapophyses.

THE FORTY-EIGHTH VERTEBRA.

This vertebra is like the last, except that there are no subcentral excavations. The *diapophyses* extend less dorsad; and the *parapophysial* projection is smaller on each side.

THE FORTY-NINTH VERTEBRA.

This vertebra differs from the preceding chiefly in the sudden reappearance of a parapophysis of considerable size. It is, however, continuous with the diapophyses, the two appearing as a transverse process, which projects outwards and slightly post-axial from the postaxial part of the side of the centrum, and expands dorso-ventrally towards its distal end (fig. 65, *d*, *p*).

THE FORTY-NINTH, OR THIRD CAUDAL VERTEBRA (natural size).

Fig. 65.

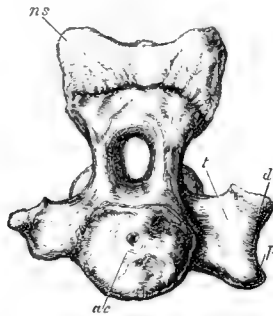


Fig. 65, preaxial aspect. Letters as before, except that *t* denotes the "transverse process," which probably contains both a diapophysial (*d*), and a parapophysial (*p*) element.

Its free outer margin is dorso-ventrally concave, the prominence at the dorsal side of the concavity representing the rounded end of the diapophysis, while the sometimes less marked prominence on the ventral side of the concavity represents the rounded end of the parapophysis. The preaxial surface of the transverse process is excavated and dorso-ventrally concave.

THE FIFTIETH VERTEBRA.

The fiftieth vertebra is slightly smaller than the forty-ninth, which it greatly resembles, except that the parapophysial (ventral) extremity of the transverse process is decidedly more produced than the diapophysial one.

The neural canal is also smaller, and the lateral summits of the laterally bifurcating neural spine more divergent.

THE FIFTY-FIRST VERTEBRA.

Here we find an intensification of the differences noticed in describing the fiftieth vertebra; and the outer margin of the centrum also more nearly approaches a circle.

The preaxial surface of the centrum is decidedly concave.

THE FIFTY-SECOND VERTEBRA.

This vertebra closely resembles its serial predecessor, but is smaller in size (fig. 66).

THE FIFTY-SECOND, OR SIXTH CAUDAL VERTEBRA (natural size).

Fig. 66.

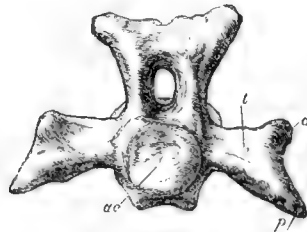


Fig. 66, preaxial aspect. Letters as before.

THE FIFTY-THIRD VERTEBRA.

Here the transverse processes project more postaxial and ventrad, and the diapophysial part has greatly decreased relatively to the parapophysis. The spinous process shows a more or less marked tendency to become trifold transversely at its apex.

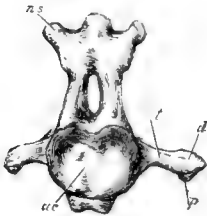
THE FIFTY-FOURTH VERTEBRA.

This vertebra (fig. 67) is much smaller than its predecessor. The transverse processes are very much smaller, but the apex of the neural spine is very distinctly trifold transversely.

The preaxial surface of the centrum is decidedly concave, as in all the vertebræ since the fiftieth.

THE FIFTY-FOURTH, OR
EIGHTH CAUDAL VERTEBRA
(natural size).

Fig. 67.



THE FIFTY-FIFTH AND FIFTY-SIXTH, OR
NINTH AND TENTH CAUDAL VERTEBRÆ
(natural size).

Fig. 68.



Fig. 69.

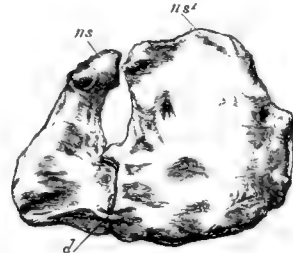


Fig. 67, preaxial aspect (letters as before); 68, preaxial aspect of ninth caudal vertebra; *ns'*, neural spine of tenth caudal vertebra; 69, lateral aspect; *d*, osseous bridge connecting the portions.

THE FIFTY-FIFTH VERTEBRA.

This vertebra is devoid of transverse processes; or there are at most but minute faint

traces of diapophysial and parapophysial prominences. The neural spine is more or less trifid at its distal end (fig. 68, *ns*).

The postaxial surface of the centrum is decidedly concave.

The vertebra often becomes anchylosed with the next and last, both by its centrum and the distal portion of its spine.

THE FIFTY-SIXTH VERTEBRA.

This vertebra has no neural arch and no transverse process (fig. 69).

It is a dorso-ventrally extended lamina of bone, extremely compressed laterally, with a very irregular, generally more or less rounded, margin dorsally, ventrally, and post-axially. It often anchyloses with the preceding vertebra at the dorsal and ventral parts of its preaxial surface, or rather margin, thus producing a foramen which looks from side to side.

The existence of another (but minute) foramen placed postaxially to that just described may indicate that this bone really consists of two or more vertebræ fused and anchylosed into one osseous mass.

Sometimes a little bridge of bone (fig. 69, *d*) connects its centrum, laterally, with the centrum of the fifty-fifth, or ninth caudal, vertebra.

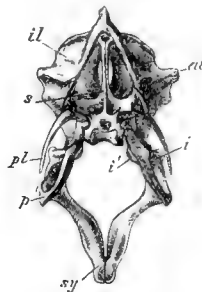
THE PELVIS.

This enormous bone consists of no less than twenty-two vertebræ, more or less completely anchylosed together (in the adult), and with the two ossa innominata, which latter thus cannot conveniently be excluded from the description of the axial skeleton.

Preaxially the sacrum exhibits the preaxial surface of the first sacral vertebra (with characters corresponding with the vertebra naturally preaxial to it) roofed over by the

PREAXIAL ASPECT OF PELVIS ($\frac{1}{8}$ natural size).

Fig. 70.



at, antitrochanteric process; *i* and *i'*, ischium; *il*, ilium; *p*, pubis; *pl*, rib; *s*, spinous process of postanterior vertebrae; *sy*, pubic symphysis.

two iliac bones (*il*), which meet together over the dorsal end of its spine and diverge ventrad at an angle of about 63°—the two diverging lines being carried on by the two anchylosed ribs (*pl*) of the first sacral vertebra.

Within the line of these ribs is to be seen a very large ventral arch, each side or lateral half of which is bent at an angle into a dorsal and ventral division or limb, which, when viewed preaxially, appears as follows:—

The dorsal division, or limb, consists mainly of the pubic bone (*p*), which diverges from its fellow of the opposite side at an angle of about 66° . The external margin of this limb is, in the main, concave externally; but the outline is interrupted by the more distant jutting out of the posterior part (*i*) of the ischium. The internal margin of the dorsal limb is convex, but with its outline interrupted, and the convexity exaggerated by the projecting inwards (*i'*) of the more anterior part of the ischium.

The ventral division or limb is bent inwards on the dorsal limb (of the same half of the great ventral arch) at an angle of about 115° , and consists of the pubis, which terminates ventrally by meeting its fellow in (*sy*) a ventral symphysis.

The external margin of this ventral division is concave; its internal margin is convex.

When the pelvis is viewed *postaxially* the same great ventral arch is seen to be connected dorsally with a pentagonal mass, one angle of which is dorsad, and which has in its midst the postaxial surface of the small twenty-second sacral vertebra, *i. e.* the forty-seventh vertebra of the whole spinal column.

The two dorsal sides of the pentagon meet at an angle of about 118° ; and the margin of each, from the point of junction outwards, is slightly concave, then more strongly convex, then still more sharply concave, the sharp concavity being produced by the prominence of the antitrochanteric process. Each of these dorsal sides is formed by an ilium.

From the tip of this last-mentioned process each lateral margin of the pentagon proceeds ventrad, forming with the adjacent dorsal side an angle of about 90° ; its margin is, for its greater part, gently concave, and is formed by the ischium; it forms with the ventral side of the pentagon an angle of about 120° .

This ventral side of the pentagon is formed by the pubes, and is more or less horizontal.

When the pelvis is viewed *laterally* (fig. 71), the sacrum being horizontal, we have a dorsal elongated mass (made up of the ilium and sacrum) something like the skull of a bird, with the tip of the beak turned postaxially, from which two long bars of bone (*i* & *p*) diverge ventrally and proceed postaxiad to join and end in a great recurved process (*sy*).

These bars proceed from beneath the acetabulum.

The acetabulum is placed on the ventral side of the ilio-sacral mass, so that its postaxial margin is on the preaxial side of the middle point of that elongated mass.

Within the acetabulum are to be seen the four slender, dorsally and preaxially extended diapophyses of the thirty-second, thirty-third, thirty-fourth, and thirty-fifth vertebræ.

The dorsal margin of the preacetabular part of the ilium forms the roof of the cranial

part of what may be fancifully compared to a bird's skull, while the same margin of the postacetabular part of the ilium forms the apparent upper margin of the beak of such a skull, the whole (straight) inferior margin being formed by the ventral surface of the sacrum.

The ventrally proceeding osseous bars (the pubis and ischium) join in an expansion (*i*) situated ventrally to and opposite the postaxial end of the sacrum.

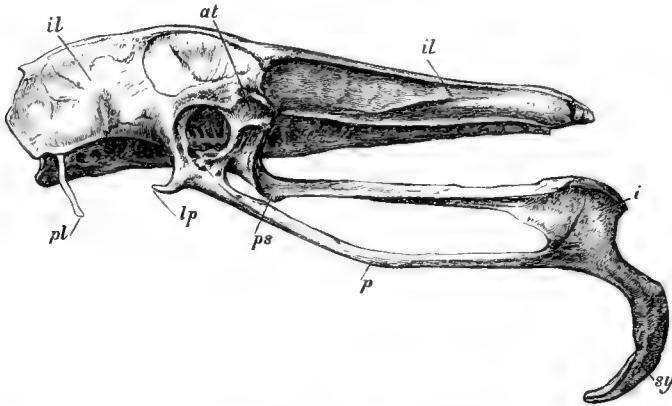
Beyond this point the pubis curves backwards, and then sharply first downwards (*sy*) and then forwards, its preaxial extremity advancing a little preaxial of the extreme point to which the whole sacrum extends postaxial.

The obturator foramen is very elongated, and is divided into a very small anterior and a very larger posterior portion by a process (*ps*) of the ischium which joins the pubis a little behind the acetabulum.

The pubis, at its junction with the ilium, develops a strongly projecting, curved and pointed ilio-pectineal process (*lp*). Sometimes a small process projects from the middle of the ventral margin of the pubis.

LATERAL ASPECT OF PELVIS ($\frac{1}{6}$ natural size).

Fig. 71.



Letters as last, except *lp*, ilio-pectineal process, and *ps*, process of ischium dividing off the small anterior part of the elongated obturator foramen.

The extreme pre- and postaxial extent of the pelvis is almost double its greatest dorso ventral dimension.

When the pelvis is viewed *dorsally* (fig. 72) we see in the middle of its preaxial third the dorsal iliac median ridge, and on each side the concave external margins of the ilia, with the two sacral ribs (*pl*) protruding, one on each side, from the more preaxial part of those margins. At about the middle third of the total pre- and postaxial diameter of the pelvis the antitrochanteric processes (*at*) stand sharply outwards. Behind a transverse line joining these processes we have five elongated pieces of bone, the middle

one of which proceeds directly postaxiad, while on each side of it two pieces proceed postaxiad and obliquely outwards till they reach a transverse line nearly coinciding with the postaxial end of the median piece, after which they bend inwards, at an angle of about 90° , to meet in the middle line.

The median piece consists of the postacetabular parts of the two ilia with the postacetabular sacral vertebræ; its lateral margins are gently concave; and it terminates postaxially in two diverging horns, which consist of the two postaxial ends of the two ilia projecting postaxiad beyond the last sacral vertebra. Between the antitrochanteric processes each ilium presents a rather wide convex surface; but this very rapidly narrows postaxially till at about the last sacral vertebra but two, whence it again slightly expands laterally to about the postaxial margin of the last sacral vertebra, after which it gently contracts to a bluntly pointed termination directed postaxiad, ventrad, and slightly outward.

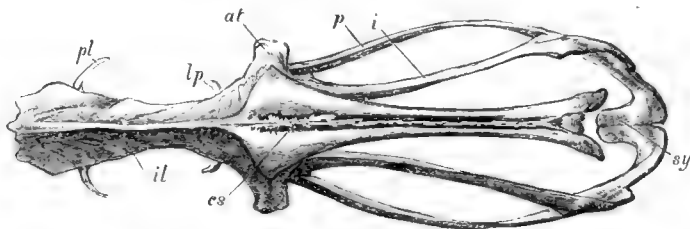
The two postacetabular dorsal expansions of the ilia are separated from the conjoined expansions of the spines of the sacral vertebræ (*cs*) by two very elongated narrow fissures, which run pre- and postaxiad nearly parallel to each other. The primitive distinctness of those conjoined sacral spines is indicated by successive foramina or defects of ossification.

The two lateral diverging pieces (*i* & *p*) on each side of the median postacetabular ilio-sacral piece are, of course, the ischium and pubis on each side.

The two ischia (*i*) seem to diverge at an angle of about 20° , the two pubes (*p*) at an angle of about nearly 30° ; but the latter curve inwards and join the ischia at the lateral expansion before mentioned. Preaxiad of this junction the outer margin of the pubis is convex, and its inner margin concave, while the outer margin of the ischium is concave and its inner margin convex.

DORSAL ASPECT OF PELVIS ($\frac{1}{8}$ natural size).

Fig. 72.



Letters as last, except *cs*, median crest formed by the coalesced spinous processes of the sacral vertebræ.

Postaxiad of the lateral expansions the two pubes converge and meet in the symphysis (*sy*), and then project sharply preaxiad. Each pubis, therefore, postaxially to the lateral expansion, has a postaxial margin which is convex, and a preaxial margin which is concave.

The greatest transverse diameter of the entire pelvis is across the pubes, at about the middle of their antero-posterior extent.

The greatest transverse diameter of the ilio-sacral mass is between the antitrochanteric processes.

The pelvis when viewed *ventrally* (fig. 73) presents, of course, relations corresponding with those already noticed as shown by the dorsal view. Here, however, the two iliopectineal eminences (*lp*) are very conspicuous, diverging, as they do, preaxial from the preaxial end of each pubis.

The rough surface for the attachment of a small bone, or else a bony process, is also noticeable at about the middle (pre- and postaxially) of the ventral surface of each pubis.

The ventral surface of the sacrum is visible throughout, forming one elongated bone in the middle line (in the adult), except that sometimes the last (twenty-second) sacral vertebra shows the line of junction of its centrum with that of the twenty-first sacral vertebra.

This median bone, then (formed of the coalesced centra), is widest in front of the acetabula, where it is concave transversely, and finally (between the two postaxial halves of the postacetabular parts of the ilia) it is flat, with successive pairs of antero-posteriorly directed excavations with a bony median ridge between each such pair of excavations.

The sacrum tapers backwards very gradually indeed.

The lateral processes of the adult sacrum are shown by immature specimens to have various natures.

Thus we have on each side at first (at the twenty-sixth vertebra) a truly articulated rib.

Next an anchylosed rib,

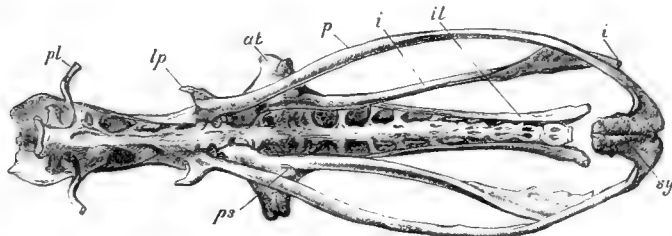
Next a transverse process arising entirely from the neural arch, and much inclined postaxiad (fig. 58, 28, *d*),

Next one similar, but smaller (fig. 59, *d*¹),

Then a shorter, formed by a preaxial process of the centrum and by the parapophysis of the thirtieth vertebra,

VENTRAL ASPECT OF PELVIS ($\frac{1}{3}$ natural size).

Fig. 73.



Letters as before.

Next a still smaller process formed by the adjacent parapophysial processes of the centra (thirtieth and thirty-first), together with the neural parapophysis of the thirty-first vertebra (fig. 59 & 60).

After this follows a larger process on a lower (more ventral) level, abutting directly against the proximal end of the ischium, and formed almost exclusively by the adjacent parapophysial (central) processes of the thirty-first and thirty-second vertebræ (fig. 59, *p* 3 & *p* 4).

Next follows a smaller and even shorter process, formed by the adjacent parapophysial (central) processes of the thirty-second and thirty-third vertebræ (fig. 59, *p*⁴ & *p*⁵).

Then we have a closely approximated smaller process, similarly formed by the thirty-third and thirty-fourth vertebræ, and, after, a scarcely noticeable prominence formed in the same way by the thirty-fourth and thirty-fifth vertebræ (fig. 60, 6, 7).

Next follow three conspicuous capitula, uniting distally to form an expanded plate, and belonging respectively to the thirty-sixth, thirty-seventh, and thirty-eighth vertebræ (figs. 59, 60, & 61, *p*^{8 9 10}).

Eight transverse processes then serially succeed, belonging to the eight next vertebræ; and the prominent lateral margins of the centra of the five most posterior sacral vertebræ may be regarded as rudimentary parapophyses.

THE ILIUM (figs. 70-74).

This bone extends preaxial to roof the twenty-sixth or even the twenty-fifth vertebra; its dorsal margin is gently convex; its preaxial margin is irregular, more or less produced at its ventral part. The ventral margin of the preacetabular part of the ilium is concave, being bent more or less strongly ventrad preaxially to the acetabulum. At its ventral end it here gives rise to a sharp-pointed ilio-pectineal process (*lp*) or spine, which projects strongly preaxially outwards and somewhat ventrad.

The ilium forms the preaxial and dorsal border of the acetabulum and the dorsal half of the much-projecting antitrochanteric process (fig. 74).

The postacetabular part of the ilium is longer than the preacetabular part; but the excess is less in the young than in the adult. Unlike the preacetabular part, it is separated, even in the adult, from the spines (fig. 72, *cs*) of the caudo-sacral vertebræ; and, in the young, even from those of the true sacral vertebræ. It tapers gradually backwards, the two borders (dorsal and ventral) being nearly straight and approaching each other postaxial at an angle of about 13°.

The free postaxial extremity curves somewhat outwards in the adult (fig. 72).

The dorsum of the ilium is marked by a gluteal line or ridge, which curves outwards and postaxially (fig. 72) to above the antitrochanteric process; thence it continues on postaxial, at first curving inwards, but ultimately (at about the middle of the postacetabular part of the ilium) curving outwards to the posterior extremity of the bone.

THE PUBIS.

The pubis is an exceedingly long and narrow bone, extending postaxiad and ventrad from the acetabulum to considerably beyond the postaxial extremity of the ilium, yet not so much so relatively in the young as in the adult.

The pubis first curves slightly downwards, as well as strongly postaxiad, then somewhat dorsally and outwards, then inwards and ventrad, and curves sharply round directly ventrad, and afterwards and finally preaxiad, at the same time meeting its fellow of the opposite side in a postaxial and ventral pubic symphysis.

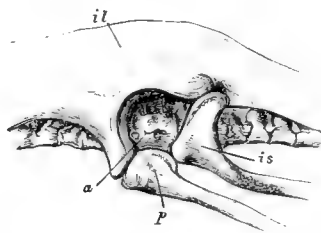
In the adult the pubis anchyloses with the ischium (fig. 71, *i*).

The pubis forms a small ventral portion of the margin of the acetabulum (fig. 74, *p*).

LATERAL ASPECT OF THE ACETABULAR REGION OF AN IMMATURE PELVIS

($\frac{1}{2}$ natural size).

Fig. 74.



a, acetabulum; *il*, ilium; *is*, ischium; *p*, pubis.

It develops a ridge on its dorsal aspect a little behind the acetabulum, which ridge makes a projection dorsad in the ventral margin of the obturator foramen.

The pubis does not seem to take any share in forming the ilio-pectineal spine.

At its ventral convexity the ventral margin of the pubis may, at about its middle, develop a bony process. This process is generally, however, only represented by a slight thickening of the margin. To this point a small distinct bone¹ is sometimes attached, which, when it becomes anchylosed, constitutes the process referred to as occasionally present.

THE ISCHIUM.

The ischium is the shortest of the three pelvic bones. Narrow for the greater part of its length, it expands at each end.

Preaxially it anchyloses with the ilium dorsally, and with the pubis ventrally.

Postaxially it anchyloses with the pubis (fig. 71, *i*), but not at all with the ilium.

It forms about a third (the postaxial ventral third) of the margin of the acetabulum, and the ventral half of the antitrochanteric process (fig. 74, *is*).

From the outer postaxial margin of this process a sharp ridge continues ventrad upon

¹ This bone has been described and figured by Mr. A. H. Garrod (in the Proc. Zool. Soc. for March 1872, p. 359), who has suggested the possibility of its representing the marsupial bone.

a ventrally extending prominence (figs. 71 & 73, *ps*), which approaches the pubis very closely, and nearly divides a small oval preaxial part of the obturator foramen from a very elongated and large postaxial portion.

The shaft of the ischium is divided by three longitudinal ridges:—one well marked and dorsal in position; another ventral, and only marked at the more postaxial part of the shaft; a third external and very marked, extending from the process approaching the pubis to the postaxial extremity of the bone.

At its postaxial end the ischium in the adult expands into a subquadrate dorso-ventrally expanded plate of bone (fig. 71, *i*) more or less convex externally for the greater part of its extent.

The ischium extends postaxially beyond the ilium, relatively more in the young condition than in the adult bird.

THE RIBS.

The ribs consist of two series, the *vertebral* and the *sternal* ribs, the former series being the more developed both in number and size.

THE VERTEBRAL RIBS.

Of these there may be said to be normally ten on each side, though the first and last of these very generally appear in the form of ankylosed transverse processes of their respective vertebræ.

Five of the vertebral ribs articulate with sternal ribs, which themselves join the sternum directly by distinct articular surfaces (fig. I, IV, V, VI, VII, & VIII).

Behind these there are normally two ribs, which end freely at their ventral extremities; but there may be three such ribs. In the latter case the first of these may be continued on ventrally by a distinct, curved, rod-like bone, which bone does not reach the sternum, but is applied to the ventral side of the sternal rib next in advance.

The First Rib.

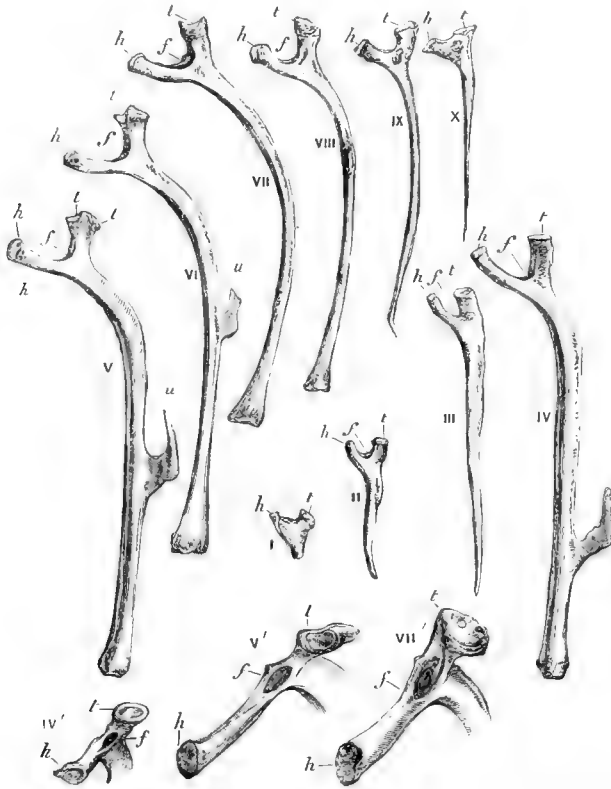
This little rib (fig. 75, 1) is attached to the eighteenth vertebra, and very often ankyloses with it. It is a flat bone, subtriangular in shape, with its three margins concave, but especially the preaxial margin. Its length only exceeds its breadth by one quarter, if so much, of the latter, and is less than half that of the centrum of the vertebra to which it is attached. It projects freely postaxially at its distal end; and preaxially it presents a head and neck, or *capitulum* (*h*), and a tubercle or *tuberculum* (*t*), subsequently developed to articulate respectively with the para- and diapophysis. Both capitulum and tuberculum are broad and rather flattened pre- and postaxially, being less slender and less rounded than the distal end of the rib.

The capitulum exhibits scarcely any distinct rounded articular surface; but the tuberculum shows a flattened, slightly excavated facet at its extremity.

There is a small pneumatic foramen in the vertebral margin near the head of the rib. The dorsal (or more postaxial) margin of the rib is rather shorter than the ventral one, owing to the head and neck being slightly longer than the tubercle.

THE VERTEBRAL RIBS OF RIGHT SIDE (size of figures I-X, $\frac{1}{4}$ natural size; figures IV', V', VII', $\frac{1}{2}$ natural size).

Fig. 75.



I. first rib: its preaxial margin is between *h* and *t*; its vertebral margin extends downwards from *t* to the apex of its ventral margin. II. second rib. III. third rib. IV, fourth rib; IV'. proximal end of fourth rib, showing the pneumatic foramen (*f*), the cup-like surface for the diapophysis (*t*), and the convex tubercle (*h*) for the parapophysis. V. fifth rib; V'. its proximal end (the small but sharp prominence near the letter *f* is produced by the ridge which passes outside the root of the capitulum). VI. sixth rib. VII. seventh rib; VII'. its proximal end, showing the great articular surface for the diapophysis and the very large pneumatic foramen. VIII. eighth rib, showing the small opening or defect of ossification on the tuberculum, near its junction with the capitulum. IX. ninth rib, showing a defect of ossification larger than that in the eighth rib. X. tenth rib, with a defect of ossification relatively yet larger. In all the figures, *h* denotes the capitulum, and *t* the tuberculum; *u*, the uncinat process.

The Second Rib.

This still absolutely small rib (fig. 75, II) is relatively much elongated compared with the first rib, its length being about three times its greatest breadth, and three times the

length of the first rib, or even more. Nevertheless its length is to the extreme length of the nineteenth vertebra (to which it is attached) only as about seven to six.

It projects freely ventrad (fig. 1, II), and is in the form of a **Y** with very short arms and with a curved stem. The stem is, on the whole, rather concave outwards, but with a slightly sigmoid flexure. The head and neck of the rib (*h*) may be more slender than any part except the distal end of the rib; more slender absolutely, and very much more so relatively than in the first rib. The head itself has a subcircular circumference.

The tuberculum (*t*) is slightly shorter than the neck, but considerably broader, much flattened pre- and postaxially, but with a rounded articular concavity at its tip. It is very little larger absolutely, and very much less so relatively, than in the first rib.

The vertebral margin (between the head and tubercle) is strongly concave, very much more so than in the first rib. It presents an exceedingly large pneumatic foramen (*f*).

The ventral or preaxial margin of the rib is more rounded than the dorsal or postaxial one. Proceeding distad from the capitulum, this margin is at first gently concave and then gently convex.

The postaxial margin may develop a low, long prominence, with a rounded outline, a little distad of the tuberculum. On this account this margin, proceeding distad from the tuberculum, is at first concave, then convex, and then again gently concave.

The Third Rib.

The third rib (fig. 75, III) is a little more than twice the length of the second rib; but neither the capitulum nor the tuberculum is quite twice the length of the capitulum and tuberculum of the latter.

This third rib bears a proportion in length to the twentieth vertebra (to which it is attached) about as $3\frac{1}{2}$ to $7\frac{1}{2}$.

It projects freely ventrad and slightly postaxiad; and the tail of its **Y** has a similar, though less marked, curvature to that of the second rib (fig. 1, III).

The capitulum is relatively rather longer and more slender in proportion to the tuberculum than in the second rib; it is the slenderest part, except close to the actual extremity of the free distal end.

The head itself presents a rounded, convex, articular surface for the parapophysis; that on the tubercle (for the diapophysis) is nearly twice the size of the corresponding surface on the second rib. Its dorso-ventral diameter slightly but decidedly exceeds its pre- and postaxial extent.

The vertebral margin (between the capitulum and tuberculum) is much more sharply concave than in the second rib, forming an acute angle of about 60° ; but its pneumatic foramen is little, if any, larger.

The tuberculum seems to continue on in the main and general direction of the rib, and the capitulum to diverge obliquely inwards from this.

The preaxial or ventral margin of the rib is generally rounded, the dorsal margin sharp.

There is no sudden inflection in the rib which can be called an "angle;" nor does its dorsal margin develop a rounded prominence as was the case in the second rib.

The entire preaxial margin is at first (*i. e.* proximally) concave, and afterwards very gently convex.

The entire dorsal margin is at first very slightly convex, and then concave in a little more marked degree.

The Fourth Rib.

Though the increase in length of the fourth rib (fig. 75, IV & IV') is much less than we meet with in proceeding from the second to the third, yet it exceeds the last-mentioned very considerably in bulk and massiveness, though it is less, if not much less, than half as long again (fig. 1, IV).

The fourth does not end freely, but articulates distally by an expanded concave surface, with the second sternal rib; it is attached dorsally to the twenty-first vertebra.

The increase in length of the capitulum of the rib (as compared with that of the third rib) is considerably greater than that of the tuberculum. Concomitantly with this, it seems rather to be the capitulum which continues on the general curve of the rib, from which the tuberculum diverges obliquely dorsad.

The stem or tail of the **Y**, *i. e.* the shaft or body of the rib, presents no sigmoid flexure, but bends rather suddenly a little distad of the junction of the capitulum and tuberculum. Through this bending, the rib may be said to have a sort of "angle."

The capitulum is actually longer than that of the third rib, and relatively longer as compared with the tuberculum, though not as compared with the whole rib. It is actually the slenderest part.

The head itself (fig. 75, IV', *h*) presents a convex articular surface, which is preponderatingly developed dorso-ventrally, being nearly twice as long in this direction as transversely.

The vertebral margin (between the capitulum and tuberculum) is less sharply concave, its margins forming an angle of about 70°. The pneumatic foramen (*f*) is actually larger, but relatively smaller.

The tuberculum and its articular surface for the diapophysis (*t*) are much more extended antero-posteriorly, the latter being thus twice as long as broad.

The preaxial margin of the body of the rib is sharper than in the third rib; in fact a rounded ridge near the preaxial margin (on the visceral surface of the rib) seems to answer to the actual ventral margin of the third rib, as, like the latter, it continues on the prominence of the capitulum. If so, then the actual preaxial margin of the fourth rib, at its proximal part, would seem to be formed from a lamella of bone being developed on the ventral side of what was, in the third rib, the actual preaxial margin.

The whole preaxial margin is nearly on one level vertically.

The postaxial margin is sharp, and becomes more prominent at the angle, causing this part of the margin to be convex.

At about the dorsal end of the distal third of the postaxial margin of the rib a large lamelliform uncinatè process is thrown out. It stands out at its origin nearly at right angles to the course of the rib, and then turns sharply dorsad and tapers to a point, running nearly parallel to the course of the rib; the uncinatè process is thus bent at right angles.

The Fifth Rib.

This rib (fig. 75, v & v') which is attached dorsally to the twenty-second vertebra, closely resembles the fourth: it is, however, larger; and its distal part is more slender, expanding, nevertheless, at the distal end to form a concave surface for junction with the third sternal rib (fig. 1, v).

Both the capitulum and tuberculum are longer and diverge at an angle of about 75°, having a large pneumatic foramen (fig. 75, v', f) at the vertebral margin, where they bifurcate.

The length of the capitulum, as compared with that of the tuberculum, has also somewhat increased.

The shaft of the rib is more bent on the head and tubercle, and has a rather more decided "angle;" but its margins are in the main similar to those of the third rib.

The uncinatè process (*u*) is placed more proximally, springing from nearer the middle of the length of the shaft of the rib; it extends out rather less, and its recurved portion is more slender.

The preaxial margin of the shaft is continued into that of the tuberculum by a ridge (fig. 75, v', near *f*) passing outside the root of the capitulum, *i.e.* preaxially to that root.

The Sixth Rib.

This rib (fig. 75, vi) is attached to the twenty-third vertebra, and very closely resembles the fifth, which it about equals in length; its distal half, however, is more slender and more rounded, though its distal end may, on the contrary be more expanded. It articulates distally with the fourth sternal rib (fig. 1, vi).

The pneumatic foramen is larger; and the capitulum and tuberculum diverge at an angle of about 80°.

The proximal part of the shaft of the rib is rather more bent.

The uncinatè process (*u*) springs from the dorsal margin, at about the middle point between the distal end of the rib and the root of the tuberculum. It is very much smaller, and, though rather broader at its root, much blunter, and may be not half the length of the recurved part of that of the fifth rib.

The articular surface for the diapophysis is rather larger and more concave.

The ridge passing outside the root of the capitulum is more marked than in the fifth rib.

The Seventh Rib.

The seventh rib (fig. 75, VII & VII') is attached to the twenty-fourth vertebra. In spite of its being much more bent, it is decidedly shorter (by nearly the length of its tuberculum) than the sixth rib, though it is longer than the fourth rib when measured along its convexity (fig. 1, VII).

The capitulum and tuberculum diverge at an angle of about 80°. The pneumatic foramen (VII', *f*) is still larger, forming quite a chasm. The articular surface for the diapophysis is also rather larger (VII', *t*).

The shaft of the rib is more rounded and slender generally, especially towards its distal part, which, however, expands towards its extremity so largely as to about equal in size the distal end of the sixth rib. It articulates at its distal end with the fifth sternal rib.

The shaft is also bent, with a decided or slight sigmoid flexure, convex postaxially at its more proximal part, and convex preaxially at its more distal part; but it may only show a preaxial concavity and a postaxial convexity.

The ridge traversing the outside of the root of the capitulum is still more marked.

There appears to be generally no rudiment even of an uncinatè process, but it may be developed, though always to a less extent than in the seventh rib.

The Eighth Rib.

This rib (attached to the twenty-fifth vertebra) is smaller in all dimensions (fig. 75, VIII) than the seventh rib, and in length is intermediate between the third and the fourth ribs.

It closely resembles in shape the seventh rib; but the capitulum is rather less long compared with the tuberculum; the pneumatic foramen is smaller; but there are small openings on the postaxial or inner surface of the tuberculum. The articular surface for the diapophysis is smaller and nearly flat.

The shaft of the bone is more or less bent; it may exhibit a rudiment of an uncinatè process. It articulates at its ventral end with the sixth sternal rib (fig. 1, VIII).

The Ninth Rib.

The ninth rib (attached to the twenty-sixth vertebra) is much shorter, about the same length as the third, and, like the latter, ends freely at its distal end (fig. 75, IX). It is much more slender than any other rib. Compared with the eighth rib, the capitulum is again shorter relatively, exceeding the tuberculum less in proportion. The pneumatic foramen on the margin of the neck is minute; but there is a large aperture on the postaxial aspect of the tuberculum, where the capitulum joins it. The shaft of the bone is again straighter (fig. 1, IX).

The ninth rib may have at its ventral end an extremely long, slender, curved bone applied by its other extremity to the outer or ventral side of the sixth sternal rib.

The Tenth Rib.

This rib (normally ankylosed in the adult with the sacrum and pelvis) generally appears as an elongated ventrally produced process (figs. 70, 71, 72, & 73, *pl*) of the twenty-seventh vertebra, as therein noticed. The rib is compressed from within outwards (fig. 1, *x*).

The tenth is only about from $\frac{2}{3}$ to $\frac{3}{4}$ as long as the ninth rib, and may be somewhat shorter than the second rib when this latter is measured from the root of the tuberculum distad. Its inner (here actually postaxial) surface between the tuberculum and capitulum is but very slightly concave; its preaxial margin is convex, and its postaxial one concave.

On the postaxial side of the expanded proximal part of the rib is a large pneumatic opening.

The ridge, which in more preaxial ribs ascended the outer surface of the shaft to the interval of the head and tubercle and went on ultimately to the tubercle, is here produced into a sharp crest, which is the actual outer and preaxial margin of the shaft of the rib, and which lies close to that margin all the way to the dorsal extremity of the tuberculum.

An Eleventh Rib

may be developed, which then closely corresponds with the conditions here attributed to the tenth rib. When this development occurs, the tenth rib approximates in its form very nearly to what has here been described as the ninth rib.

THE STERNAL RIBS.

These six ribs increase gradually in length postaxially from the first to the sixth; so that the fourth is rather more than twice the length of the second, and the sixth is from two and a half to three times the length of the second; the third is more than half the length of the sixth (fig. 1, II, III, IV, V, VI).

The sternal ribs are greatly expanded dorso-ventrally at their distal (sternal) ends, but do not bifurcate and divide into two processes like the tuberculum and the capitulum of the vertebral ribs.

All these ribs, except the first, unite with one or other of the vertebral ribs by a distinct joint.

The angle formed by the second sternal rib with its vertebral rib is only slightly obtuse, viz. about 129° ; the angle formed by the third sternal rib with its vertebral rib is more obtuse, viz. about 140° .

The fourth sternal rib continues on the curve of its vertebral rib, while the fifth sternal rib cannot be said to form any angle other than 180° with its vertebral rib.

The First Sternal Rib.

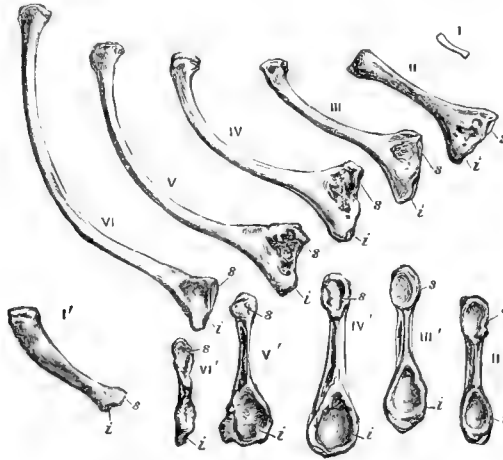
This rib (fig. 76, 1 & 1'), of which I have not been able to see an adult specimen, seems (from the immature skeleton) to be a subcylindrical bone but little expanded at

its sternal end, and only a little more than half the length of the second sternal rib. It is articulated distally in front of the fossa, which is preaxial to the first vertical septum of the pleurosteon.

It only seems to be connected with the third vertebral rib by soft tissues intervening between them.

STERNAL RIBS OF RIGHT SIDE (I-VI, $\frac{1}{4}$ natural size; I', the first rib of an immature specimen, natural size; II', III', IV', V', and VI', $\frac{1}{2}$ natural size).

Fig. 76.



I-VI. Lateral aspect of the six sternal ribs; I'-VI'. The articular surfaces of the second, third, fourth, fifth, and sixth sternal ribs.

In all the figures *s* represents the concavity which articulates with the dorsal convexity of each pleurosteal septum, and *i* represents the concave articular surface for the ventral articular convexity of each such septum.

The Second Sternal Rib.

The second sternal rib (fig. 76, II & II') is of about the same length as the second vertebral rib, though it articulates with the fourth vertebral rib. It is irregularly rounded at its proximal end; but its distal end is very greatly expanded dorso-ventrally, and compressed pre- and postaxially, with a pneumatic foramen on its postaxial surface at its expanded part.

The ventral end of the rib presents two superimposed elongated concavities (*s* & *i*) to fit on to the two superimposed articular convexities of the first septum of the pleurosteon of the sternum (fig. 79, *i*, *s*). The bone is slightly curved, with the convexity dorsad.

The Third Sternal Rib.

This rib (fig. 76, III & III') is rather less than half as long again as the second sternal rib, and is more curved.

Its proximal end is rounded, but more antero-posteriorly compressed than in the second sternal rib.

Its distal end is absolutely more but relatively less expanded; and the two concave articular surfaces are no longer subequal in size, but the ventral one (*i*) much exceeds the dorsal one.

The postaxial surface of the distal expansion of the bone exhibits large irregular excavations.

The postaxial surface of the shaft of this rib is flattened; but its preaxial surface exhibits a prominent ascending ridge.

The Fourth Sternal Rib.

The fourth sternal rib (fig. 76, *iv* & *iv'*) is slightly more than twice the length of the second, and is more curved, the concavity, of course, being also dorsal.

The preaxial end presents a wider articular surface for the vertebral rib.

Its distal end is only very slightly more expanded dorso-ventrally, and is therefore relatively less so expanded.

The disproportion between its two concave distal articular surfaces is still greater, the dorsal surface (*s*) being relatively still smaller.

The postaxial surface of the distal expansion is still more excavated.

The postaxial surface of the shaft is again flattened; but the ridge on its preaxial surface is much less marked.

The Fifth Sternal Rib.

The fifth sternal rib (fig. 76, *v* & *v'*) is longer and slightly more curved than the fourth, being about once and a half the length of the third sternal rib.

Its proximal surface (for articulation with the seventh vertebral rib) is broader and flatter than the corresponding surface of the fourth sternal rib, is absolutely rather less dorso-ventrally expanded, and therefore very decidedly so relatively.

Its articular surfaces (*s* & *i*) are still more unequal. Its shaft is more rounded post-axially as well as preaxially, and there is no ascending ridge on either surface.

The Sixth Sternal Rib.

This rib (fig. 76, *vi* & *vi'*) is longer again than the fifth one, but slightly less curved; its length is decidedly more than two and a half times the length of the second sternal rib.

Its proximal end is still flatter, and the antero-posterior dimension of its articular surface is less inferior to its transverse extent.

The sternal end of the rib is less extended dorso-ventrally than in any other sternal rib, except the first, and its articular surfaces have again approached each other. The inner, or rather preaxial, margin of the shaft is sharper than in the other sternal ribs.

Occasionally a long delicate ossicle, a *seventh sternal rib* (though it does not join the sternum), may be developed, extending ventrad and preaxial from the ventral end of that rib which is postaxial to the one which distally unites with the sixth sternal rib.

It is applied externally and ventrad to the side of the sixth sternal rib. It is, in fact, the ossified cartilage of a "false" rib.

THE STERNUM.

This is a wide sheet of bone with four margins and two surfaces (figs. 77 & 78).

Its external (inferior or ventral) surface is convex, but irregularly undulating. Though there is no true keel, yet there is an oval elevated and flattened tract placed in the middle line at the postaxial half of the bone (fig. 77, *f*). The extreme antero-posterior length of the sternum is to its transverse dimension as about 5 to 3. Medianly and preaxially from the flattened tract a very low ridge may be developed forwards and dorsad. The internal (superior or visceral) surface of the sternum is strongly concave in both directions. At the bottom of the concavity there may be small openings into the substance of the bone.

THE STERNUM (figs. 77 & 78, $\frac{1}{3}$ natural size; fig. 79, $\frac{1}{3}$ natural size).

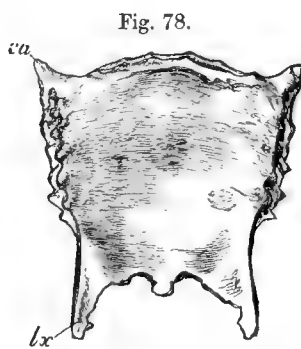
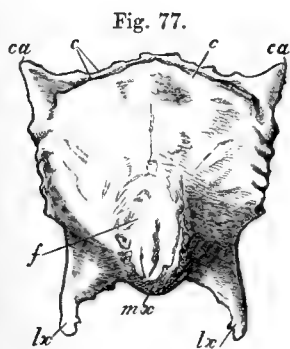


Fig. 77, outer aspect; fig. 78, inner aspect; *c c*, coracoid grooves; *f*, flattened tract; *ca ca*, costal angles; *lx lx*, lateral xiphoid processes; *mx*, median xiphoid process.

Fig. 79, lateral aspect, showing the five excavations of the pleurosteon separated by five septa, each septum with two articular convexities for one of the sternal ribs; *i*, one of the ventral articular convexities; *s*, one of the dorsal articular convexities.

The preaxial margin shows two elongated coracoid grooves, which form with each other an angle of about 120° . These two grooves nearly meet together in the middle line (fig. 77, *cc*).

The ventral (inferior) margin of the grooves does not extend so far preaxially as does the dorsal (superior) margin, especially towards the outer ends of the grooves.

At the middle of the dorsal margin there may be a wide notch or a slight median prominence. Between this notch or prominence and the outer ends of the dorsal lip of the preaxial margin that lip is concave, owing to the production preaxially and outwards of the costal angles (fig. 77, *ca*).

The postaxial margin of the sternum is deeply excavated, owing to the prominence of two external xiphoid processes (fig. 77, *lx*). In the middle of the postaxial margin there is a prominence, the median xiphoid, which, however, does not extend far (fig. 77, *mx*). Between this and each lateral xiphoid there is another rather irregular and less marked prominence.

Each lateral margin of the sternum is slightly concave, owing to the angle (about 155°) formed by the external margin of the lateral xiphoid with that of the pleurosteon.

The pleurosteon has a very wide and excavated external margin to receive the dorso-ventrally expanded ends of the sternal ribs: it is divided by five more or less complete bony septa, between which are, in the dry skeleton, five deep excavations (fig. 79). The edges of these septa proceed obliquely ventrad and postaxiad; and each develops two convex articular surfaces (one at the dorsal and one at the ventral part of each septum) for the corresponding articular concavities of the sternal ribs. The first septum has these articular convexities most prominent and most approximated (fig. 79, *is*). The fifth septum has them but very slightly marked.

VERTEBRAL PARTS AND PROCESSES.

It remains now, in conclusion, to consider the several parts and processes of the vertebræ, as regards the varying condition of the same parts in different regions of the spinal column.

Centra.

With the exception of that of the atlas, each centrum is connected by suture or ankylosis with the rest of the vertebra to which it belongs.

In absolute size the centra of the true dorsal vertebræ excel.

Except the preaxial surface of the axis (and apart from the atlas) all the cervical and true dorsal vertebræ have their centra concavo-convex at each axial end.

The centra may, however, be slightly biconcave, as in some of the caudal vertebræ.

Adjacent centra may be ankylosed together from the twenty-sixth to the forty-sixth vertebra inclusive.

The centra may or may not develop parapophysial, catapophysial, or hypapophysial processes.

The pre- and postaxial diameter of centra may greatly exceed their transverse dimension, as in the cervical vertebræ.

The reverse condition may obtain, as in the thirty-first to thirty-seventh vertebræ.

The ventral surface of the centrum may be much excavated antero-posteriorly, as in the caudal vertebræ.

Neural Laminae.

The neural laminae are attached to their own centra only, except in the thirty-second to the thirty-sixth vertebræ.

In the thirty-second, thirty-third, and thirty-fourth vertebræ the neural arch rests on part of the centrum of the adjacent preaxial vertebra; but the arch may, as in the thirty-first vertebra, partly rest on the centrum postaxial to its own.

The neural arches are highest relatively to their transverse extent in the lumbar vertebræ; they are most pre- and postaxially developed in the cervical vertebræ, and least so in the caudal vertebræ.

Adjacent neural arches may join each other by suture, as in the lumbar and sacral vertebræ in the young condition—by ankylosis, as in the sacral region of the adult—by articular processes, as in most parts of the axial skeleton—or in none of these ways, as in the caudal region.

The neural laminae almost always develop diapophyses.

Neural Spines.

These parts attain their maximum height in the lumbar region, where (in the adult) they unite together by ankylosis.

They are most pre- and postaxially extended in the cervical region, and most transversely extended, relatively, in the caudal region.

A neural spine may be trifold, as in the eighth caudal.

Prezygapophyses.

These surfaces may be wanting when the postzygapophyses exist in the same vertebra, as in the atlas; they may be wanting as well as the postzygapophyses, as in the post-dorsal vertebræ.

Very much longer (pre- and postaxially) than broad, they may broaden considerably, as in the dorsal vertebræ.

Having become larger they may again diminish in size, as in the posterior dorsals.

Strongly convex pre- and postaxially, as in the cervical region, they may become nearly flat, as in the dorsal region.

Looking mainly dorsad in the cervical region, they come to look mainly inwards in the dorsal region.

Postzygapophyses.

These may exist without prezygapophyses, as in the atlas.

They undergo changes of form and direction corresponding with those of the prezygapophyses, but they never become quite so small as do the latter in the dorsal region.

Metapophyses.

These processes would escape notice were it not for their recognition through their more developed homologues in other animals.

They are more or less to be distinguished outside and ventrad of the prezygapophyses from the fourth vertebra to about the eighteenth, after which they seem to merge in the wider diapophysial expansion.

Hyperapophyses.

These are only conspicuous in the axis and the third and fourth cervical vertebræ, where they are situated above the postzygapophyses. Rudiments of them are to be found on the atlas, and on vertebræ postaxial to the fourth, till perhaps the tenth vertebra.

Paraxial Parts.

By *paraxial parts*¹ I mean those portions of the skeleton which diverge from the centra and neural arches laterally, and tend to surround the visceral cavity.

They include:—1, upper transverse processes or diapophyses; 2, lower transverse processes or parapophyses; 3, pleurapophysial parts, *i. e.* the ribs, with their capitular and tubercular portions, sternal ribs, and sternum, or parts representing the whole or portions of each pair of capitula and tubercula, with only a rudiment, or without any rudiment, of more distal pleurapophysial elements.

These parts considered as one whole are, of course, as to size, most developed and most differentiated in the true dorsal vertebræ.

They are least differentiated in the true caudal region, where they stand out laterally as simple imperforate “transverse processes.”

Diapophyses.

These are, with the neural spines, the most constant of all the processes, appearing even in the lumbar, dorsal, and caudal regions, where there are no zygapophyses.

More or less antero-posteriorly extended in the cervical region, they are much so in the dorsal one. In the lumbar region they are long and slender, singularly remote from their respective parapophyses, and widely diverging from the latter.

In the first four postsacral vertebræ the diapophyses quite coincide with the para-

¹ See P. Z. S. 1870, p. 260, note; and see also Trans. of Linnean Society for April 21, 1870.

pophyses, as also in the posterior caudal vertebræ, though in the latter a tendency to diverge is shown by the projecting extremities of each transverse process.

Parapophyses.

These are very constant structures, existing either as lower transverse processes or as articular surfaces for the capitula of the ribs.

In the lumbar region their place of development singularly descends, being there placed quite at the ventral edge of the sides of the centra.

They ascend through the three true sacral vertebræ, till in the most anterior caudal (or anterior sacro-caudal) vertebræ they reassume the same position they occupied in the posterior dorsal region. In the more postaxial vertebræ their place of origin again descends, and occupies the side of quite the ventral surface of each centrum.

The parapophysis of the thirty-first vertebra is almost entirely formed by the neural arch; but in the three succeeding vertebræ each parapophysial prominence is produced by the concurrence of processes from the centra of adjoining vertebræ, the thirty-second, thirty-third, and thirty-fourth vertebræ having each such a projection from each end of each side of each centrum.

These low complex parapophysial projections abut against the ischium and ventral margin of the acetabulum.

Pleurapophyses.

By *pleurapophyses* I mean ribs and all elements of the paraxial system which are serially homologous with ribs, including their capitula and tubercula.

Consequently when the diapophyses and parapophyses are respectively connected by an osseous bridge, such bridge is pleurapophysial.

To the thirty-sixth, thirty-seventh, and thirty-eighth vertebræ three capitula of large size are attached; they expand as they extend postaxial and dorsad to abut against the ilium.

Hypapophyses.

These are developed as twofold or *azygos* processes from beneath certain vertebræ, generally from the seventeenth to the twenty-first inclusive, as already described.

Catapophyses.

These have been already noticed as developed from the more postaxial of the true cervical vertebræ, generally anterior to the seventeenth vertebra.



XIII. *On the Osteology and Dentition of Hylomys.* By JOHN ANDERSON, M.D., Curator of the Indian Museum, and Professor of Comparative Anatomy in the Medical College, Calcutta.

Read June 4th, 1872.

[PLATE LXIV.]

THIS most interesting form, originally described by S. Müller and Schlegel¹ from two individuals, one from the island of Sumatra and the other from Java, was afterwards discovered by Blyth² in a collection of Mammals forwarded to him by Major Berdmore, from Shuay Gyeen, in the valley of the Sitang, in the Tenasserim Provinces. Blyth writes of the specimens (which were two in number, an adult male and female) that "they so nearly resembled the *H. suillus* of the Archipelago, figured and described by Dr. S. Müller, that I should have considered them identical were it not for the greater development of the tail." Having, however, removed the skull of one of Blyth's specimens, and finding it agree with the figure of the skull of *H. suillus*, S. Müller and Schlegel, I am inclined to regard them as of one species, although at the same time I propose to retain Blyth's term until the question can be determined by the comparison of Peguan with Sumatran specimens.

Dr. Gray³, in describing the genus *Ptilocercus*, which seems to be closely allied to *Tupaia*, incidentally mentions *Hylomys*, and states that the geographical range of the Tupaiinæ appears to be confined to the Asiatic islands, and that Borneo may be regarded as their more proper home, as possessing all the genera, viz. *Tupaia*, *Hylomys*, and *Ptilocercus*; but he does not mention his authority for extending the distribution of *Hylomys* to this island. Now, however, it has been ascertained that *Tupaia* and *Hylomys* occur in Java, Sumatra, and Pegu, and that they are associated in these two islands and in the Malayan peninsula with *Gymnura*. The next notice of *Hylomys* that I am aware of is by Wagner⁴, who, however, added nothing to what had been already recorded about the characters of the genus. Mivart, in 1867, in his most valuable review of the osteology and dentition of the Insectivora⁵, reproduced all that was known regarding these points

¹ Verhand. over. d. Nat. Gesch. d. Nederl. Mamm. 1843, pp. 153-158, pl. xxvi. fig. 1, pl. xxv. figs. 4-7, skull.

² Journ. As. Soc. Bengal, vol. xxviii. 1859, p. 294; *ibid.* p. 286.

³ Proc. Zool. Soc. Lond. 1848, p. 23.

⁴ Schreber's Säugeth. Suppl. ii. 1841, p. 554; *ibid.* Suppl. v. p. 855, pp. 529, 530, tab. 36.

⁵ Journ. Anat. & Phys. vol. i. pp. 301, 302.

in the structure of *Hylomys*; and again in 1868, in a further contribution to the same subject¹, gave a short synopsis of the dentition and the general characters of the skull.

The foregoing appears to be the extent of the literature on this most interesting form.

In 1868, I obtained a specimen which may be provisionally referred to *H. peguensis*, Blyth. I found it lying dead on a path on a thickly wooded hill-side, in the Kakhien hills to the east of Bhamô, in Upper Burmah, at an elevation of 3000 feet. A skeleton was made of this specimen, and I also used one of Blyth's types for the same purpose; and the result of my examination of these materials is as follows:—

The rather long snout (Pl. LXIV. fig. 1) and the general form of the animal, if we exclude its large and rounded ear and short tail, confer on it the aspect of a Shrew; and when I saw my specimen lying on the road, before I picked it up, I thought it was a Shrew that had lost the greater part of its tail. The snout is slightly depressed, moderately attenuated and pointed. The bare fleshy portion at the tip is prolonged backwards on to the upper surface, for some distance behind the nostril; and in front it is marked by a longitudinal groove, which is continued downwards and backwards between the first incisors, with a fleshy ridge on either side of it, each of which terminates at the base of the incisor tooth of its own side. The upper and posterior extremity of the groove ends in a line with the anterior margin of the nostril; and behind this it is embraced by a triangular groove, the apex of which is directed backwards. The two sides of the triangle spring from the anterior margin of the nostril. The posterior margin of the nostril has a convoluted fringe of about twelve fleshy papillæ. The eye is of moderate size, smaller than in *Tupaia*. The ears are large and oval, and might be designated nude, as they are only sparsely covered with pale, very short hairs, with the exception of a pencil of hair on the free margin of the tragus. The orifice of the ear is very wide and triangular, the apex of the triangle being directed downwards. The fore limbs are rather short, as are also the fingers; and from a short way above the wrist the anterior surface of the feet is almost nude, having only a slight covering of short, white and brownish, rather bristly hairs, through which the skin is quite apparent. The under surface of the manus is quite nude. Each finger bears on its under aspect from three to six transverse tubercles, that give it a resemblance to the finger of a Gecko. There is a small rounded tubercle at the base of the first finger, a larger quadrangular tubercle, or pad, at the base of the second, a still larger protuberance of the same kind at the bases of the third and fourth, and a rounded tubercle at the base of the fifth. A prominent oval, anteriorly pointed pad covers the carpus, the palm being smooth, but longitudinally folded; and the first and fifth fingers so approximate, when the limb is at rest, that they have to be pulled asunder to display the palm, which is of proportionate size to the body. The claws are rather stout, of moderate length, and very little curved. The hind limb is likewise

¹ Journ. Anat. & Phys. vol. ii. (2nd series, vol. i.) p. 146.

rather short, and is bare downwards from the middle of the tibia and fibula, being only sparsely covered with short hairs, as in the corresponding part of the fore limb. The whole under surface of the heel, however, has a covering of short, somewhat rigid, dark brown hairs, directed backwards; but the sole is quite naked, and has tubercles distributed over it as on the palm, and over the toes as on the fingers. The claws are more curved than those of the fingers.

The tail is mouse-like, short, only one sixth the length of the trunk and head; it is almost nude, having only a sparse covering of short brown hairs, as on the tail of a rat, and the skin is thrown into little eminences, which are arranged in an annular manner. Above the root of the tail (dorsal aspect) there is a rather large surface, which is all but bare, having only a few minute hairs. This surface is covered with a brownish substance, probably an exudation from the skin; it is continuous with a similar but tumid surface surrounding the anus, and reaching forwards to the genitalia. Immediately before the anus, and in the female occupying the narrow interval between the opening of the vagina and anus, there are two nipple-like structures side by side, with a slight eminence before them and an obscure rounded eminence between and behind them. Each of the nipple-like bodies has an apical pore, with a fine bristle protruding from it. From the external margin of the vaginal surface a faint fold or linear eminence passes backwards to the root of the tail, where it is continuous with another slight fold that runs over the base of that organ. The former bears from four to six pores in a longitudinal series. I can observe only one pair of inguinal, and one pair of thoracic mammæ.

Length from tip of snout to vent 4 inches 11 lines; vent to tip of tail 11 lines. Anterior angle of eye to tip of snout 10 lines; posterior angle of eye to anterior margin of ear 6 lines; greatest length of ear 7 lines; greatest breadth of ear 7 lines; length of fore foot 8 lines; length of hind foot 1 inch.

The general colour above is rusty brown, and on the underparts a pale yellowish white, the seminude portions of the limbs and tail being brownish yellow. The fur consists of three kinds of hairs:—1st, a very delicate fine hair, the basal half of which is either succeeded by blackish or yellowish tipped with black; 2nd, stronger erect hairs, their dark basal halves succeeded by a broad rufous yellow band, which may be either terminal or tipped with black; and 3rd, a still stronger kind of almost bristly hair, with the terminal halves wholly black. The fur of the under surface is much shorter than that of the back and sides, and is mouse-coloured in its basal half, terminating in pale yellowish white.

The whiskers are black, and not very long.

The *skull* (figs. 2, 3, & 4) differs from that of *Tupaia* in being less tapered both anteriorly and posteriorly, but more especially in the latter direction. The facial portion (snout) of the skull, although long, is not so attenuated as in *Tupaia*; and the nasal bones are not so much arched downwards as in the species of that genus,

but are straight and directed forwards and downwards, the upper surface of the snout being flat and not convex transversely as in *Tupaia*. The nasals are slightly dilated in the middle, beyond which they contract posteriorly to a point, contracting also anteriorly, but again feebly dilating at their anterior extremities. They reach back to nearly in a line with the anterior margin of the orbit; and their posterior fourth is invested externally by the frontals. The lateral concavity of the snout between the second premolar and lateral incisor of *Tupaia* is absent in *Hylomys*, the sides of its snout being almost straight. The maxillæ reach a long way posterior to the nasals; and in this the skull differs both from *Tupaia* and *Erinaceus*. The præmaxillæ do not reach to the frontal, but their inferior margin is on a line with the first premolar. In *Tupaia* the skull from the parietal eminence slopes markedly downwards and backwards to the lambdoidal crest, the two sides of which meet in a point, giving a triangular outline to that portion of the skull; and there is a semicircular interparietal. In *Hylomys* there is only a slight depression between the vertex and the middle line of the lambdoidal crest, which is almost on a level with the vertex, and not considerably below it as in *Tupaia*. The lambdoidal crest is much truncated above, forming an obtuse angle with its sides. This portion of the cranium, therefore, of *Hylomys* is much broader than in *Tupaia*; and the occipital region is slightly fuller, and, instead of sloping downwards and forwards as in the latter genus, it is directed downwards and backwards, the foramen ovale looking more backwards than downwards. In the character of the hinder part of the cranium, *Hylomys* approaches more to *Erinaceus*¹. The space between the orbits is nearly flat, and is not so broad as in *Tupaia*; neither is the orbit enclosed by bone behind, nor the zygomatic arch perforated; and in this it resembles *Erinaceus*. The malar is a small spicule of bone applied to the outside of the perfect zygomatic arch. It also approaches *Erinaceus* rather than *Tupaia* in its large infra-orbital foramen and shorter canal, and in the prominent ridge at the anterior margin of the orbit. The temporal fossa is large. The postorbital process, which, however, is very minute, is more distinctly marked than in *Erinaceus*; and immediately behind there is a slight contraction of the skull, so that that portion of the skull is narrower than the narrowest part between the orbits; and in this respect also it resembles *Erinaceus*, and differs from *Tupaia*. It is like the latter genus, however, in having the ridge from the postorbital process, reaching backwards within a short way of the lambdoidal crest; but the sagittal ridge, which results from the union of the ridges of either side, is very feebly developed, and before it joins the lambdoidal ridge it forms a flat triangular surface, with the apex directed forwards. In *Erinaceus* these postorbital ridges are far removed from the lambdoidal, by nearly half the length of the cranium. In *Hylomys* the skull attains its greatest breadth at the posterior roots of the zygomata. The palatal surface, unlike *Tupaia* and *Erinaceus*, has not any imperfections; but a faintly marked median ridge occurs as in *Erinaceus*. It is deeper than in *Tupaia*, and of more

¹ I regret that there is no skull of *Gymnura* in this Museum with which to compare *Hylomys*.

equal breadth throughout, it being widest between the first and second molars. Its posterior margin is slightly thickened, but not nearly so strongly as in the last-mentioned genus. The palatal suture terminates posteriorly in a very minute spine, the equivalent of that structure which is so strongly developed in *Erinaceus*; and there are indications of the transverse bony plate which is so well defined at the posterior margin of the palate of the Hedgehog. The pterygoid fossa is deep and well developed, and reaches forwards, even anterior to the posterior margin of the palate; and the outer plate is decidedly larger than the internal, and is directed outwards and slightly downwards, being prolonged backwards to the tympanic bulla, from which it is only separated by an extremely short ridge, internal to the foramen ovale. The mesopterygoid fossa is rather deep and narrow from before backwards, more so than in *Tupaia*, and less so than in *Erinaceus*. The ectopterygoid plate is perforated externally, at its base, by two prominent foramina, one before the other, with an intervening arch of bone, producing the appearance of an incomplete canal, which is intensified by the grooved surface before the foremost foramen and which forms the outer margin of the sphenoidal fissure. The two foramina and the foramen ovale are in one line, and only separated from each other by narrow bony septa. One or two minute foramina open almost into the posterior border of the hindmost of the two foramina, which is slightly below, but immediately anterior to, the foramen ovale. Are these two foramina external alisphenoid canals? or is the more anterior of them the foramen rotundum? What leads me to believe they are the former is their direction; for a fine wire can pass straight through them from before backwards from the outer surface of the cranium. If this opinion is correct, the foramen rotundum is merged in an enlarged sphenoidal fissure, which is large, and has its floor formed by the ectopterygoid and pterygoid plate of the palatine bone. The optic foramen is round, and separated from the inner and anterior margin of the sphenoidal fissure by a thin plate of bone. Below, and slightly posterior to the optic, is the suboptic foramen, which is even larger than the former. A fine wire passed through it comes out at a small foramen on the inner side of the internal opening of the optic foramen of the opposite side. The two foramina between the optic foramina, on the inner aspect of the skull, are transversely oval, rather well-marked apertures, much more developed than in *Erinaceus*; and in looking through the optic foramina from without they are seen beyond it. There is a minute foramen on the anterior margin of the optic foramen, and three venous foramina a short way above and anterior to it, two of which are directly above each other and posterior to the third, and lead at once into the cavity of the skull. Another and larger, slightly above and posterior to the two, and on the anterior orbital margin of the parietal and between it and the orbito-sphenoid, leads backwards to a short canal that opens on the internal aspect of the parietal, traversing it and the squamosal in the groove of the lateral venous sinus that communicates with the supraglenoid foramen. It opens between the parietal and squamosal slightly posterior to the postglenoid foramen, which is large. Anterior to

this foramen and the three previously mentioned foramina, and at a considerably higher level than it, there is a well-marked foramen below and slightly anterior to the post-orbital process. It is directed upwards and rather backwards, apparently leading into the frontal sinuses; at least a fine wire inserted along it does not appear in the cranial cavity. The sphenopalatine canal is of moderate size, and opens at a short distance anterior to the sphenoidal fissure, and rather on a line external to it. Its lower border is formed by the pterygoid plate of the palatine. The posterior palatine canal is very short, and opens anterior to the external angle of the slightly thickened posterior margin of the palate. The anterior palatine foramina are bounded in front, within, and externally by the præmaxillæ, and posteriorly by the maxillæ. The lachrymal foramen, which opens into the orbit above and rather external to the infraorbital foramen, is marked at its anterior border by a strong process that projects outwards and slightly backwards, being continued upwards along the margin of the orbit to near the postorbital process as a distinct ridge as in *Erinaceus*; and, as in that genus, the prelachrymal process itself is perforated by a minute foramen. Externally the lachrymal canal appears as a distinct ridge, arching forwards and downwards to the upper margin of the external orifice of the infraorbital foramen. Immediately above the infraorbital foramen there is a small deep lachrymal pit, which also occurs in a less-marked degree in *Erinaceus*, but is not observed in *Tupaia*. The infraorbital foramen is separated from this pit by a thin plate of bone. It is a large opening leading into a wide and moderately long canal, that opens by a large orifice immediately above the interior fang of the fourth premolar.

To return to the base of the skull (fig. 2), the mesopterygoid fossa terminates in a true excavation, but not of the same marked character as in *Erinaceus*. In *Hylomys* the tympanic bullæ are more posteriorly divergent than in *Erinaceus*, and in this they more approach *Tupaia*; but the area between them is excavated into two shallow, elongated, oval troughs lying side by side at the extremity of the basisphenoid, but separated from each other by a well-marked, low, sharp, longitudinal ridge, and defined on the sides by the expansions of the basisphenoid, which go to assist in the formation of the tympanic bullæ. At the base of these processes there are one or two small foramina. The glenoid surface is nearly flat externally, but slightly concave internally. The condyles of the occipital are divided, or nearly so, into two articular facets, of which the lower is almost circular; but the skulls do not appear to be young. There is a rather large precondyloid foramen on each side, immediately below the condylar constriction; and anterior to it is a jugular foramen. There is a well-marked paroccipital process, anterior to which are two rather obscure processes in the mastoid region, and behind the glenoid surface a postglenoid foramen, but no process. The tympanic is ring-like; but there is a vacuity between it and the tympanic process of the basisphenoid, and its anterior extremity is ankylosed to the process of the alisphenoid immediately below the foramen ovale, which is enclosed by the last-mentioned bone.

The mandible is proportionally shorter than that of *Tupaia*, and in general form it

approaches more to that of *Erinaceus*, which it also resembles in its stouter horizontal ramus, and in the more erect position and form of its coronoid. The condylar articular surface has not a great transverse extension. The ridge (internal) running from the condyle to the ramus is very prominent. The anterior orifice of the dental canal is below the anterior margin of the last premolar. The process of the angle is hook-like and pointed.

The dental formula is:—i. $\frac{3+3}{3+3}$, c. $\frac{1+1}{1+1}$, pm. $\frac{4+4}{4+4}$, m. $\frac{3+3}{3+3}=44$ (figs. 5, 6, & 7).

The first incisor is conical and curved, with a very minute posterior cusp at the base of the crown. The second incisor, separated by a short interval from the first, is considerably smaller than that tooth, and is not so much curved; but it has also a minute cusp at its base posteriorly. It has about the same length as the canine. The third incisor is placed close to the second, and is about half its size, but differs from it in having a small, laterally compressed, almost triangular crown, with a constriction above it, the posterior basal angle of the crown showing the indication of a rudimentary cusp. The canine is immediately behind the premaxillary suture, separated by a short interval from the third incisor. The anterior half of its crown resembles the second incisor; but the hinder half bears a minute, almost hook-shaped cusp at its base. The first premolar is immediately behind the canine, and is followed in close succession by the second and third premolars, all having the cingulum more or less developed internally and externally. They are all small teeth, with about the same downward extension. The second is slightly larger than the tooth on either side of it; but all are of about the same length as the third incisor. Each has a central conical crown, very faintly curved, with a small cusp at its base anteriorly and posteriorly, a development of the cingulum. The anterior cusp is most developed in the second; and the third tooth has the most pronouncedly marked posterior cusp, with the anterior cusp hardly visible. The crown of this last-mentioned tooth is more truncated than that of the others. These premolars have a much stronger resemblance to the first, small anterior premolars of *Erinaceus* than to the corresponding teeth of *Tupaia*. The fourth premolar is a large tricuspidate tooth, with an external cingulum and large pointedly conical crown, which has the greatest vertical extension of all the teeth in the upper jaw. It has two internal, pointed, conical cusps, the anterior of which is much the longer and larger. Besides these, however, the cingulum is so much developed posterior to the crown that it almost produces another cusp. This tooth is very closely allied by its structure to the last premolar of *Erinaceus*, and is very different from the same tooth of *Tupaia*. It is almost the exact fellow of the former. The fourth molar is the largest of the teeth in the upper jaw, and consists of four cusps, two external and two internal; but the cingulum which encircles the tooth is very strongly developed externally, and behind the postero-external cusps it almost forms a fifth cusp. The anterior of the external cusps, which are conical with a greater vertical extent than the internal cusps, has a less vertical extent than its fellow. The internal cusps are the same as in *Erinaceus*. Situated, internal to the postero-

external cusp, and between the two internal cusps, is a small conical tubercle (the ridge of Huxley and Mivart in *Erinaceus*), that for its size and characters merits to be regarded as a cusp. It is not a ridge, but a distinct fifth cusp, situated in the locality I have indicated; and in a skull of an Indian *Erinaceus* before me it forms a well-marked cusp in the same situation. The second molar is the same as the first, only smaller, and without the median cusp (ridge), which, however, is represented by a ridge connecting the postero-external to the antero-internal cusp. The third molar is still smaller than the former, with the cingulum less developed externally, and only one internal cusp, = tricuspidate. The antero-external cusp is the same as in the preceding molars; but the postero-external cusp is externally broad, and about twice the breadth of its fellow before it, and its apex shows an obscure notch, which would seem to indicate that it has resulted from union with the postero-internal cusp. The solitary internal cusp has all the characters of the antero-internal cusps of the two preceding molars. That the premolars and other molars of this curious insectivorous mammal should have such a remarkable resemblance to the corresponding teeth of *Erinaceus*, and that its last molar should differ so much from the same tooth of that form, is very remarkable. The first incisors of the lower jaw are widely different in form from those of the upper jaw. They have cylindrical fangs, terminating in laterally expanded, shovel-like crowns, compressed from before backwards, slightly convex externally and concave internally. The second incisor has a strong resemblance to the first, but the crown has not quite the lateral expansion of that tooth. The posterior margin, a little above the neck of the tooth, is marked by a very minute process, which becomes intensified in the same position in the tooth posterior to it, where it is evidently the product of the cingulum. The crown of the third incisor is also laterally compressed, somewhat oval in outline, and is set on unequally to the fang, projecting anteriorly more in advance of the shaft of the tooth than posteriorly. The margin of the crown posteriorly above the neck bears a well-marked process. The canine partakes of the characters of the lower incisors in its compressed character from without inwards, and general form. The crown above the neck is slightly contracted; but it expands and terminates in a more truncated point than the first incisor. Its surface, along the posterior margin, is markedly concave. The first, second, and third premolars are the smallest teeth in the lower jaw, and they have all one form, the middle tooth being the smallest of the three. They are more or less compressed laterally; and the first is set obliquely in the jaw like the teeth preceding it; but the second is less so, and the third is nearly vertical. The crown of the first is small and conical, with a cusp nearly as large as itself projecting forwards from its anterior margin, and another, and smaller, posteriorly, the product of the cingulum. In the second the crown is merged in the anterior cusp, so that the external outline of the crown is rounded, with only the posterior cusp developed. The third has a slightly recurved, small, short, conical crown, with an anterior and a posterior cusp. The fourth premolar is the most verti-

cally extended tooth of the whole lower jaw. The crown is long, conical; and slightly recurved; and the cingulum encircling it forms a process anteriorly and posteriorly at its base, but no distinct cusp. The first and second molars have five cusps, of the same form and arrangement as in *Erinaceus*, with the cingulum very strongly marked externally. The third molar, which is only a little more than half the size of the first, has also five cusps, the anterior of which, however, is even less developed than it is in the second molar.

The basihyal is a flat, transversely extended, bony plate, consisting of two halves placed side by side, with a posterior cornu directed outwards and backwards, to which the slender, slightly upwardly curved thyrohyal is attached. The ceratohyal is a short, rather stout, cylindrical bone, constricted in the middle, with a head at either end; and it is succeeded by another, slender, laterally compressed bone, bent at its upper half—which leads me to believe that it is the stylohyal. But as the hyoid apparatus before me is imperfect, I cannot speak with any degree of confidence as to the number of pieces in the anterior arch.

Measurements of the Skull of Hylomys peguensis, Blyth.

| | in. | lin. | in. | lin. |
|---|-----|------|------|------|
| Greatest length of skull to tip of intermaxillaries | 1 | 4½ | to 1 | 4¾ |
| Greatest breadth across zygomatic arch | 0 | 9 | „ 0 | 8¾ |
| Greatest breadth of squamosal | 0 | 7 | „ 0 | 6½ |
| Breadth above lachrymal process | 0 | 5⅔ | „ 0 | 5⅓ |
| Lachrymal process (upper margin) to tip of intermaxillaries . | 0 | 7 | „ 0 | 7⅓ |
| Breadth in front of canines | 0 | 2⅔ | „ 0 | 2⅔ |
| Breadth in front of fourth premolar | 0 | 4 | „ 0 | 4 |
| Breadth (external) at first incisors | 0 | 2 | „ 0 | 2 |
| Breadth behind supraorbital process | 0 | 4 | „ 0 | 3⅔ |
| Least breadth between orbits | 0 | 4⅔ | „ 0 | 4⅓ |
| Posterior palatine margin to tip of intermaxillaries | 0 | 9 | „ 0 | 8¾ |
| Greatest breadth between alveolar internal margins (between second and third molars) | 0 | 3⅓ | „ 0 | 3 |
| Length of alveolar border | 0 | 9 | „ 0 | 8½ |
| Breadth behind origin of zygomatic arch, inferior aspect of skull | 0 | 7 | „ 0 | 6½ |
| Distance between tympanic bullæ (anterior extremity) | 0 | 1 | „ 0 | 1 |
| Distance between tympanic bullæ (posterior extremity) | 0 | 4⅔ | „ 0 | 4⅔ |
| Depth of skull at anterior extremity of nasals | 0 | 1⅔ | „ 0 | 1⅔ |
| Depth of skull at posterior extremity of nasals | 0 | 3 | „ 0 | 2½ |
| Depth through posterior margin of palate | 0 | 4⅔ | „ 0 | 4⅓ |
| Depth through highest point of parietal | 0 | 4⅔ | „ 0 | 4⅔ |

| | in. | lin. | in. | lin. |
|--|-----|------|------|------|
| Anterior extremity of symphysis to extremity of process of lower jaw | 0 | 11½ | to 0 | 11⅔ |
| Anterior extremity of symphysis to condyle | 1 | 0 | ,, | 1 0 |
| Anterior extremity of symphysis to coronoid process | 0 | 11¼ | ,, | 0 11 |
| Length of alveolar surface | 0 | 7½ | ,, | 0 7½ |
| Depth through coronoid process | 0 | 4½ | ,, | 0 4½ |
| Depth from base of corono-condyloid notch | 0 | 3⅔ | ,, | 0 3 |

Skeleton (figs. 8–19).—The most striking features of the skeleton are the great size of the skull, the very short tail, and the united tibia and fibula. The vertebræ are distributed as follow:—seven cervical, fourteen dorsal, six lumbar, four sacral, and fourteen caudal. The column from the atlas to the sacrum has two well-marked curves. From the first vertebra as far as the seventh cervical the curve is downwards and backwards, and then upwards and backwards as far as the second lumbar vertebra, from which the column is directed downwards and backwards.

Spinous processes.—In the vertebræ generally the spinous processes are not well developed, if we except the axis (in which it constitutes a prominent, laterally compressed, antero-posteriorly expanded, halbert-shaped plate) and the second dorsal (in which it forms a long, slender, backwardly projecting process), with the processes of the third, fourth, fifth, and sixth vertebræ only feebly developed. The process of the first dorsal is very small; and from the third to the seventh cervical it is represented by only a minute spine, most marked in the last of the neck-segments. In the twelfth to the fourteenth dorsal this process partakes, more or less, of the character it assumes in the lumbar region, where it is an antero-posteriorly expanded plate directed forwards, overlapping the vertebra in front of it. The spinous ridge of the sacral vertebræ is a low, thin plate, with its anterior margin directed forwards, retaining faint indications of the low original spines.

Hyperapophyses begin to show themselves in the thirteenth dorsal, and become more marked as they are traced backwards to the third lumbar, in which they attain their maximum development, but beyond which they diminish in size to the last lumbar.

Metapophysial processes are first found on the second dorsal, beyond which they increase in size as far back as the fourth lumbar. Traces of these processes are also observable in the sacral vertebræ, and they may be detected in the caudal vertebræ up to the seventh.

Anapophyses first appear in the twelfth dorsal, but they are most strongly developed in the second and third lumbar, beyond which they rapidly diminish, disappearing in the last vertebra of the loins.

Transverse processes.—These processes are rather small in the second to the seventh cervical vertebræ; and each, in one specimen before me, is capped with a small ossicle. The pleurapophysial plate appears first as a well-marked bony ridge running from the

base of the transverse process to the root of the odontoid process, or at least to form a part of that ridge at its origin from the transverse process, because in the third vertebra an undoubted pleurapophysial element becomes distinguishable in a similar position. In the sixth cervical this plate becomes much developed antero-posteriorly, and is connected to the same process of the seventh vertebra, in which it is spinous and capped by a small ossicle in apposition with a similar ossicle on the sixth vertebra. In the thirteenth and fourteenth dorsal vertebræ the intervertebral foramen has a process above and below, the inferior being the most strongly developed; and in the latter vertebra they are in such close conjunction that they produce a deep groove. A trace of this arrangement is also observable in the twelfth dorsal. The superior of these processes in the fourteenth dorsal is in the same line with the transverse process of the first lumbar. In the lumbar vertebræ these processes are thin longitudinal plates extending the whole length of the bodies of the vertebræ, with their tips directed outwards and very slightly forwards. In transmitted light they are seen to consist of two portions—a thick anterior transverse, with a fine osseous lamella continuous with it behind. In the tail these processes can be detected as far back as the sixth vertebra. In the first and second they are antero-posteriorly expanded; but the largest does not extend along the whole of the body of its vertebra, and they rapidly decrease in size. The vertebrarterial canal perforates all the cervical vertebræ, but is largest in the sixth. On the axis it opens externally immediately below the foramen for the inferior branch of the first spinal nerve.

Hypapophyses.—A small bifurcate process occurs on the atlas; and a well-developed hypapophysial plate all the length of the centrum, and terminated posteriorly by a recurved hook, appears on the axis. An almost as extensive plate is seen on the third cervical; and the fourth vertebra is distinguished by a well-marked bifurcate process, while from the fifth cervical to the fifth dorsal there are distinct indications of a hypapophysial ridge. In the cervical it is a fine, low ridge, which increases in width from before backwards; but in the dorsal vertebræ it is hardly distinguishable as such. The first to the third lumbar vertebræ show a hypapophysial ridge which consists almost of two lateral halves, whereas in the fourth to the sixth it is simple. A simple ridge occurs also in the first sacral vertebra.

Chevron bones occur from the second to the seventh caudal vertebræ, the united bones of each side resembling the figure **H**.

The *scapula* (fig. 12) is rather narrow; but its distinguishing feature is the great development of the mesoscapula, which has a larger area than either the postscapula or the præscapula. The posterior margin of the bone is slightly concave, but nearly straight, whilst the præscapula forms nearly the half of a very elongated oval. The upper postscapular margin is slightly convex. The mesoscapula is folded backwards, more especially at its lower acromial half, where its inferior acromial margin projects backwards beyond the hinder border of the postscapula. The acromion is largely deve-

loped, first as a thin plate, rather deeply concave anteriorly, almost resembling an osseous bulla from behind forwards, terminating in only a slightly thickened extremity that overhangs the head of the humerus in close apposition to it. Posterior to and above this, there is a prominent metacromial process directed downwards and backwards, more developed than in *Gymnura*, but of the same character.

The notch at the inferior extremity of the mesoscapula, formed by the downwardly projecting acromion, is very deep. The coracoid appears to be the elongated anterior process of the glenoid cavity, which projects over the anterior aspect of the head of the humerus. The glenoid cavity thus presents a cup-shaped hollow, behind which it is continuous with the coracoid. The postscapular surface is oblong and slightly concave, due to the outward folding of its posterior half. Viewed laterally, its inferior half is hidden by the lower portion of the spine and by the acromion. The lower end of the posterior margin terminates in a rather prominent process, which is separated from the glenoid cavity by a faint depression. The prescapular surface presents a well-marked furrow from above downwards, which divides the bone into two portions:—the posterior being a very elongated triangular; and the anterior small and defined posteriorly by the furrow, and anteriorly by its convex margin. The inner aspect of the scapula is marked by a mesial longitudinal furrow, corresponding to the situation of the spine, anteriorly by a faint ridge on the position of the furrow on the opposite side of the præscapula, and posteriorly by another ridge produced by the furrow on the external aspect of the postscapular surface. The inner aspect of the bone thus presents four surfaces, corresponding to those on its external face. The postscapular ridge has a small ridge-like process posterior to its inferior end; and the prescapular ridge runs into the coracoid. In a young individual the acromion of one scapula has broken off from the mesoscapula, showing that it is of considerable extent, and that the bulla-like portion of that part of the bone is wholly acromial; and in the other scapula of the same animal there is a fracture at the same place on the mesoscapula, but the acromion has not become entirely detached.

The *clavicle* is a rather slender bone, with an obtuse inward and forward curve at its vertebral end. At its sternal extremity it is separated from the præsternum by a distinct osseous præcoracoid of considerable size; but I cannot detect any mesoscapular segment.

The *præsternum* (fig. 19), viewed in front, is laterally dilated in its upper half into two wings, separated from each other by a well-developed longitudinal ridge, while the wings on either side of it are slightly concave. The lower half is a laterally compressed rod of bone, on to the anterior aspect of which the præsternal ridge is continued. Viewed from the side, the præsternum is only slightly broader above than below (in its rod-like portion), and its posterior surface is concave. The *mesosternum* consists of four pieces, of which the first is a short, laterally compressed rod like the posterior half of the præsternum, but slightly thicker at its two extremities. From the second to the third the pieces gain in lateral expansion; and the last is a quadrangular flat piece of bone. The

xiphosternum is a dorso-ventrally flattened rod of bone, slightly expanded at its two extremities, and about the length of the first and second mesosternal pieces, with an obscure longitudinal ridge on its outer surface.

The *humerus* (fig. 14) is a rather short bone, only a very little shorter than the ulna. It is strong, and marked by a not very prominent deltoid ridge, in which region the bone is slightly laterally compressed. It has a rather large supracondylar foramen, which is wider behind than in front. The ectocondylar ridge does not extend on to the shaft, but forms a short eminence, with the surface external to it concave. The anconeal fossa is rather shallow.

The shaft of the *radius* arches over the ulna, but the bones are separated by only a very narrow interval. The *ulna* is a third the length of the radius longer than that bone. The olecranon is large, strong, and incurved, externally convex, and internally concave. Its posterior extremity is divided into two surfaces, there being a lower rough surface for the attachment of the triceps extensor muscle.

The *carpus* is provided with a scapholunare and os intermedium and a large pisiform bone, resembling in miniature the pisiform of a Bear. The longest metacarpal bone is one third the length of the ulna. The first metacarpal is but little longer than the second, which reaches only to the anterior extremity of the middle third of the third metacarpal, which is of the same length as the fourth, which, in its turn, is twice as long as the fifth.

The *innominate bone* (fig. 16) is long and narrow, with an elongately oval obturator foramen, with the very small symphysis pubis posterior and inferior to the foramen, with the tuberosity of the ischium nearly immediately above it, but the two separated from each other by the greatest width of the innominate bone, which here forms a triangular, externally concave, surface, with its posterior margin concave from behind forwards. The outer surface of the *ilium* is concave; and the spine of the *ischium* forms a well-marked lesser sciatic notch with the smooth surface for the tendon of the obturator internus muscle well displayed.

The *femur* (fig. 17) is short and strong, with the muscular ridge continuous with the great trochanter, and passing down one half the length of the bone. The neck is very well defined. The patella is an elongated oval.

The *tibia* and *fibula* (fig. 18) are completely united throughout one half of their extent; and in front, at their united extremity, there is a rather deep pit. The outer surface of the tibia, immediately below the knee-joint, forms a sharp ridge of bone, which is folded outwards with a deep concavity external to it. The fibula is very delicate; and where not united to the tibia, the two bones enclose a very much elongated oval space. In the specimen before me the epiphyses of the upper extremity of the two bones have completely united, while the upper extremities of the shafts are distinct. At the lower end the epiphyses of the two bones have disappeared. The *calcaneum* is a long rod-like bone, with its under surface rounded from side to side, but longitudinally quite flat, projecting only a short way behind the bones of the lower leg.

The first toe, if the terminal joint is included, reaches only to the extremity of the second metatarsal, which does not reach quite so far forwards as the third and fourth, which are of equal length. The fifth metatarsal is little more than half the length of the fourth; and its first phalange reaches only to the end of the fourth metatarsal. The united tibia and fibula are one fourth the length of the femur longer than it; and the extreme length of the foot from the heel to the extremity of the third toe is only a very little shorter than the tibio-fibula.

Measurements of the Skeleton of Hylomys peguensis, Blyth.

| | in. | lin. |
|---|-----|------------------|
| Length of vertebral column along curve of upper surface | 4 | 7 |
| Length of caudal vertebræ | 0 | 6 $\frac{2}{3}$ |
| Length of cervical region | 1 | 2 $\frac{2}{3}$ |
| Extreme length of os innominatum (from tip of ilium to symphysis) | 0 | 11 $\frac{2}{3}$ |
| Extreme breadth (across ilium) | 0 | 1 $\frac{2}{3}$ |
| Upper margin of acetabulum to tip of ilium | 0 | 6 $\frac{1}{2}$ |
| Inferior margin of acetabulum to tip of symphysis | 0 | 4 $\frac{1}{2}$ |
| Inferior margin of acetabulum to tip of tuberosity of ischium | 0 | 3 $\frac{1}{2}$ |
| Length of obturator foramen | 0 | 2 $\frac{1}{2}$ |
| Breadth of obturator foramen | 0 | 0 $\frac{2}{3}$ |
| Breadth at ischial space | 0 | 2 |
| Breadth between symphysis and tuberosity of ischium | 0 | 3 $\frac{1}{2}$ |
| From superior mesoscapular margin to tip of acromion | 0 | 8 $\frac{1}{3}$ |
| Length of metacromial process | 0 | 1 $\frac{1}{2}$ |
| Mesoscapular margin to tip of coracoid | 0 | 8 $\frac{1}{3}$ |
| Mesoscapular notch from upper margin to margin of glenoid cavity | 0 | 1 $\frac{1}{2}$ |
| Extreme breadth of scapula | 0 | 8 $\frac{1}{2}$ |
| Breadth above glenoid surface (least width) | 0 | 1 |
| Length of humerus | 0 | 9 |
| Length of radius | 0 | 11 $\frac{1}{2}$ |
| Length of ulna | 0 | 10 |
| Length of entire hand | 0 | 11 |
| Length of third metacarpal | 0 | 3 |
| Length of phalanges of third finger | 0 | 3 $\frac{1}{2}$ |
| Length of femur | 0 | 10 |
| Length of united tibia and fibula | 1 | 0 $\frac{1}{2}$ |
| Length of entire foot from heel to end of third toe | 1 | 0 |
| Length of third metatarsal | 0 | 3 $\frac{1}{2}$ |
| Length of phalanges of third toe | 0 | 4 $\frac{1}{2}$ |

From the foregoing description of the skeleton and dentition of this remarkable form, it would seem that *Hylomys* is more closely allied to *Gymnura* and *Erinaceus* than to

Tupaia, however much in general form it resembles the last-named genus, from which it is widely separated in the details of its structure. Witness how different the pterygoid region of the skull is from that which occurs in *Tupaia*, and in contrast to the characters of which may be enumerated its imperfect tympanic bullæ, its slightly excavated basi-sphenoid, its paroccipital and mastoid processes, the imperfect orbit, the ridge before the latter, the imperforate malar, the palate without defects of ossification, and its dentition—besides other details of its skull, all of which, along with the foregoing, demonstrate that its nearest affinity is with *Gymnura*, and through *Gymnura* with *Erinaceus*. Added to these are the characters of its scapula and pelvis, which resemble the corresponding structures in *Gymnura*; and, like the latter, *Hylomys* has the important feature of a united tibia and fibula.

It is to be regretted that the viscera had been removed from Blyth's specimens when they were originally preserved, and that those of my specimens had been entirely destroyed by insects; otherwise these remarks might have been supplemented by the characters of the digestive tube.

DESCRIPTION OF THE PLATE.

PLATE LXIV.

- Fig. 1. Side view of head of spirit specimen of *H. peguensis*, Blyth.
- Fig. 2. Inferior view of skull.
- Fig. 3. Upper view of skull.
- Fig. 4. Side view of skull and mandible.
- Fig. 5. Side view of teeth of upper jaw (twice nat. size).
- Fig. 6. Teeth of upper jaw seen from below (twice nat. size).
- Fig. 7. Teeth of lower jaw seen from above (twice nat. size).
- Fig. 8. Skeleton (nat. size), *H. peguensis*, Blyth.
- Fig. 9. Tenth dorsal to fifth lumbar vertebra (twice nat. size).
- Fig. 10. Upper surface of atlas.
- Fig. 11. Side view of axis.
- Fig. 12. Dorsal view of axis.
- Fig. 13. Left scapula.
- Fig. 14. Right humerus.
- Fig. 15. Right radius and ulna.
- Fig. 16. Left os innominatum.
- Fig. 17. Right femur.
- Fig. 18. Right tibia and fibula.
- Fig. 19. Sternum.



XIV. *Report on the Hydroids collected during the Expeditions of H.M.S. 'Porcupine.'*
By Professor G. J. ALLMAN, F.R.S.

Read 18th February, 1873.

[PLATES LXV. to LXVIII.]

THE Hydroids obtained during the two expeditions of the 'Porcupine' (1869 and 1870), and placed in my hands for determination, consist of trophosomes, in some cases destitute of gonosome, but in others provided with this important element of the colony. No free planoblasts are contained in the collections of either expedition.

The dredgings of 1869 are, on the whole, from greater depths, and contain a greater number of new species than those of 1870; for though a few of the specimens of the expedition of 1869 are from inconsiderable depths (64, 75, and 90 fathoms), the majority are from very deep water, having been dredged from depths varying from upwards of 100 to between 600 and 700 fathoms. The deepest dredgings of 1870 were from 539 fathoms.

One result of the expeditions has been the determination of the very extensive range of depth enjoyed by some well-known species. Thus *Sertularella polyzonias*, though very generally distributed in the zone between tide-marks, was brought up by the 'Porcupine' explorers from a depth of 374 fathoms. *Hydrallmania falcata*, though a common species on the European shores of the Atlantic in the coralline zone of Forbes, which corresponds to a depth of between 15 and 50 fathoms, was obtained by the 'Porcupine' explorers from a depth of 542 fathoms; while *Thuiaria articulata* was brought up from 632 fathoms, though frequenting a depth of less than 50 fathoms round our shores.

Many species which have not yet been obtained elsewhere were brought up from great depths. Among these is a *Diphasia* from a depth of 632 fathoms; while a Plumularidan which must be referred to a new genus (*Cladocarpus*) was brought up by the same haul of the dredge. Two new species of *Thuiaria* were dredged from a depth of 640 fathoms, and a *Lafoëa* from 345 fathoms. A *Sertularella* nearly allied to *S. Gayi*, of which it may, perhaps, be regarded as only a variety, ranged from 290 to 605 fathoms. It is a fact by no means without significance, that, in every case hitherto observed, these deep-water Hydroids belong to forms which produce fixed sporosacs instead of planoblasts.

In the records of the expedition of 1869, it is stated that fragments of a Hydroid were

brought up from the enormous depth of 2435 fathoms. These evidences of abyssal hydroid life have never come into my hands: they appear to have been lost; so that a nearer determination of them is now impossible¹.

The cold area lying between Shetland and the Faroe Isles, where the bottom is overflowed by a deep icy current from the Polar Seas, and whose discovery by the 'Porcupine' explorers constitutes one of the most important additions to our knowledge of the physical geography of the North Atlantic, is not without a deep-sea Hydroid fauna, although its bottom varies from the freezing-point of fresh water to nearly two and a half degrees of Fahrenheit below it. The two new species of *Thuiaria* already alluded to were obtained from it where the temperature of the bottom was as low as 30° Fahr.; while, from the same area, the new Plumularian genus (*Cladocarpus*), with the new species of *Diphasia* and *Laföä*, also referred to above, were obtained from water whose temperature varied in different places from 30°·5 Fahr. to 29°·8 Fahr.

It will thus be apparent that, so far as the natural history of the HYDROIDA alone is concerned, the results of the expedition are important, bringing, as they do, to our knowledge many species hitherto unknown, and throwing new light on the relations between this most interesting group of organisms and the physical conditions which surround them.

The following species, already known and described in systematic works, were obtained during the expedition of 1869:—

| Name. | N. lat. | W. long. | Depth. | Temperature at bottom. |
|--------------------------------------|---------|----------|----------|------------------------|
| | ° '. | ° '. | fathoms. | ° Fahr. |
| <i>Eudendrium ramosum</i> | 59 34 | 7 18 | 542 | 43·8 |
| · <i>Laföä fruticosa</i> | { 60 23 | 0 33 E. | 75 | 44·0 |
| | { 60 32 | 0 29 | 64 | 49·1 |
| <i>Laföä dumosa</i> | { 60 23 | 0 33 E. | 75 | 44·0 |
| | { 60 32 | 0 29 | 64 | 49·1 |
| <i>Filellum serpens</i> | { 60 23 | 0 33 E. | 75 | 44·0 |
| | { 60 32 | 0 29 | 64 | 49·1 |
| <i>Diphasia pinaster</i> | { 52 25 | 11 40 | 90 | 50·0 |
| | { 60 23 | 0 33 E. | 75 | 44·0 |
| | { 60 32 | 0 29 | 64 | 49·1 |
| <i>Sertularella polyzonias</i> | 59 23 | 7 4 | 374 | 46·0 |
| <i>Sertularella Gayi</i> | 59 23 | 7 4 | 374 | 46·0 |
| <i>Sertularia abietina</i> | { 60 23 | 0 33 E. | 75 | 44·0 |
| | { 60 32 | 0 29 | 64 | 49·1 |
| <i>Thuiaria articulata</i> | 60 14 | 6 17 | 632 | 30·5 |
| <i>Grammaria abietina</i> | 62 1 | 5 19 | 114 | 45·0 |
| <i>Hydrallmania falcata</i> | 59 34 | 7 18 | 542 | 43·0 |

¹ See Preliminary Report, Proc. Roy. Soc. vol. xviii. 1869, p. 429.

The following hitherto undescribed forms were obtained during the same expedition:—

| Name. | N. lat. | W. long. | Depth. | Temperature at bottom. |
|--|---------|----------|---------|------------------------|
| | ° ' / | ° ' / | fathoms | ° Fahr. |
| <i>Thuiaria hippuris</i> | 61 21 | 3 44 | 640 | 30·0 |
| <i>Thuiaria laxa</i> | 60 21 | 3 44 | 640 | 30·0 |
| <i>Thuiaria salicornia</i> | 60 25 | 8 10 | 384 | 30·6 |
| | 62 1 | 5 19 | 114 | 45·0 |
| | 59 56 | 6 27 | 363 | 31·4 |
| <i>Sertularella Gayii</i> , var. <i>robusta</i> | 60 4 | 6 19 | 605 | 29·8 |
| | 61 10 | 2 21 | 345 | 30·0 |
| | 60 39 | 3 9 | 203 | 47·6 |
| | 60 14 | 4 30 | 290 | 41·5 |
| <i>Diphasia coronifera</i> | 60 14 | 6 17 | 632 | 30·5 |
| <i>Halicornaria ramulifera</i> | 61 21 | 3 44 | 640 | 30·0 |
| | 60 14 | 6 17 | 632 | 30·5 |
| <i>Cladocarpus formosus</i> | 60 34 | 4 40 | 560 | 29·8 |
| | 61 3 | 5 58 | 167 | 44·3 |
| <i>Lafoëa halecioides</i> | 61 10 | 2 21 | 345 | 30·0 |
| | 61 21 | 3 44 | 640 | 30·0 |

During the expedition of 1870 the following known species were obtained:—

| Name. | N. lat. | W. long. | Depth. | Temperature at bottom. |
|---------------------------------------|---------|----------|----------|------------------------|
| | ° ' / | ° ' / | fathoms. | ° Fahr. |
| <i>Calycella fastigiata</i> | 42 44 | 9 23 | 81 | 53·5 |
| <i>Cuspidella grandis</i> | 42 44 | 9 23 | 81 | 53·5 |
| <i>Lafoëa dumosa</i> | 42 44 | 9 23 | 81 | 53·5 |
| <i>Diphasia pinaster</i> | 36 44 | 8 8 | 364 | 52·7 |
| | 42 44 | 9 23 | 81 | 52·5 |
| <i>Sertularella polyzonias</i> | 38 15 | 9 0 | 64 | |
| <i>Sertularella Gayi</i> | 42 44 | 9 23 | 81 | 53·5 |
| <i>Antennularia antennina</i> | 42 44 | 9 23 | 81 | 53·5 |
| <i>Aglaophenia myriophyllum</i> | 36 44 | 8 8 | 364 | 52·7 |
| | 42 44 | 9 23 | 81 | 53·5 |

The following are the hitherto undescribed species which were obtained during the same expedition:—

| Name. | N. lat. | W. long. | Depth. | Temperature at bottom. |
|-----------------------------------|---------|----------|----------|------------------------|
| | ° ' / | ° ' / | fathoms. | ° Fahr. |
| <i>Aglaophenia dromaius</i> | 48 6 | 9 18 | 539 | 48·0 |
| | 48 13 | 9 11 | 257 | 50·0 |
| <i>Aglaophenia elongata</i> | 48 6 | 9 18 | 539 | 48·0 |
| | 48 13 | 9 11 | 257 | 50·0 |
| <i>Diplopteron insigne</i> | 36 44 | 8 8 | 364 | 52·7 |

It will be noticed that, with one exception (that of *Eudendrium ramosum*), all the species enumerated belong to calyptoblastic genera. Besides *Eudendrium ramosum*, a

few other gymnoblastic species were collected. These belong apparently to the genera *Eudendrium* and *Perigonimus*; but the state of preservation of the specimens is not such as to render it possible to determine them more closely.

DESCRIPTIONS OF NEW SPECIES.

LAFOËIDÆ.

LAFOËA HALECIOIDES. Plate LXVI. figs. 1, 1^a.

Trophosome.—Stem attaining a height of about two inches, pinnately branched, rigid, branches alternate, main stem and primary branches fascicled; ultimate ramuli jointed at irregular intervals, not fascicled. Hydrothecæ shortly pedunculate and disposed with a regularly pinnate and alternate arrangement along the length of the ultimate ramuli, and along that of the principal branches, one almost always situated in the axil of each ultimate ramulus; deeply cyathiform, with the axis slightly curved, and with the margin even, and slightly everted, usually marked for some distance below the margin by faint circular striæ.

Gonosome not known.

The present species has a very rigid habit, and possesses much of the aspect of certain Haleciums. It approaches *Lafoëa fruticosa* by its large size and shrubby growth, but differs from it by its pinnate ramification and *Halecium*-like habit. As in every other species of *Lafoëa* hitherto described, no gonosome was present.

It was dredged from the cold area at depths of 640 and 345 fathoms, the temperature in both cases having been ascertained to stand at 30° Fahr.

THUIARIDÆ.

THUIARIA LAXA. Plate LXV. figs. 1, 1^a.

Trophosome.—Stem attaining a height of about nine inches, and furnished with fan-shaped groups of dichotomous branches for some distance from the distal extremity, while it is destitute of branches for the greater part of its course; groups of branches about an inch in length, flexile, arched, with the convexity of the curve looking upwards, arranged spirally, rather distant, each branchlet of every bifurcation having a joint at its base, and having for the most part one or more joints at irregular distances along its length; stem gently zig-zag, annulated at the base, and with groups of two or three annuli at intervals for some distance upwards, giving the appearance of joints. Hydrothecæ scattered upon the main stem, but on the branches alternate, each separated from those above and below it by a space equalling about one fourth of its own height; orifice transversely elliptical, provided with a valve-like operculum.

Gonosome.—Gonangia piriform, springing from the upper side of the branches, each in an interval between two neighbouring hydrothecæ of a series.

This species has a peculiar habit, caused by its long, rather distantly disposed, flexile branches, which give it a loose diffuse character, by which it contrasts with the closer and more compact habit of other species.

It was obtained from the cold area lying between Shetland and the Faroe Isles, in two dredgings—one at 640 fathoms, where the bottom had a temperature of 30° Fahr., and the other at 363 fathoms, with a bottom-temperature of 30°·6 Fahr.

THUIARIA HIPPURIS. Plate LXV. figs. 2, 2^a.

Trophosome.—Stem attaining a height of about six inches, slightly zig-zag, except towards its base; its proximal end for about one sixth of its entire length destitute of branches, annulated irregularly at the base, and with joint-like annuli at irregular intervals for some distance upwards; branches repeatedly dividing dichotomously so as to form fan-shaped groups. Hydrothecæ on the main stem scattered, on the branches alternate; those in each series separated from one another by a distance of little more than two thirds of their height; orifice semicircular, provided with a valve-like operculum.

Gonosome not known.

Thuiaria hippuris has somewhat the aspect of *T. thuia*, from which, however, it differs by its less crowded ramuli and more distant hydrothecæ, as well as by its more attenuated and flexile stem.

It was dredged in the deep cold area between Shetland and the Faroe Isles, along with *Thuiaria laxa*, from a depth of 640 fathoms, where the temperature of the bottom was as low as 30° Fahr.

THUIARIA SALICORNIA. Plate LXV. figs. 3, 3^a.

Trophosome.—Stem attaining a height of about two inches, jointed at rather irregular intervals, simple or sparingly branched, somewhat rigid, with pinnately disposed branchlets above, destitute of branchlets below; pinnæ alternate, about four lines in length, articulated to projections of the stem. Hydrothecæ flask-shaped, alternate, immersed for the greater part of their depth, but becoming free at a short distance from the orifice, simply distichous on the main stem, and with the axes of all the hydrothecæ in each row turned in the same direction, but on the pinnæ having their axes alternately directed to the right and left, so as to give them here an apparently tetrastichous arrangement.

Gonosome not known.

The alternating directions of the axes of the hydrothecæ composing each row of the pinnæ confer on this species a striking physiognomy. *T. salicornia* further differs from other species of *Thuiaria* in the less complete immersion of the hydrothecæ, and from most species in its simple pinnately disposed ramuli. It was obtained west of the Faroe Isles, in lat. 62°, long. 5° 30', at a depth of 114 fathoms.

SERTULARIDÆ.

DIPHASIA CORONIFERA. Plate LXVI. figs. 2, 2^a.

Trophosome.—Stem attaining a height of about three inches, simple (in specimen), stout, rigid, not fascicled, tapering towards the summit, pinnate; pinnæ alternate. Hydrothecæ tubular, with the margin entire, free for about the upper third, which diverges without any abrupt bending from the axis, each pair of hydrothecæ on the pinnæ separated from its neighbouring pairs by an interval of about half the length of the hydrotheca, but by about double that interval on the main stem.

Gonosome.—Gonangia (male) springing from the pinnæ, each at a point just below a hydrotheca, contracted below into a short curved peduncle, rapidly expanding upwards, and terminating in a broad circular summit, whose circumference is raised into eight similar, strong, broad spines, and from whose centre projects a short papilliform process carrying the orifice on its extremity. Female gonangia not known.

This species was dredged in lat. 64° 15', long. 6° 15', from a depth of 632 fathoms.

SERTULARELLA GAYI, var. ROBUSTA. Plate LXVI. figs. 3, 3^a.

The form here recorded as a variety of *Sertularella Gayi* is a Hydroid with a strongly fascicled, thick, rigid stem, which attains a height of about six inches, and sends off on all sides simple, non-fascicled, obliquely jointed ramuli, and occasionally a fascicled branch, from which non-fascicled ramuli then proceed, as in the main stem. The hydrothecæ are borne one on each internode of the ramuli, immediately below a joint; they arch outwards from the ramulus, are turgid below, marked upon the upper side by transverse rugæ, smooth below, and have an obscurely four-toothed aperture.

The gonangia (female ?) are ovate, on short peduncles, strongly annulated towards the summit, but smooth below; the summit is in the form of a saucer-shaped expansion, from the centre of which rises a conical process, carrying on its top an obscurely two-lobed orifice.

If it were not for the occurrence of intermediate forms, I should have regarded the present Hydroid as specifically distinct from *Sertularella Gayi*. It differs from typical specimens of *S. Gayi* by the irregular disposition of its ramuli (which in the latter species are pinnate), and by the tubular summit of the gonangia. From *S. polyzonias*, with which *S. Gayi* is closely allied, it differs by its much more robust habit and thick fascicled stems. In specimens obtained from some other dredgings of the 'Porcupine,' the ramification is rather more pinnate. It seems, indeed, to form a connecting link between *S. polyzonias* and *S. Gayi*, and would thus go far to justify us in regarding all three as merely varieties of a single species.

The form here described would seem to be rather widely distributed over the area explored. It was obtained from the cold region, at depths of 345, 363, and 605 fathoms, with a bottom-temperature which varied from 31°·4 Fahr. to 29°·8 Fahr., while it was

also brought up in dredgings made outside of this region in depths of 203 and 290 fathoms, with temperatures of 47°·6 Fahr. and 41°·5 Fahr.

PLUMULARIDÆ.

Among the eight genera to which the new hydroid species of the expeditions may be referred, no less than four belong to the family of the Plumularidæ—a family in which the dredgings were especially rich, both in new species and in species which had been already described. Among the species now for the first time made known, are several highly interesting forms, which not only render necessary the construction of some new generic groups, but suggest the modification of some old ones.

I propose to distribute the new Plumularidæ of the 'Porcupine' expeditions under the following four genera—*Aglaophenia*, *Halicornaria*, *Cladocarpus*, and *Diplopteron*.

AGLAOPHENIA.

The genus *Aglaophenia* is here understood in a somewhat restricted sense, and must be regarded as limited by the following diagnosis:—

Trophosome.—Hydrocaulus with pinnate ramification. Hydrothecæ usually with an intrathecal ridge. Nematophores fixed; lateral nematophores one on each side of the orifice of the hydrotheca; mesial nematophores adnate for a greater or less extent to the front of the hydrotheca.

Gonosome.—Gonangia included in corbulæ, each of which replaces an ordinary pinna.

The presence of an intrathecal ridge, referred to in the above diagnosis, affords a character hitherto overlooked in the descriptive zoology of the Plumularidæ. I have given this designation to a more or less obliquely transverse ridge, which occurs in the interior of the hydrothecæ of a large number of Plumularidæ, where it forms an imperfect septum, by which the hydrotheca becomes divided into a proximal and a distal portion. The form of this ridge varies, and will afford characters available in specific diagnosis.

AGLAOPHENIA DROMAIUS. Plate LXVII. figs. 1, 1^a, 1^b, 1^c.

Trophosome.—Stem attaining a height of between five and six inches, simple, flexile, slender, not fascicled, divided into internodes of equal length; pinnæ springing each from a point near the middle of an internode, alternate, rather distant, of nearly equal length, extending along the stem to within a short distance of its base. Hydrothecæ deeply concave in front just above the line of attachment of the mesial nematophore; margin deeply toothed; intrathecal ridge strong, commencing at the front of the hydrotheca just below the orifice by which the cavity of the mesial nematophore communicates with that of the hydrotheca, and thence extending backwards but not meeting the mesial line of the back; mesial nematophore adnate for about two thirds of its length to the front of the hydrotheca; lateral nematophores of moderate size, slightly overtopping the hydrotheca.

Gonosome.—Corbula closed, rather elongated, with seven or eight moderately developed serrated ribs; no free spur-like appendage at its base.

Aglaophenia dromaius is a lax flexile species, strongly suggesting, both in size and form, one of the slender loose-barbed plumes of an Emu's feather. It comes very near to *Aglaophenia tubulifera*, Hincks, from which, however, it differs by its smaller lateral nematophores, and by its more elongated corbulæ as well as by the slighter development of their serrated crests, and by the absence of the spur-like appendage at their base. It was dredged off the Spanish coast from a depth of 539 fathoms.

AGLAOPHENIA ELONGATA. Plate LXVII. figs. 2, 2^a, 2^b.

Trophosome.—Stem attaining a height of about six inches, irregularly or subalternately branched, not fascicled, divided into equal internodes; pinnæ slender, alternate, each attached to a point a little below the distal end of an internode. Hydrothecæ deep and narrow, nearly cylindrical, margin cut into distinct and equal teeth; intrathecal ridge extending but a short distance from the posterior walls of the hydrotheca near the fundus of its cavity; mesial nematophore adnate for nearly its entire length, and attaining about one third the height of the hydrotheca; lateral nematophores scarcely overtopping the hydrotheca.

Gonosome.—Corbulæ closed, short and deep, with about seven moderately developed serrated ribs.

This is a slender, loosely branched, rather straggling form, and is especially distinguished by its deep narrow hydrothecæ. It was dredged along with *Aglaophenia dromaius* on the coast of Spain from a depth of 539 fathoms.

HALICORNARIA, Busk (modified).

Trophosome.—Hydrocaulus with pinnate ramification. Hydrothecæ usually with an intrathecal ridge. Nematophores fixed; lateral nematophores one on each side of the orifice of the hydrotheca: mesial nematophores usually adnate for a greater or less extent to the front of the hydrotheca, rarely free.

Gonosome.—Gonangia not included in corbulæ or protected by gonangial branches.

The generic name *Halicornaria* was proposed by Busk for such Plumularidæ as are deprived of corbulæ, and are otherwise referable to the type of the *Plumularia setacea* of authors. The name of *Halicornaria*, however, is displaced by Lamouroux's prior name of *Aglaophenia*, which, though applied by Lamouroux not only to the forms referable to the type of *Plumularia setacea* but to those also which have *Plumularia pluma* of authors as their type, may be now restricted to the latter, thus allowing the *Plumularia setacea* and its allies to retain undisturbed possession of the name of *Plumularia* assigned to both forms by Lamarck. Rather than introduce a new name, I have deemed

it better to employ the existing name of *Halicornaria* (though in a sense somewhat different from that assigned to it by Busk) for such Plumularidæ as possess the trophosome of *Aglaophenia* but have their gonangia destitute of corbulæ or other protection. Among British species the genus would include the *Plumularia pennatula* of Lamarck.

HALICORNARIA RAMULIFERA. Plate LXVII. figs. 3, 3^a, 3^b, 3^c, 3^d.

Trophosome.—Stem attaining a height of about an inch and a half, slightly recurved, simple, fascicled below, but becoming single towards the summit; pinnæ alternate, borne each upon a short process of the stem and extending along the stem for about three quarters of its entire height, longest towards the centre of the series, where they have a length of about two lines, and thence decreasing in length upwards and downwards, jointed, with each joint supporting a hydrotheca, and with its cavity constricted from distance to distance by imperfect septa. Hydrotheca adnate to the pinna for a little more than half its height, free for the remainder, adnate portion tumid, free portion funnel-shaped, abruptly bent forwards, with its anterior wall forming nearly a right angle with the adnate portion and having the margin deeply serrated; no intrathecal ridge; mesial nematophore detached from the hydrotheca, and forming a stout free tubular spine opening by a slit along that side which faces the hydrotheca; lateral nematophores forming a pair of short tubular diverging spines; a long jointed usually simple ramulus, destitute of hydrothecæ, given off from every joint of the pinnæ between the fundus of the hydrotheca and the mesial nematophore, emitting nematophores from distance to distance and curving over the hydrotheca towards the distal extremity of the pinna; main stem carrying a pair of nematophores at the base of every pinna.

Gonosome.—Gonangia (female?) ovate, with truncate summit, each springing from the front of one of the processes which are emitted by the main stem for the support of the pinnæ.

This is a very distinct and well-marked form. It will be easily recognized by the funnel-shaped and abruptly divergent distal portion of the hydrothecæ, and by the long ramuli, which do not develop hydranths and which are emitted by the pinnæ at the base of each hydrotheca. It is also rendered very remarkable by the way in which the accessory ramulus interposes itself between the hydrotheca and its mesial nematophore. It plainly constitutes a connecting link by which *Aglaophenia* passes into *Plumularia*.

Halicornaria ramulifera was obtained in the deep cold area along with *Thuiaria laxa*, *Thuiaria hippuris*, and *Lafoëa halecioides*, from a depth of 640 fathoms, where the thermometer registered 30° Fahr., thus living in a temperature which was 2° Fahr. below the freezing-point of fresh water.

CLADOCARPUS, Allman.

Trophosome.—Hydrocaulus with pinnate ramification. Hydrothecæ with an intra-

thecal ridge. Nematophores fixed; lateral nematophores, one on each side of the orifice of the hydrotheca; mesial nematophores usually adnate for a greater or less extent to the front of the hydrotheca, occasionally free.

Gonosome.—Gonangia not included in corbulæ, but borne on the sides or at the base of special protective branches, which are appendages of the pinnæ.

I have constructed the genus *Cladocarpus* for a group of Plumularidæ in which the proper hydrothecæ-bearing pinnæ carry peculiar branching appendages (Plate LXVIII. fig. 1^a, *a*, *a*), which are destined to support the gonangia or in some other way to afford protection to them.

These appendages differ essentially from the open and closed corbulæ of other forms in the fact that they are not, like corbulæ, metamorphosed pinnæ, which take the place of unaltered pinnæ, but appendages superadded to the pinnæ.

In Kirchenpauer's subgenus *Macrorhynchia*, the gonangia are also borne on special branches (gonocladia and nematocladia, of Kirchenpauer); but these are always, as in the true corbulæ, metamorphosed pinnæ.

Macrorhynchia is further distinguished from *Cladocarpus* by the form of its mesial nematophores, which are very long, usually far surpassing the height of the hydrotheca, and which, as Kirchenpauer first pointed out, are always provided with a lateral as well as a terminal orifice after they cease to be adnate to the hydrotheca.

It will be seen that the genus *Cladocarpus* is nearly allied to *Aglaophenia*. With this genus it is coincident so far as regards its trophosome; but it differs from it in its gonosome, which is not provided with corbulæ, and instead of these receptacles has special ramuli, which are appendages of the pinnæ and are destined for the protection of the gonangia. Its connexion with *Aglaophenia* is maintained through the forms included by Kirchenpauer in his subgenus *Macrorhynchia*.

CLADOCARPUS FORMOSUS. Plate LXVIII. figs. 1, 1^a, 1^b.

Trophosome.—Stem attaining a height of between two and three inches, slightly recurved, simple, or with some small branches given off from its anterior aspect, fascicled below, pinnæ alternate, jointed, each joint supporting a hydrotheca, pinnæ near the centre of the series about three quarters of an inch in length, and thence decreasing in length upwards and downwards. Hydrothecæ nearly cylindrical, with the margin provided with short teeth; mesial nematophore forming a stout spine extending to about half the height of the hydrotheca, to which it is adnate for the greater part of its length, becoming free at a short distance from its summit; lateral nematophores forming short blunt conical processes, slightly rising above the margin of the hydrotheca. Main stem (rachis) giving off minute nematophores, which are disposed in more or less regular verticils.

Gonosome.—Gonangia-bearing ramuli springing each from the basal joint of a pinna,

dichotomously branched, provided with numerous nematophores along their length, and carrying the gonangia singly at the points of bifurcation; a gonangium is also frequently borne by the main stem close to the origin of a pinna. Gonangia (sex indeterminable in the specimens) nearly sessile, obovate.

This very beautiful species was dredged from a depth of 167 fathoms, where the temperature of the bottom stood at 44°·3 Fahr.

DIPLOPTERON. Gen. Char.

Trophosome.—Hydrocaulus plumose, doubly pinnate, nematophores movable, never adnate to the hydrotheca; hydrothecæ destitute of intrathecal ridge; two pairs of lateral nematophores flanking the hydrotheca.

Gonosome.—Gonangia not protected by corbulæ or by special ramuli.

The genus *Diplopteron* is distinguished from *Plumularia* by its doubly pinnate ramification, and by the possession of two pairs of lateral nematophores. The doubly pinnate hydrocaulus of *Diplopteron* confers upon this genus a very striking and instantly recognizable feature, which marks it out from *Plumularia* as distinctly as *Antennularia* is distinguished from the same genus by its verticillate ramification.

We know of no other member of the family in which there is more than a single pair of lateral nematophores.

DIPLOPTERON INSIGNE. Plate LXVIII. figs. 2, 2^a, 2^b, 2^c.

Trophosome.—Stem attaining a height of about 6 inches, giving off an occasional branch, rooted by an entangled mass of tubular filaments, and carrying closely set, regular, opposite, primary pinnæ, which are destitute of hydrothecæ; and carry along their entire length the ultimate or hydrotheca-bearing pinnæ; stem and primary pinnæ fascicled, becoming single only towards the distal extremities; ultimate pinnæ borne not only on the primary pinnæ but on the stem, in the intervals between the primary pinnæ, closely set, alternate, and of nearly equal length, divided by oblique joints into internodes, and giving off each close to its origin a branchlet, which often bifurcates. Hydrothecæ deep, bell-shaped, free for about the distal half of their length, orifice circular, entire, slightly everted, every internode of the ultimate pinnæ carrying a hydrotheca. Two very large bithalamic lateral nematophores borne on each side of the hydrotheca and there articulated to a lateral process of the internode, while a pair of minute lateral nematophores is carried just above them, a mesial nematophore borne by the internode at the proximal side of the hydrotheca and another at its distal side.

Gonosome.—Gonangia oval, with truncated summit, borne on a short two-jointed peduncle, which springs from the ultimate pinna close to its origin.

In the opposite disposition of the primary pinnæ of *Diplopteron insigne* we are reminded of the ramification of *Plumularia catharina*. In this Hydroid, however, the

ramification is, like that of all the true *Plumulariæ*, singly pinnate, while it is exceptional only in the opposite instead of alternate arrangement of the pinnæ or hydrotheca-bearing ramuli.

A rather striking feature of *Diplopteron insigne* consists in the ramulus which each of the ultimate pinnæ gives off near its origin. This ramulus, which usually bifurcates, consists of slender elongated internodes, each bearing a hydrotheca and nematophores quite like those of the pinnæ. The gonangia form two closely set alternating series running along the front of the rachis and along that of the primary pinnæ from the base to the apex.

Diplopteron insigne, when living, must be a singularly beautiful object, while the great development of the nematophores must especially fit it for the observation of the characteristic phenomena of these bodies. Indeed the spirit-specimens examined were to a great extent enveloped and obscured by irregular filaments and masses of a granular mucus-like substance, which I have no doubt are the remains of the pseudopodial extensions from the protoplasmic contents of the nematophores. It was dredged off the south-west coast of Spain, from a depth of 364 fathoms.

DESCRIPTION OF THE PLATES.

PLATE LXV.

- Fig. 1. *Thuiaria laxa*, natural size.
 Fig. 1^a. *Thuiaria laxa*, portion of hydrothecal ramulus magnified.
 Fig. 2. *Thuiaria hippuris*, natural size.
 Fig. 2^a. *Thuiaria hippuris*, portion of hydrothecal ramulus magnified.
 Fig. 3. *Thuiaria salicornia*, natural size.
 Fig. 3^a. *Thuiaria salicornia*, a portion magnified.

PLATE LXVI.

- Fig. 1. *Lafoëa halecioides*, natural size.
 Fig. 1^a. *Lafoëa halecioides*, a portion magnified.
 Fig. 2. *Diphasia coronifera*, natural size.
 Fig. 2^a. *Diphasia coronifera*, a portion magnified.
 Fig. 3. *Sertularella gayi*, var. *robusta*, natural size.
 Fig. 3^a. *Sertularella gayi*, var. *robusta*, a portion magnified.

PLATE LXVII.

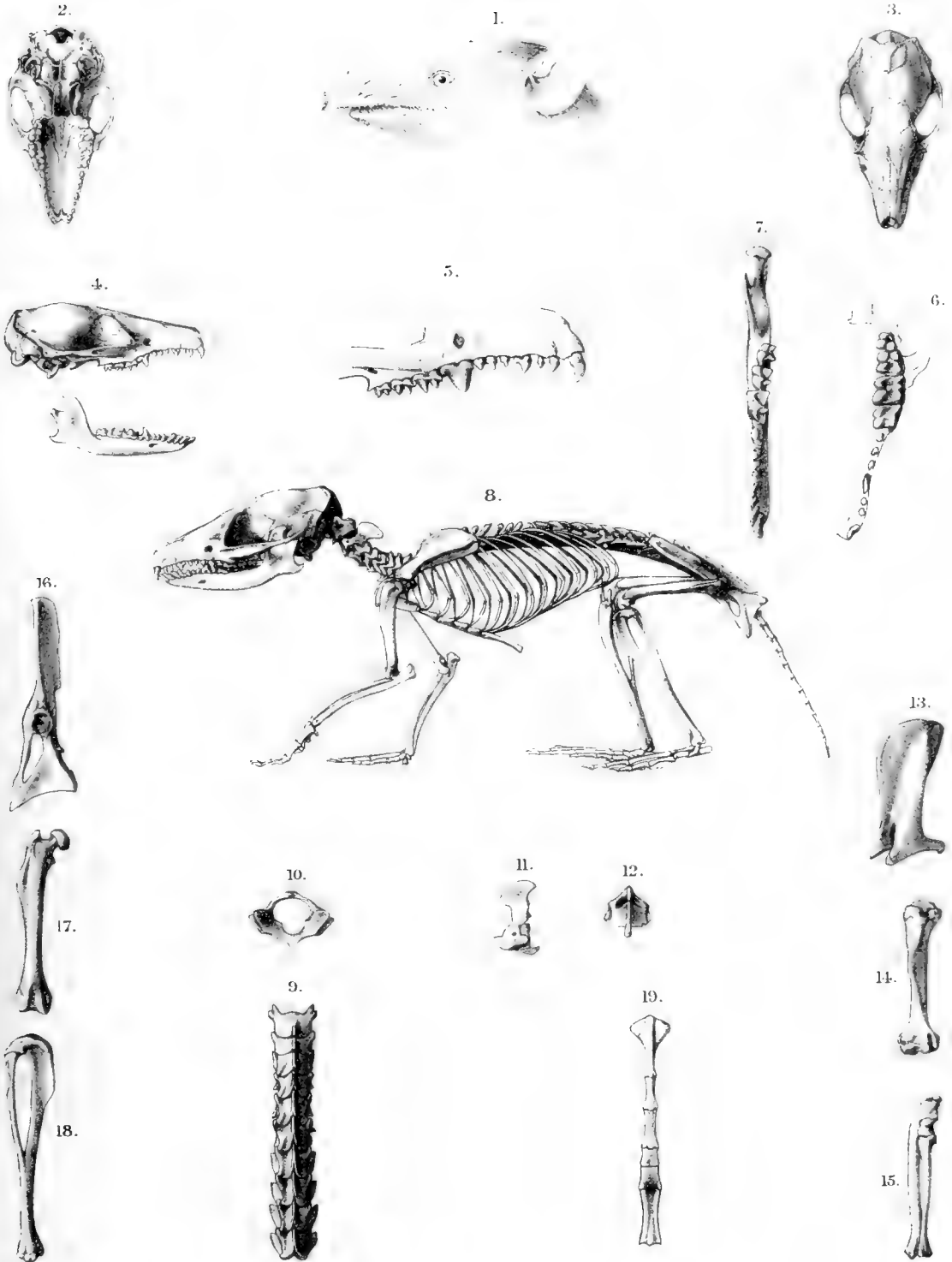
- Fig. 1. *Aglaophenia dromaius*, natural size.
 Figs. 1^a, 1^b. *Aglaophenia dromaius*, portions of hydrothecal ramuli magnified.

- Fig. 1^c. *Aglaophenia dromaius*, portion of stem, with corbula, magnified.
 Fig. 2. *Aglaophenia elongata*, natural size.
 Fig. 2^a. *Aglaophenia elongata*, portion of hydrothecal ramulus magnified.
 Fig. 2^b. *Aglaophenia elongata*, corbula magnified.
 Fig. 3. *Halicornaria ramulifera*, natural size.
 Fig. 3^a. *Halicornaria ramulifera*, a portion magnified.
 Figs. 3^b, 3^c. *Halicornaria ramulifera*, portions still further magnified.
 Fig. 3^d. *Halicornaria ramulifera*, portion of stem close to the root, magnified, showing its fascicled condition.

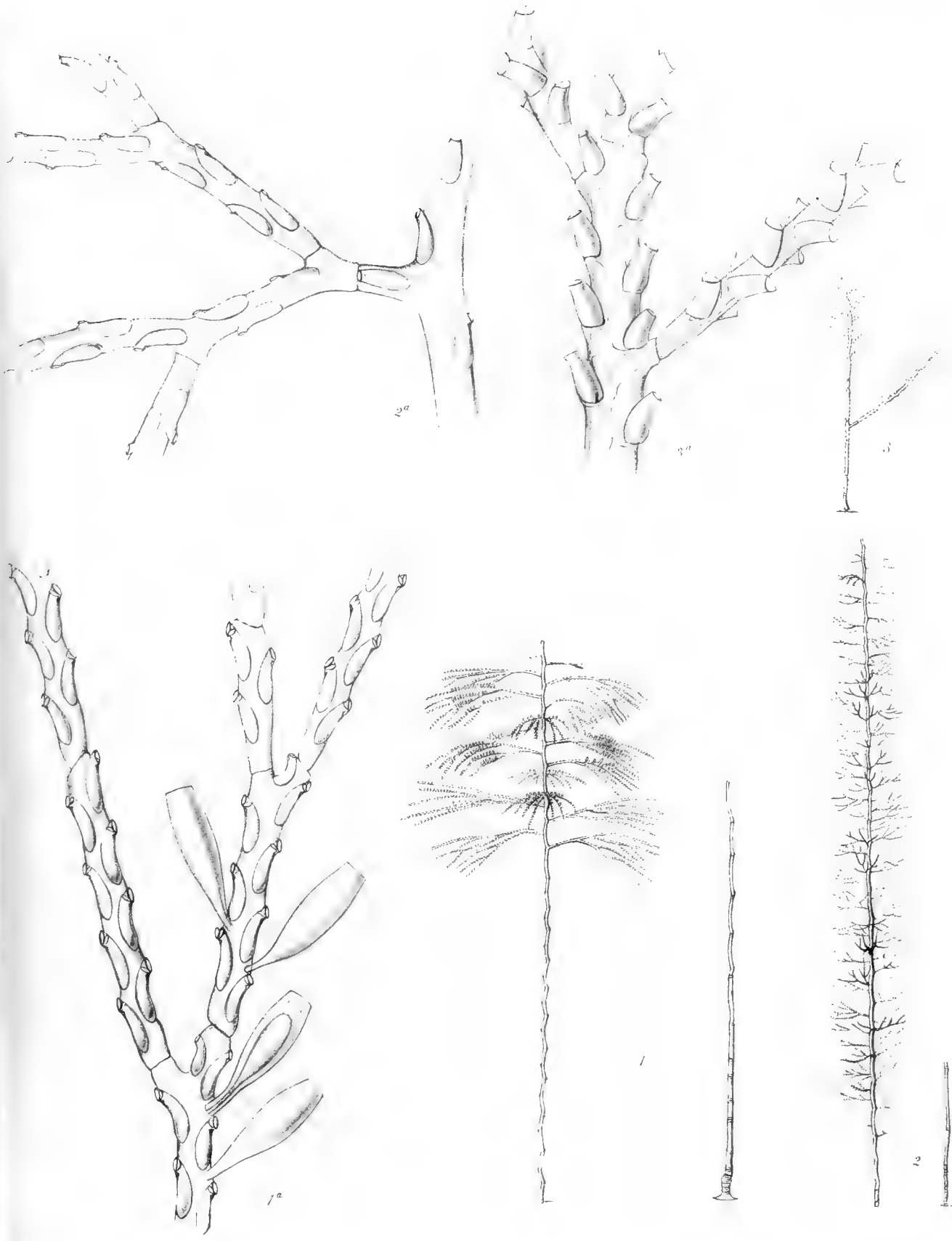
PLATE LXVIII.

- Fig. 1. *Cladocarpus formosus*, natural size.
 Fig. 1^a. *Cladocarpus formosus*, portion of stem, with hydrothecal and gonangial ramuli, magnified. *a, a.* gonangial ramuli.
 Fig. 1^b. *Cladocarpus formosus*, hydrotheca magnified (front view).
 Fig. 2. *Diplopteron insigne*, natural size.
 Fig. 2^a. *Diplopteron insigne*, portion magnified.
 Fig. 2^b. *Diplopteron insigne*, portion of hydrothecal ramulus (profile).
 Fig. 2^c. *Diplopteron insigne*, portion of hydrothecal ramulus (front view).









J. Smith lith

W. C. Cushman, imp

NEW HYDROIDS.
OF THE PORCUPINE EXPEDITION





7 cent. 1/2 h

M & N Hanhart. imp

NEW HYDROIDS
OF THE PORCUPINE EXPEDITIONS



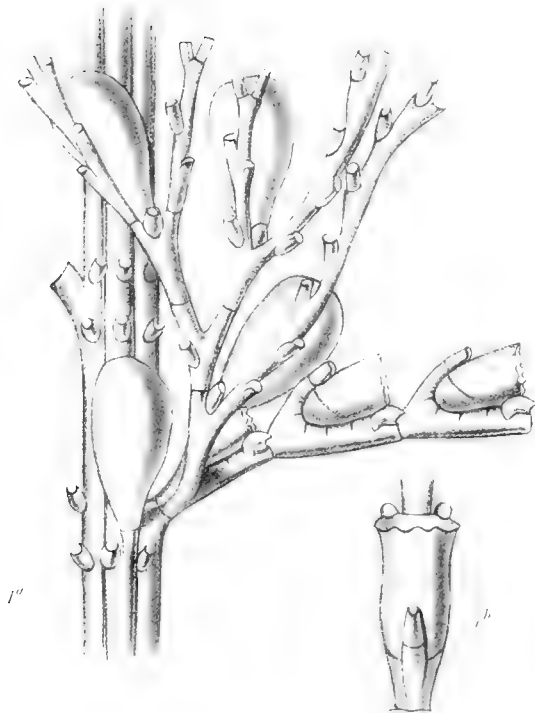
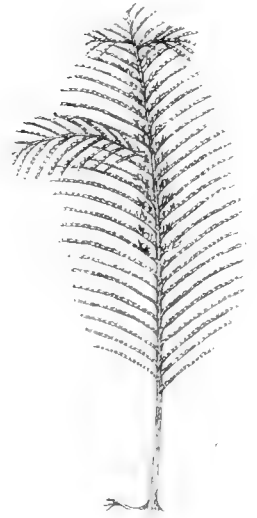
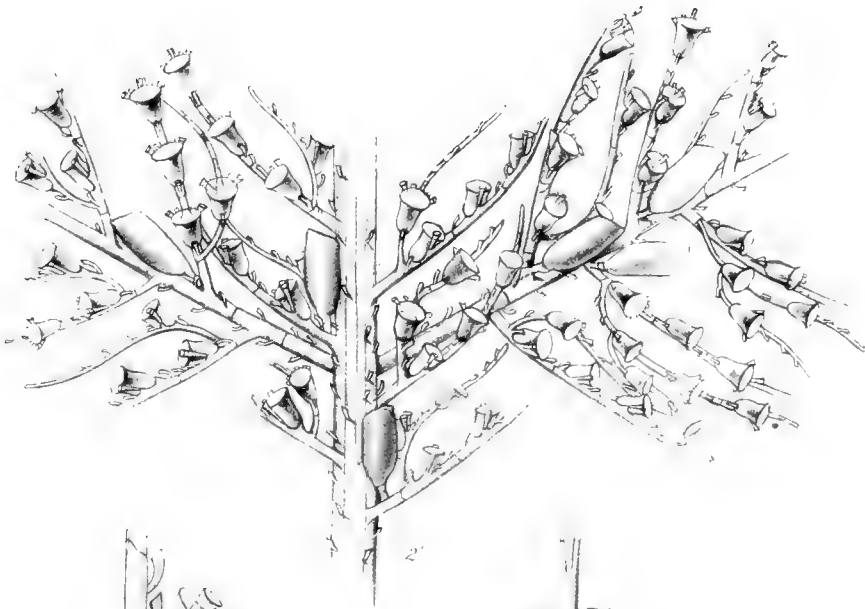


J Sims del

M & N Harshart sculp

NEW HYDROIDS
OF THE PORCUPINE EXPEDITIONS







XV. *On the Osteology of the Marsupialia.* (Part IV.) *Bones of the Trunk and Limbs.*
Phascolomys. By Professor OWEN, C.B., F.R.S., F.Z.S.

Read 3rd December, 1872.

[PLATES LXIX. to LXXXIV.]

THE endeavour to restore the lost species of Wombat presumes a power of recognizing the bones or portions of bones when discovered in a fossil state; and this can only be acquired by a knowledge of the characters of the corresponding bones of the existing species.

Such knowledge has been imparted, in reference to the skull of *Phascolomys*, in my former Papers; I propose to make the remainder of the skeleton the subject of the present 'Part,' in which the descriptions and figures are limited to those bones of the trunk and limbs yielding satisfactorily distinctive and determinative characters subservient to the above-defined aim.

Vertebral Column.—The general characters of the vertebral column in the genus *Phascolomys* are defined in my first memoir¹. The annular atlas is there shown, from a specimen (of *Phascolomys vombatus*) in the Museum of the Royal College of Surgeons of England, to have the lower part of its ring "completed by dried gristly substance," not, as in some kinds of Kangaroo, by "extension of ossification from centres in the superior laminae"². The term 'neurapophysis' had not then been proposed for these vertebral elements, nor had I, in 1838, satisfied myself that the 'centrum' of the atlas was the 'odontoid process' of the succeeding vertebra. It is further remarked that "the transverse processes are grooved merely by the vertebral arteries," and that "the atlas presents only the perforation on each side of the superior [now called 'neural'] arch"³.

These general characters of the atlas of the bare-nosed Wombat of Tasmania are repeated in that of a not fully grown specimen of *Phascolomys platyrhinus* (Pl. LXIX. figs. 3 & 4); but in the atlas of an older and larger specimen of that species ossification has extended into the sclerous representative of the pleurapophysis, and has converted the vertebrarterial notch into a foramen on both sides (as indicated by the dotted line, *p l*, in fig. 3, Pl. LXIX.).

The same bony circumscription obtained on the right side in the atlas of a *Phascolomys latifrons* (Pl. LXIX. figs. 1 & 2, *p l*). The first cervical nerve, in both species,

¹ "On the Osteology of the Marsupialia" (Part I. 1838), Trans. Zool. Soc. vol. ii. p. 379 *et seq.*

² *Ib. ib.* p. 394. I have since seen the atlas of an old male *Macropus rufus*, incomplete below.

³ *Tom. cit.* p. 394.

perforates obliquely the neurapophysis (at *c* 1, figs. 1 & 3), the aperture within the neural canal being above the articular concavity (*z'*, *z'*) for the occipital condyle.

The transverse diameter of the atlas is less in proportion to its vertical one in *Phascolomys latifrons* (ib. figs. 1 & 2) than in *Phascolomys platyrhinus* (ib. figs. 3 & 4); the cups for the condyles (fig. 1, *z'*, *z'*) are less turned outward, and the diapophyses (ib. *d*, *d*) are more tuberosus in *Phascolomys latifrons*; in *Phascolomys platyrhinus* (figs. 3 & 4, *d*, *d*) they are flattened below as well as above. The articular surfaces for the odontoid are more oblong and more nearly transverse in *Phascolomys latifrons* (fig. 2, *z'*, *z'*), and their outer border is not so much inclined backward as in *Phascolomys platyrhinus* (ib. fig. 4, *z'*, *z'*). The unossified lower tract of the atlantal ring is greater in the bare-nosed Wombats (ib. figs. 3 & 4, *h*); but this character varies with age. Nevertheless in the atlas of the large old *Phascolomys platyrhinus* the interval is greater than in the atlas of the *Phascolomys latifrons* (ib. figs. 1 & 2, *h*), the skeleton of which shows fewer marks of age.

The neurapophyses of the dentata are thicker and narrower from before backward in *Phascolomys latifrons* (ib. fig. 5, *n*) than in *Phascolomys platyrhinus*. In both species the neural spine (ib. *ns*) is strongly developed in both height and anteroposterior breadth. That part in the succeeding cervicals is short and slender; it is longer in the fourth (*ns*, 4) and seventh (fig. 6, *ns*, *c* 7) cervicals in *Phascolomys latifrons* than in *Phascolomys platyrhinus*. The pleurapophysis of the sixth cervical extends downward and backward as a thick ridge (ib. fig. 5, *p l*).

In all existing Wombats the dorsal series begins with a sudden and great increase in the length and strength of the neural spine (Pl. LXIX. fig. 6, 1). The diapophyses (ib. *d'*) are thickest in this vertebra and are deeply cupped at the end for the tubercle of the first rib.

In the skeleton of the *Phascolomys latifrons*, described in the present 'Part,' the number of rib-bearing vertebræ is thirteen, leaving six for the lumbar series. In this particular the hairy-nosed species agrees with the majority of the Marsupialia. The greater number of dorsal vertebræ in the bare-nosed Wombats¹ is exceptional in the order.

The first rib (Pl. LXIX. fig. 7) is the shortest and broadest; the last (ib. fig. 10) is the most slender and is least curved. The articular surface is retained on the tubercle (ib. figs. 7, 8, 9, *b*) in the ten anterior pairs of ribs; only a trace of tubercle, rough for ligamentous attachment, is seen on the last three pairs.

The costal head (ib. fig. 7, *a*) is furthest from the tubercle (*b*), or, in other words, the neck (*c*) is longest, in the first rib. The head shows, as in the succeeding ribs, two articular facets (*a'*), which meet at a rather acute angle. Each side of the hind surface of the seventh cervical accordingly shows the facet (ib. fig. 6, *p l*) fitted to the anterior of those surfaces. The tubercle presents an articular surface (ib. fig. 7, *b*, *b'*) larger and

¹ *Phascolomys vomatus*, e. g., Part I. tom. cit. p. 393.

more convex than in any of the other ribs; and this fits the deep cup on the diapophysis of the first dorsal vertebra (ib. fig. 6, *d'*). There is a rough low tuberosity (ib. fig. 7, *d*) on the middle of the outer or anterior surface of the first rib for the attachment of a strong scalenus muscle. In the second rib (ib. fig. 8) besides the head (*a*), neck (*c*), and tubercle (*b*), there is, on the outer border, at the same distance from the tubercle as this is from the head, a second tubercle or process (*e*), smaller than the normal one (*b*), and serving exclusively for muscular attachment; it answers to what is called the 'angle of the rib' in anthropotomy. The articular surface on the tubercle is flat (*b*), as in all the succeeding ribs possessing it; anterior to this surface is a tubercle for the attachment of the costal ligament. In the fifth rib (ib. fig. 9), besides the process holding the same relative position to the tubercle as in the second rib, there is another (*f*) at a greater distance, which answers better to the 'angle.'

The neck (*c*) shortens as the ribs recede in position, and disappears with the loss of the articular tubercle in the last three pairs. The longest ribs are the seventh and eighth pairs in *Phascolomys latifrons*. The hind border of the proximal third of the shaft is slightly produced, indicative of an 'intercostal groove.' The shaft is flattened and expanded at its distal end (*g* and fig. 9'), which is twisted at right angles to the broadest part of the neck of the rib. This terminal expansion (fig. 9') is lost in the three last pairs (fig. 10). Six anterior pairs of rib-cartilages (Pl. LXIX. fig. 11, *h*, 1-6) articulate directly with the sternum, which consists of six bones, including the manubrium (*m*) and xiphisternal (*x*). The fourth and fifth sternobers coalesce earlier than any of the others; the articulation of the cartilages of the fifth pair of ribs (5) indicates the place of the harmonia and the shortness of the fifth sternober compared with the rest; its antero-posterior thickness is considerable, and increases as it recedes (as shown in the side view (Pl. LXIX. fig. 11 *a*, 1). The cartilages of the sixth pair of ribs (*h*, 6) articulate to the lower angles; and the inner or hind border alone affords attachment to the xiphisternal (*x*). The manubrium (ib. fig. 11, *m*) is subcarinate, and affords oblong syndesmotic surfaces for the strong clavicles.

Phascolomys, like all the other genera of Marsupialia of which the vertebral formula is known, has twenty-six vertebræ between the skull and sacrum. The nineteen vertebræ following the seven cervical vary as to the number of the pleurapophyses developed as movably articulated ribs. In the two examples of *Phascolomys platyrhinus* of which I have had the opportunity of examining the entire skeleton, fifteen vertebræ sustain such pairs of ribs, leaving four vertebræ as 'lumbar;' and this was the formula presented by the corresponding part of the vertebral column of the *Phascolomys vombatus* described in a former Paper¹. In the only complete skeleton of *Phascolomys latifrons* which has yet reached me the number of lumbar vertebræ is six. In this formula it deviates less from the rule of 'dorsal' and 'lumbar' vertebral notation in the marsupial order than do the bare-nosed Wombats of Tasmania and Australia.

¹ Trans. Zool. Soc. vol. ii. p. 395, pl. lxxviii.

The number of vertebræ which are confluent in the sacral region of *Phascolomys latifrons* is four (Pl. LXX. fig. 1, s 1-s 4), the two foremost of which articulate with the ilia. The syndesmotoc surface is formed on each side by an expansion of the hinder half of the diapophysis of the first vertebra (ib. *d* 1) and of the whole of that of the second (*d* 2), forming together an oblong subreniform tract (ib. fig. 2) with an indication of its division into two surfaces (*d* 1, *d* 2). The entire longitudinal extent of this joint is 1 inch 2 lines, with an extreme breadth of 6 lines. The diapophyses are confluent along their expanded distal halves of the first and second, and by a less proportion in the third and fourth sacrals, leaving vacuities (*sd* 1-*sd* 3) between their proximal portions, into which open the joints between the bodies of the sacral vertebræ. These joints are not ankylosed in the specimen figured. The bodies of the sacral vertebræ (ib. fig. 1, s 1-s 4) are depressed, losing vertical extent as they recede, but maintaining breadth beyond the first, which is the largest. In the first sacral the prezygapophyses resemble those of the lumbar vertebræ, and develop external to the joint a small tuberosus metapophysis. The postzygapophyses are small; and both articular processes of the neural arch decrease in size to the last sacral. Between this and the third sacral the coalescence is limited to the extreme ends of the diapophyses, which in the last (*d* 4) are produced forward.

In the first caudal (ib. fig. 1, *c* 1) the broad depressed diapophyses (*d* 5) are curved backward, as in the succeeding caudals (*d* 6, *d* 7).

In a large full-grown *Phascolomys platyrhinus* there are four sacral vertebræ by terminal coalescence of diapophyses, the two anterior of which articulate with the ilia, the articular surface being extended along the whole terminal expanse of the first sacral diapophyses. The fifth vertebra by the backward direction of its diapophysial expansions indicates its caudal characters; but on the right side the diapophysis is confluent with that of the following vertebra.

In the sacrum of a second, not quite full-grown, example of *Phascolomys platyrhinus* (Pl. LXX. fig. 3) the vertebra (*c* 1) succeeding the four ankylosed sacrals has its diapophyses (*d* 5) similarly directed and expanded, the left touching the one in advance by its extreme angle, with the interposed ligamentous matter not yet ossified. In the sixth vertebra (*c* 2) the diapophysial expansions extend backward and coalesce at their hinder angles with the diapophyses of the seventh vertebra, forming, as it were, a second small sacrum (*d* 6, *d* 7), according to the character of coalescence.

The articular surface for the ilium (Pl. LXX. fig. 4) is longitudinally more extended, and the proportions contributed by the first and second sacrals (*d* 1, *d* 2) are further apart than in *Phascolomys latifrons* (fig. 2).

In the example of *Phascolomys vombatus*, described in the 'Catalogue of the Osteology in the Museum of the Royal College of Surgeons' (4to, 1853, no. 1814, p. 333), ankylosis of the fifth vertebra having expanded antroverted diapophyses with those of the fourth sacral has been completed, and a sacrum of five vertebræ by coalescence results.

But, in both specimens, as in the skeleton of the Tasmanian Wombat (*tom. cit.* p. 330, no. 1792), the two anterior vertebræ only are sacral by the character of abutment against and syndesmotic junction with the iliac bones.

In an old individual of *Phascolomys vombatus* I have seen, and figured¹, a sacrum of seven vertebræ by ankylosis of the centrums. Of these the first four repeat the characters of the four sacrals in *Phascolomys latifrons* by coalescence of the terminally expanded diapophyses; those of the three succeeding vertebræ are retroverted and ankylosed together. Moreover the articulation with the ilia is extended along the expanded ankylosed end of the four anterior sacrals.

But under all these modifications the homologies of the respective vertebræ (as indicated by the symbols, *s* 1-*c* 3) in both bare-nosed (fig. 3) and hairy-nosed (fig. 1) Wombats are unmistakable; and we discern, in the degree in which the caudal characters are assumed by the vertebræ succeeding the four ankylosed sacrals in *Phascolomys latifrons*, that the general character of the sacro-caudal region of the spine in Marsupialia is least departed from in that species.

The tail is short and inconspicuous in all kinds of Wombat. Reckoning the series of vertebræ to begin after the fourth sacral, there are not more than eleven caudals; and the two or three terminal ones are mere tubercular rudiments of the centrum.

Bones of the Fore Limbs.—The clavicle in *Phascolomys* (Plate LXIX. figs. 12, 13) is a long, strong, slightly bent and twisted bone, expanded at both ends, but chiefly at the sternal one (ib. *a*). This is deeply canaliculate, the groove (ib. *b*) opening upon the fore or outer surface of the bone. The sternal end (*a, b*) is larger, and the groove is less and shorter in *Phascolomys latifrons* (ib. fig. 12) than in *Phascolomys platyrhinus* (ib. fig. 13); and the convex articular part forms a larger proportion of that end. The shaft of the bone is triedral in *Phascolomys latifrons*; it is subcompressed in *Phascolomys platyrhinus*, in which the bone is flatter on the fore or outer surface, and is more convex on the opposite surface. The longitudinal bend is somewhat greater in *Phascolomys platyrhinus* (fig. 13); the acromial end is also flatter and rather broader in this species (ib.), and the two surfaces for ligamentous attachment to the acromion are more distinct and further apart than in *Phascolomys latifrons*.

The scapula of *Phascolomys* (Plate LXXI.) maintains the form of a pretty regular quadrilateral plate nearly as far forward as the attachment of the spine extends (ib. *e, f*, figs. 1 & 4), the length of the quadrilateral being one third greater than the breadth in *Phascolomys platyrhinus* (figs. 4, 5), and nearly one half greater in *Phascolomys latifrons* (figs. 1, 2). The hind border (*a, a'*) is continued on straight, or nearly so, to the glenoid cavity; the fore border (*b, b'*) gives the length of the quadrilateral plate by its parallelism with the hind one, and is then continued on by a deep and large emargination (*c*) to the base of the coracoid (*h*); this emargination defines what may be termed the 'neck of the scapula.' The upper border or 'base' (*d*) is straight, and at right angles to *a* and *b*.

¹ Anatomy of Vertebrates, vol. ii. p. 331, fig. 213.

The spine (*e*) beginning near the angle (*b*) of the base (*d*) rapidly gains in depth or breadth as it approaches the neck (*c*), where the acromion (*f, f'*) rises clear of the body of the bone. The spine is thickest at the two ends and along its free border, which gradually gains thickness as it bends downward to form the acromion (*f'*), where thickness becomes breadth, the plane of the process being nearly at right angles with that of the spine.

The glenoid cavity (*g*, and figs. 7, 8) is an irregular oval, with the small end upon the base of the coracoid (*h*). The tubercular ridge (*i*, figs. 3, 6) for the 'triceps longus' muscle is well marked; it begins near the lower usually sharp border of the glenoid cavity; and a roughness may be traced from it along one third of the hind border (*a*). The acromion (*f, f'*) extending beyond the glenoid cavity, curves gently toward the coracoid. This element, or process (*h*), is short, thick, and inclines obliquely inward, or toward the subscapular surface or aspect (figs. 2, 5). This surface is undulate. A longitudinal channel, parallel with the origin of the spine, is bounded by longitudinal convexities, the upper one subsiding to a concavity at the antero-superior angle of the quadrilateral, the lower one to a concavity along the hind border. The short straight 'base' (*d*) or 'vertebral border' of the scapula is thicker than either of the other borders or 'costæ,' and is thickest at the angles where it joins them, and which are rounded off. The spine takes a more oblique course to the neck in *Phascolomys platyrrhinus* (fig. 4) than in *Phascolomys latifrons* (fig. 1); the body of the scapula is broader in proportion to its length, and the glenoid cavity is narrower in proportion to its length in *Phasc. platyrrhinus*. In *Phasc. latifrons* I have noted a variety in which the antero-inferior angle of the quadrilateral was more produced and the cervical emargination shorter and deeper; but usually the form of this part is nearly the same in both species. The hind angle of the base is produced backward in *Phasc. latifrons* (figs. 1 & 2, *a*); not so in *Phasc. platyrrhinus*. The subscapular surface (figs. 2, 5, *k*) near the postsuperior angle (*b*), for the attachment of part of the 'serratus magnus,' is defined by a stronger ridge in *Phascolomys latifrons* (fig. 2) than in *Phascolomys platyrrhinus* (fig. 5).

I append the following dimensions:—

| | <i>Ph. latifrons</i> ¹ . | | <i>Ph. platyrrhinus</i> ² . | |
|--|-------------------------------------|-----------------|--|--------|
| | in. | lines. | in. | lines. |
| Extreme length of the blade-bone | 5 | 0 | 6 | 0 |
| Length of hind border ('external or axillary costa') . . . | 4 | 0 | 4 | 3 |
| Length of front border ('superior costa') | 3 | 1 | 3 | 5 |
| Length of base ('vertebral costa') | 1 | 11 | 2 | 4 |
| From lower (cervical) angle of front border to end of coracoid | 1 | 11 ³ | 2 | 5 |
| Breadth of the middle of the scapula | 1 | 10 | 2 | 5 |

The head of the humerus (Pl. LXXII. figs. 1-4), especially the articular part (*a*), shows

¹ Pl. LXXI. figs. 1-3.

² From a larger individual than the subject of Pl. LXXI, figs 4-6.

³ In a second specimen it was 2 inches 2 lines.

a difference of proportion corresponding with the indication afforded by the glenoid cavity of the scapula; its antero-posterior or short diameter is greater, in comparison with its transverse or long diameter, in *Phascolomys latifrons* (ib. fig. 2, *a*), where it extends lower down and is narrower at its termination at the back of the humerus, than in *Phasc. platyrhinus* (ib. fig. 4, *a*). The entire bone is stronger, broader in proportion to its length, in *Phasc. latifrons* (ib. figs. 1 & 2).

In both species the proximal tuberosities are well developed, but they are relatively more so in *Phasc. latifrons* (figs. 1 & 2, *b*, *c*). In this species the 'ecto-tuberosity' extends its base over half the diameter of the fore part of the humerus (ib. fig. 1, *b*); in *Phasc. platyrhinus* over two fifths (ib. fig. 3, *b*).

The ento-tuberosity protrudes inward further in *Phasc. latifrons* (ib. figs. 1 & 2, *c*) than in *Phasc. platyrhinus* (ib. figs. 3 & 4, *c*).

The ridge (*d*) for the insertion of the conjoined 'teres major' and part of the 'triceps' is shorter, thicker, more prominent, and better defined in *Phasc. latifrons*; it is situated chiefly on the thenal or fore part of the shaft, near the inner surface; but more of it is visible in the anconal view in *Phasc. latifrons* (fig. 2, *d*) than in *Phasc. platyrhinus* (fig. 4, *d*).

The line of insertion (*e*, *e'*) of the large and complex 'pectoralis' extends from the lower and fore part of the ecto-tuberosity to that of the deltoid ridge (*f*), nearly along the mid line of the fore part of the humerus; but it is to the inner side of that line in *Phasc. latifrons* (fig. 1, *e*, *e'*), and to the outer side in *Phasc. platyrhinus* (fig. 3, *e*, *e'*).

The outer contour of the humerus curves almost parallel with the 'pectoral' ridge to the projecting angle of the deltoid one (*f*) in *Phasc. latifrons* (fig. 1). This angle is less prominent in *Phasc. platyrhinus* (fig. 3, *f*), and the distance between it and the 'predeltoid ridge' (*g*) is less.

The 'supinator ridge' (*h*, *h'*) is strongly developed in both species, and terminates above in a freely projecting, sometimes unciform process (*h*); below, it rapidly expands into the ectocondylar triangular surface (*h'*), giving attachment to the origin of the 'extensor digitorum' muscle. The entocondylar process (*i*) is more produced and angular, and is largest in *Phasc. latifrons* (ib. fig. 1). The bony bridge (*k*) extending from the fore part of the humeral shaft to that angle (*i*) is thicker in *Phasc. latifrons* (fig. 1) than in *Phasc. platyrhinus* (fig. 3). The foramen which it defines is large and elliptic in both species.

The radial division of the distal articular surface (*l*) is hemispheroid anteriorly (ib. fig. 1, *l*), the convexity subsiding somewhat as it is produced backward; the ulnar division (*m*) is almost flat transversely, convex from before backward; the joint in this direction is narrowest at its middle, where the ulnar passes into the radial division (Pl. LXXIV. fig. 13). Both divisions are larger, especially the ulnar one, in *Phasc. latifrons* (fig. 1, *m*) than in *Phasc. platyrhinus* (fig. 3, *m*). The shaft of the humerus is least thick between the deltoid and supinator crests; and a deep sulcus is continued from

the interval obliquely downward and inward, expanding and becoming lost upon the fore part of the broad distal end of the bone.

At the back or anconal part (ib. figs. 2, 4) the head of the humerus (*a*) is seen to descend lower and in a more angular form in *Phasc. latifrons* (fig. 2, *a*) than in *Phasc. platyrhinus* (fig. 4, *a*). The short transverse ridge for the humeral head of the triceps is most strongly marked in *Phasc. latifrons* (fig. 2, *n*). The margin of the supinator ridge is thicker, and is bent forward in the bare-nosed species (fig. 4, *h*).

The bone is reduced to transparent thinness between the coronal (*o*) and anconal (*p*) depressions; but I have not noticed a vacuity here in either of the continental species, as in one individual of the Tasmanian Wombat¹.

The figures 1-4 of Pl. LXXII. will supply other features of the bone, not noted in the text, which has been purposely restricted to the salient differential characters of the humerus in the two continental species of *Phascolomys*, most likely to be available in the determination of fossils.

The radius of *Phascolomys latifrons* (Pl. LXXII. figs. 5-8) is a strong bone, slightly bent, with the convexity forward; the head (fig. 7) is subcircular and concave for adaptation to the humeral ball (ib. fig. 1, *l*). From the outer side of the head a narrow semielliptical convex surface ('lesser sigmoid cavity' of Anthropotomy) (figs. 5 & 6, *a*) is adapted to the radial concavity of the ulna (fig. 11, *e*). A few lines below the neck of the radius projects a large tuberosity (figs. 5 & 6, *b*) for the biceps.

The shaft gradually expands as it descends, and assumes a triedral shape; a ridge (fig. 5, *c*) for the insertional fascia of the 'supinator longus' defines at the lower third of the shaft the fore from the inner surface of that part of the bone. This ridge leads to a small tuberosity (*d*) above the base of the short thick styloid process (*e*). The interosseal ridge or angle is well marked, and shows a rough tract at its middle third (fig. 6, *f*). The broad distal articular surface (fig. 8) is gently convex from before backward, concave from side to side; it is adapted to the large scapho-lunar carpal bone, and to the radial facet of the cuneiform.

The head of the radius is less circular in *Phascolomys platyrhinus* than in *Phasc. latifrons*, and the bicipital tubercle is rather nearer to it; the entire bone is less thick in proportion to its length; but the differences are not such as to call for a drawing of the bone in this species.

The ulna (Plate LXXII. figs. 9-11) in both Wombats is remarkable for the length and breadth of the olecranon (*a*, *a'*), and for the concavity (*b*) continued from its ulnar (inner) side (figs. 9, 10) downward below the proximal articulation. This presents three continuous facets—one (fig. 11, *c*) for the ulnar division (fig. 1, *m*) of the humeral articulation, one (fig. 11, *d*) for the back part of the radial division of the same (fig. 2, *l*), and the third (fig. 11, *e*) for the side of the head of the radius (fig. 5, *a*).

The thick hind border of the olecranon contracts into the sharper hind border of the

¹ "On the Osteology of the Marsupialia," *tom. cit.* p. 401.

shaft of the ulna, which is compressed, rounded, and thicker anteriorly, gradually narrowing from before backward to the distal end, which suddenly contracts to form the base of the short obtuse 'styloid process' (*g*). The ridge (fig. 11, *f*) opposing the interosseal one of the radius, begins below the radial articular cavity, and projects as it descends along the radial side of the anterior border of the ulna, developing a rough facet at its middle third, which is bound by strong ligaments to the corresponding surface (fig. 6, *f*) on the radius. On the radial side of the extension of the bone supporting the surface for the ulnar division of the humeral articulation is the mark of the insertion (fig. 11, *h*) of the 'brachialis anticus.'

The ulna of *Phascolomys latifrons* (ib. fig. 9) differs chiefly from that of *Phascolomys platyrhinus* (ib. fig. 10) in the quadrate form of the long olecranon (*a, a'*) which preserves its breadth to the truncate summit, while in *Phasc. platyrhinus* (fig. 10) it contracts to that summit (fig. 10, *a*), which is thick, obtuse, and tuberosus. The hind border of the olecranon is thicker in *Phascolomys latifrons* than in *Phascolomys platyrhinus*. The surface (fig. 11, *c*) for the ulnar division of the humeral joint is relatively longer, narrower, and more oblong in *Phasc. latifrons* than in *Phasc. platyrhinus*.

The carpus of *Phascolomys* (Pl. LXX. fig. 5) consists of a scapholunar (ib. *sl*), a cuneiform (ib. *cu*), a pisiform (*p*), a trapezium (*t*), a trapezoides (*z*), a magnum (*m*), and an unciform (*u*)¹. Of these seven carpals the first and last are the largest.

The scapholunar has the proximal articular surface (*sl*) traversed lengthwise by the obtuse ridge or angle between the anterior subconvex and posterior subconcave surfaces, both of which are adapted to corresponding surfaces of the radius; it articulates also with the cuneiform, trapezium, trapezoides, magnum, and unciform. Of the mammals in which a single carpal bone repeats the proportion, position, and connexions of two carpal bones, viz. the 'scaphoid' and 'lunar,' in man, the most numerous instances are afforded by the *Carnivora* and *Rodentia*². In the former the extent to which the unciform joins the lunar part of the scapholunar resembles that in man; in the latter (*Castor*, e. g.) the extent of such junction is much less. In *Phascolomys* the radial surface of the scapholunar is broader in proportion to its length, and less convex than in *Macropus*; it contracts more suddenly to its outer end above the part extended to offer the convexity to the trapezium. The anconal or dorsal non-articular tract is mainly reduced to a small subtriangular space between the concavity for the trapezoides and that for the magnum, the former concavity coming almost into contact with the radial convexity, yet separated by a linear tract continued from the triangular portion to the trapezium process or convexity. The chief extent of non-articular surface is at the under or thenal aspect of the bone.

The cuneiform (ib. fig. 5, *cu*) presents a concavity for the styliiform process of the ulna,

¹ The same letters are used as indicate the homologous bones in the carpus of *Phascolomys vomvatus* in fig. 15, pl. i., 'Nature of Limbs,' 8vo, 1849. Neither in that species, nor in the two larger continental kinds, have I found a distinct os lunare.

² CUVIER, 'Leçons d'Anat. Comp.' 8vo, 1835, vol. i. p. 427.

to the reception of which the pisiform (*p*) also contributes; the cuneiform supports the rest of the pisiform, and articulates with the lunar part of the scapholunar and with the unciform.

The pisiform (ib. fig. 5, *p*) is a strong, thick, subelongate bone, expanded at both ends; the proximal one offers two articular surfaces for the ulna and cuneiform, the distal end is simply convex and smooth; it might be mistaken for a proximal phalanx, to which it has a general resemblance; but the form of the two facets of the proximal surface distinguishes the pisiform.

The trapezium (*t*) presents a concavity to the scaphoid (*sl*), a convexity to the metacarpal of the pollex (*m I.*), and a concavity for the contiguous border of the base of the metacarpal of the index (*m II.*).

The trapezoides (*z*) supports the metacarpal of the index (*m II.*) on the major part of its distal surface, and applies the rest to the radial extension of the magnum (*m*); it also articulates with the trapezium and the scapholunar.

The magnum (*m*) pushes its head between the lunar part of the scapholunar (*l*) and the unciform (*u*), so as almost to touch the cuneiform, but leaves a small part of both those bones for mutual union, as in the Beaver. The expanded distal end of the magnum offers a very slight concavity to the broad base of the third metacarpal (*m III.*); it also contributes a facet to part of that of the index (*m II.*).

The unciform (*u*) touches the ulnar margin of the scapholunar (*sl*), presents a triangular convexity to the cuneiform (*cu*), mainly supports the metacarpals of the fourth and fifth digits at its distal surface, and touches, there, the outer extension of the base of the mid metacarpal.

The metacarpal of the index (*m II.*) has its base extended 'proximad,' to be wedged between the trapezium and pollex, on one side, and between the magnum (*m*) and medius metacarpal, on the other side, but is mainly applied to the trapezoides (*z*).

The outer or ulnar part of the base of the mid metacarpal (*m III.*) is similarly extended and interposed between the base of the fourth metacarpal and the magnum (*m*), so that the three chief metacarpals overlap, interlock, or wedge each other firmly into their places, adding, of course, to the strength and power of resistance of this main part of the fossorial foot. The comparatively narrow base of the metacarpal of the 'minimus' (*m v.*) is wedged between that of the fourth metacarpal and the unciform (*u*).

The numerical character of the digital phalanges adheres to the mammalian formula. The proximal ones of the three outer digits are shorter in proportion to their breadth than those of the thumb (*I.*) and index (*II.*), as are also the second phalanges (*2*). The ungual ones (*3*) are larger than the two preceding phalanges (*2, 1*) in the three outer digits *III.*, *IV.*, *v.*; they are depressed and subtruncate at the free end on each side the lever of insertion (fig. 7, *f*) of the flexor perforans tendon; they are subdepressed and subtruncate at the free end, near which the bone shows many small vascular perforations, indicative of the rich supply of material for the quickly worn digging claws.

A pair of strong sesamoids (fig. 6, *s, s*) increase the force of the flexor tendons as they pass over the proximal joints of the digits. A flexor process (*f*, figs. 6 & 7) adds to the leverage of insertion beneath the base of the ungual phalanges (*3*).

Pelvis.—The os innominatum in *Phascolomys* (Pl. LXXIII. figs. 1–6) is about one fourth the length of the entire skeleton: the leverage it affords to the limb-muscles by the extension of the ilium (*62, a*) in advance of the acetabulum (*t*), and by the extension of the ischium (*63, h, h'*) behind that centre of motion, is considerable and adds greatly to the power of those muscles.

The ilium, long, slender, subcompressed, and almost subprismatic, is twisted at right angles to the ischium, the plane of its expanded fore end (*a, b*) looking vertically, while that of the ischium (*h, h'*) looks laterally, in the standing pose of the skeleton.

The dorsum ilii (Pl. LXXIII. figs. 1 & 2, *62'*) is directed upward with a slight obliquity backward; it is divided into an upper facet (*62, d 62*) marked off from the hinder facet (*62'*), by a longitudinal rising parallel with the upper or sacral border (*b, u*). The part corresponding to the 'internal iliac fossa' of Anthropotomy is a short triangular tract (fig. 4, *62**) which is continued to the apex (*a*) of the outer production of the 'labrum.' About 2 inches of this expanded part of the ilium (figs. 1 & 2, *a, b*) is in advance of the sacral articulation (*p, u*, fig. 1, and *p*, fig. 3). The hind end of this part answers to the post-inferior spine (figs. 1 & 2, *u*) of the human ilium, and to the beginning of the 'great sacro-sciatic notch' (*m, l*, figs. 1 & 2). The dividing angle of the dorsal surface is continued to the tuberosity (*d*) answering to the 'ridge of the reflected tendon of the rectus muscle' in Anthropotomy, but which here gives attachment to the sole origin of the 'rectus femoris muscle'.

The anterior border or 'crest' of the ilium (*a, b, c*) is obtuse, thick, and rough, broadest at the produced angle (*a*) answering to the 'antero-superior spine' of Anthropotomy. The length of the 'crest' is less than half of that the entire ilium.

The mesial or sacral surface of the ilium is smooth and uniform, gently concave across, in a less degree convex lengthwise. The joint for the sacrum is limited to its hinder part, is reniform (Pl. LXXIII. fig. 5), and is divided into two flat, oval or oblong facets (*p 1, p 2*) for the pleurapophyses of the two anterior sacral vertebræ.

Below this surface the ilium contracts to a strong three-sided prism (*z*) with the angles rounded off, and then expands to form the anterior half of the acetabulum (*t*), where it coalesces with the pubis (*64*) and ischium (*63*). At this junction with the pubis is developed the ilio-pubic process (fig. 3, *e*).

The pubis is compressed, especially at its symphyseal part (*l*); the oblong ridge (*k*) for the articulation of the marsupial bone (fig. 7) terminates near the angle at which the symphysis begins.

The ischium, contributing the lower half of the acetabulum (*i*), is strong and

¹ This tuberosity is not the homologue of the 'anterior inferior spine' of the ilium (see 'Annals and Magazine of Natural History,' 1870, vol. v. p. 168.

triedral below that cavity, and then rapidly expands into a long and large subquadrate plate of bone (63'), the hinder angle of which (*h*) is thickened and produced upward with a curve bounding there the long sacro-sciatic notch, which is not divided by any 'spine of the ischium.' This, however, is indicated by a feeble ridge or production of the hind or upper border of the ischium (at *l*, figs. 3 & 4).

The bare-nosed Wombat differs from the hairy-nosed species in the greater production of the iliac angle (*a*, fig. 2), and in the narrower less robust body of the ilium (62, *z*); in the greater length, minor breadth, and less definite bipartition of the articular surface for the sacrum (compare figs. 5 & 6); in the minor development of the ilio-pubic process (fig. 4, *e*) and of the 'rectus tuberosity' (fig. 2, *d*); in the longer and more slender pubis (fig. 4, 64), in the shorter ridge (*k*) for the marsupial bone; in the larger obturator foramen (*o*), and the absence of the projection from its ischio-pubic margin (as at *v*, fig. 3); in the narrower ischium, prior to the expansion (63') of the great tuberosity (*h*, *h'*); in the minor extent of that expansion, which, in *Phascolomys platyrhinus*, is rather triangular (fig. 4) than quadrate as in *Phascolomys latifrons* (fig. 3, 63'). The twist of the innominatum is not carried so far in *Phascolomys platyrhinus* as in *Phascolomys latifrons*, whereby in the bare-nosed species part of the sacral plane (fig. 4, 62*) of the ilium is brought into view when that of the ischium (63') is in direct view; whilst the outer or lower border only (fig. 3, *t*) of the ilium meets the eye in this position of the bone in *Phascolomys latifrons*; and this border is thicker in *Ph. latifrons* than in *Ph. platyrhinus*. There are slight differences in the acetabulum: it is rather deeper in *Phascolomys platyrhinus* (fig. 4, *i*, *i'*); and the entering groove (*y*) is narrower in the bare-nosed than in the hairy-nosed Wombat (fig. 3, *y*).

Bones of the Hind Limbs.—The femur (Pl. LXXIV. figs. 1–4) is thicker in proportion to its length in *Phascolomys latifrons* than in *Phascolomys platyrhinus*. Both trochanters (*d*, *g*) are rather more prominent; but the generic characters of the bone, as *e. g.* depth of the post-trochanterian fossa (fig. 2, *e*), production of subtrochanterian ridge (*f*), longitudinal extent of trochanter minor (*g*, *g'*), flattening of the back part of the shaft (ib. *h*), community of rotular (fig. 1, *i*) and condylar (fig. 2, *k*, *l*) articular surfaces, are closely preserved in all Wombats.

In the genus *Phascolomys* the two bones of the 'cnemion' or leg, bear a closer resemblance and a nearer relative proportion to their homotypes in the forearm than in any other mammal. They were selected, on that account, to exemplify such homotypal relations in my work on the Archetype of the Vertebrate Skeleton (Pl. LXIX. figs. 15 & 16).

The head of the tibia (Pl. LXXIV. fig. 8), like that of the radius, presents a horizontal surface (*a*, *b*) for the condylar articulations of the proximal limb-bone (fig. 4, *k*, *l*), and a smaller vertical articular surface (fig. 6, *e*) for the contiguous bone; this surface for the lower division of the proximal articulation of the fibula (fig. 11, *d*, *e*) is the homotype of the surface in the radius (Pl. LXXII. figs. 5 & 6, *a*) for the 'lesser sigmoid cavity' of the ulna (ib. fig. 11, *e*).

As in the radius, the shaft of the tibia (Pl. LXXIV. figs. 5-7) is compressed (fig. 7), slightly bent (figs. 5, 6), with the concave border rather sharp; and the shaft gains thickness as it approaches the distal end.

The proximal end (fig. 8) retains the usual superior extent of articular surface in this bone of the hind limb as compared with its homotype in the fore limb. The surfaces (*a, b*) adapted to the femoral condyles are partially divided posteriorly by a shallow groove (*c*), the sides of which, especially the inner one, rise to give attachment to the 'crucial ligaments;' the chief and larger division (*a*) for the inner condyle of the femur, is more concave than usual, especially in *Phascolomys platyrrhinus*, recalling the form of the humeral articular surface of the radius. The rotular tuberosity (figs. 5, 8, *d, g*), homotypal with the bicipital one of the radius, is lower down and more remote from the proximal articular surface than usual. The fore part of the tibia continued down from this tuberosity soon contracts to a ridge, which near the middle of the shaft projects from the anterior contour and inclines slightly towards the fibula (figs. 5, 6, *h*). The inner side of the shaft (fig. 5) is broad, smooth, almost flat. The outer side (fig. 6), which includes what in most tibiæ is the hinder side, is sinuous at its proximal half and angularly convex across at its distal third (*i*). The concavity between the back parts of the proximal articular surfaces, answering to the 'popliteal notch' of Anthropotomy, expands, as it descends, into a longitudinal concavity, which merges into the inner side of the bone by the ridge-like backward projection of its inner border, and the low development and speedy suppression of its outer one (fig. 6, *l, i*). This border is continued lower and becomes more ridge-like in *Phascolomys platyrrhinus* than in *Phasc. latifrons*, marking out more definitely a hinder facet of the tibial shaft, although characteristically narrow, and giving a more concave or canaliculate character to the fore part of the outer surface of the shaft. A hinder surface of the tibial shaft can only be defined in *Phascolomys latifrons* at the thicker distal half. The general bend, concave backward, of the tibia is greater in *Phascolomys latifrons* than in *Ph. platyrrhinus*.

The modification of the distal articular surface of the tibia (fig. 9) resembles that of the radius. The facet for the proximal surface of the astragalus (*a*) is continued upon the inner malleolus (*b*) at a more marked angle than the homotypal surface is continued upon the 'styloid process' of the radius (Pl. LXXII. fig. 5, *e*); but the homotypy of the part so called in the radius with the part called 'internal malleolus' in the tibia (Pl. LXXIV. fig. 7, *k*) is unmistakable in the Wombat. This process (fig. 9, *b*) articulates with the scaphoid or naviculare of the tarsus (Pl. LXX. fig. 8, *s*), whilst the horizontal facet (fig. 9, *a*) articulates with the astragalus as its homotype in the forearm articulates with the 'lunar' part of the scapho-lunar bone.

The fibula in *Phascolomys* (Pl. LXXIV. figs. 10, 10', 11) presents the rare ulnar character of proximal expansion (*a*) and olecranal leverage (*b*); only that the terminal

summit of the lever retains its individuality and articular union with the basal part of the uprising process.

The proximal articular surface of the fibula has one facet (fig. 11, *d*) for the outer condyle of the femur, and a rather more concave surface (*e*) for the contiguous lateral facet or the proximal end of the tibia (fig. 6, *a*). The articular surface (figs. 10, 11, *a*) for the 'fabella' (ib. *b*) is subcircular and almost flat.

The proximal half of the fibula is triedral; the outer facet (fig. 10, *f*) between the homotype of the olecranon (*a*) and the antero-external ridge (*g*) is deeply concave, repeating the character of the homotypal facet of the ulna, the concavity in both being transverse. The anterior facet is slightly concave and of less longitudinal extent; the inner facet (fig. 11, *h*) is feebly convex transversely, with low longitudinal ridges and impressed marks of muscular attachments.

The distal half of the shaft beomes more cylindrical, though with indications of the three facets; and these are better marked in *Phascolomys platyrhinus* than in *Phascolomys latifrons*, although the fibula, like the tibia, is a relatively stronger bone in the hairy-nosed Wombat. The outer malleolus (*i*), answering to the styloid process of the ulna (Pl. LXXII. figs. 9-11, *g*), presents, as in this production at the inner side of its base, a strip of smooth articular surface (Pl. LXXIV. fig. 11, *k*) for the contiguous part of the parallel bone (fig. 6, *k*). But the 'process' or produced part of the distal end of the fibula is broader than its homotype, and is longitudinally grooved on its outer surface.

The tarsus of *Phascolomys* (Pl. LXX. figs. 8, 9, 10) consists of the usual seven bones—'naviculare' (*s*), 'astragalus' (*a*), 'calcaneum' (*cl*, *ct*), 'ento-' (*ci*), 'meso-' (*cm*), 'ecto-' (*ce*) cuneiforms, and 'cuboid' (*b*), together with the peculiar marsupial accessory ossicle (*o*) described (in *Dasyurus macrurus*) as "a small sesamoid bone wedged in between the astragalus, tibia, and fibula"¹.

The naviculare or scaphoid (*s*) is transversely oblong, interposed between the tibial malleolus and the astragalus above, and the three cuneiforms and cuboid below. The proximal surface is transversely concave for the ball of the astragalus (*a*, 4); posteriorly it is continuous with a narrow tract articulating with the fore and inner part of the calcaneum, and externally with the small flattened facet for the cuboid (*b*), which is continuous with the outer of the three facets for the cuneiforms.

The astragalus (Pl. LXX. fig. 8, *a*, & fig. 9) is broad, depressed, and remarkable for the continuity of all its articular surfaces. The upper or proximal mid surface (fig. 8, *a* 1), gently concave transversely, convex longitudinally, slightly broadening as it advances, is adapted to the horizontal terminal surface of the tibia; the lateral facets (ib. 2 & *d*) slope away from this surface, the inner one (*d*) to be adapted to the oblique one on the inner malleolus, the outer one (2) with a gentler slope to the more nearly horizontal facet at the distal end of the fibula. The anterior convexity (4) fits into the concavity of the scaphoid, touching also part of the cuboid; it is continuous internally by a

¹ "Osteology of the Marsupialia," *tom. cit.* p. 406.

narrow tract (fig. 9, *s*) with the tibial malleolar surface (fig. 8, *d*), and below with the surface articulating anteriorly with the cuboid and continued backward expanding (fig. 9, *a*) to rest upon and articulate with the calcaneum.

The calcaneum (Pl. LXX. fig. 8, *cl*, and fig. 10) has three articular surfaces on its expanded tarsal or articular half:—one above, feebly convex, subtriangular in shape (fig. 10, *a*), for the astragalus; one anterior, concave (*b*), for the cuboid; and a narrow slip continued therefrom to the inner side of the bone for articulation with the scaphoid. The posterior fulcral or 'sesamoid' part of the bone (ib. *ct*) is triedral, broad, and convex below, concave on the inner side (fig. 10, *c*), toward which the lever (*ct*) is slightly bent, flat and rough on the outside: this part shows an oblong tuberosity (*d*); and there is a second, smaller, hemispheroid one (*e*) close to the cuboidal articular surface.

Of the three cuneiforms the mid one (fig. 8, *cm*) is the smallest; their relations to the toes are shown in Pl. LXX. fig. 8. That with the scaphoid is analogous to, or homotypal with, the proximal relations of trapezium, trapezoides and magnum with the scapho-lunar in the carpus (Pl. LXX. fig. 5, *t, z, m*). The cuboid (fig. 8, *b*), like the unciform (fig. 5, *u*), is the largest of the distal series. It presents a convexity behind for the astragalus and calcaneum, a small surface for the outer end of the naviculare, and expands as it advances to support part of the proximal ends of the fourth and fifth metatarsals, the latter sending outward an obtuse process beyond the proximal articulation.

The 'pyramidale' (ib. fig. 8, *o*) has a slightly convex non-articular base, which is turned backward; the three sides of the cone are almost flat and articular; the under anterior one plays upon the hinder part of the upper articular surface of the astragalus, the upper one upon the hind end of the horizontal terminal articular surface of the tibia, the outer one upon the hind end of the malleolar surface of the fibula.

The metatarsals progressively increase in length and breadth from that of the hallux (i) to the fourth (iv); that of the fifth (v) is somewhat shorter, but is twice as thick as the fourth, and sends outward and backward a strong obtuse process from its outer and basal part. The hallux is reduced to one phalanx; the other toes have the usual number of phalanges, progressively increasing in thickness from the second to the outermost, but in a slighter degree in III. than in IV. and V., thus showing a slight tendency towards the condition¹ described in the 'Cyclopædia of Anatomy and Physiology,' vol. iii. (1841), Art. Marsupialia, p. 286, fig. 111.

¹ Flower, 'Osteology of the Mammalia,' 12mo, 1870, p. 321.*

DESCRIPTION OF THE PLATES.

PLATE LXIX.

- Fig. 1. Front view of atlas vertebra, *Phascolomys latifrons*.
 Fig. 2. Back view of atlas vertebra, *Phascolomys latifrons*.
 Fig. 3. Front view of atlas vertebra, *Phascolomys platyrhinus*.
 Fig. 4. Back view of atlas vertebra, *Phascolomys platyrhinus*.
 Fig. 5. Side view of second to sixth cervical vertebræ, *Phascolomys latifrons*.
 Fig. 6. Side view of seventh cervical and first three dorsal vertebræ of *Phascolomys latifrons*.
 Fig. 7. Side view of left first rib of *Phascolomys latifrons*; 7a', articular surface of 'head'; 7b', articular surface of 'tubercle,' of ditto, *Phascolomys latifrons*.
 Fig. 8. Side view of left third rib; 8b', articular surface of tubercle, *Phascolomys latifrons*.
 Fig. 9. Side view of right fifth rib; 9', front view of distal end of ditto, *Phascolomys latifrons*.
 Fig. 10. Side view of left last (free or dorsal) rib, *Phascolomys latifrons*.
 Fig. 11. Front or outer view of sternum, *Phascolomys latifrons*.
 Fig. 11a. Side view of distal end, with parts of attached rib and xiphoid sterneber, *Phascolomys latifrons*.
 Fig. 12. Under view of right clavicle, *Phascolomys latifrons*.
 Fig. 13. Under view of right clavicle, *Phascolomys platyrhinus*.

PLATE LXX.

- Fig. 1. Under or inner view of sacrum and anterior caudal vertebræ, *Phascolomys latifrons*.
 Fig. 2. Articular surface for ilium on the first two sacral vertebræ, *Phascolomys latifrons*.
 Fig. 3. Under or inner view of sacrum and anterior caudal vertebræ, *Phascolomys platyrhinus*.
 Fig. 4. Articular surface for ilium on the first two sacral vertebræ, *Phascolomys platyrhinus*.
 Fig. 5. Dorsal or anconal view of the bones of the right fore paw, *Phascolomys latifrons*.
 Fig. 6. Thenal view of phalanges and sesamoid of fourth digit, *Phascolomys latifrons*.
 Fig. 7. Side view of unguis phalanx of third digit, *Phascolomys latifrons*.
 Fig. 8. Dorsal or upper view of the bones of the right hind foot, *Phascolomys latifrons*.

Fig. 9. Under view of astragalus, *Phascolomys latifrons*.

Fig. 10. Upper view of calcaneum, *Phascolomys latifrons*.

PLATE LXXI.

Fig. 1. Dorsal or outer view of left scapula, *Phascolomys latifrons*.

Fig. 2. Inner or under view of left scapula, *Phascolomys latifrons*.

Fig. 3. Side view of left scapula, *Phascolomys latifrons*.

Fig. 4. Dorsal or outer view of left scapula, *Phascolomys platyrhinus*.

Fig. 5. Inner or under view of left scapula, *Phascolomys platyrhinus*.

Fig. 6. Side view of left scapula, *Phascolomys platyrhinus*.

Fig. 7. Glenoid cavity of left scapula, *Phascolomys latifrons*.

Fig. 8. Glenoid cavity of left scapula, *Phascolomys platyrhinus*.

PLATE LXXII.

Fig. 1. Anconal view of right humerus, *Phascolomys latifrons*.

Fig. 2. Thenal view of right humerus, *Phascolomys latifrons*.

Fig. 3. Anconal view of right humerus, *Phascolomys platyrhinus*.

Fig. 4. Thenal view of right humerus, *Phascolomys platyrhinus*.

Fig. 5. Thenal view of left radius, *Phascolomys latifrons*.

Fig. 6. Anconal view of left radius, *Phascolomys latifrons*.

Fig. 7. Proximal articular surface of left radius, *Phascolomys latifrons*.

Fig. 8. Distal articular surface of left radius, *Phascolomys latifrons*.

Fig. 9. Ulnar or outer side view of right ulna, *Phascolomys latifrons*.

Fig. 10. Ulnar or outer side view of right ulna, *Phascolomys platyrhinus*.

Fig. 11. Radial or inner side view of right ulna, *Phascolomys latifrons*.

PLATE LXXIII.

Fig. 1. Dorsal view of left 'innominatum,' *Phascolomys latifrons*.

Fig. 2. Dorsal view of left 'innominatum,' *Phascolomys platyrhinus*.

Fig. 3. Outer side view of left 'innominatum,' *Phascolomys latifrons*.

Fig. 4. Outer side view of left 'innominatum,' *Phascolomys platyrhinus*.

Fig. 5. Iliac articular surface for sacrum, *Phascolomys latifrons*.

Fig. 6. Iliac articular surface for sacrum, *Phascolomys platyrhinus*.

Fig. 7. Outer or under surface of left marsupial bone, *Phascolomys latifrons*.

PLATE LXXIV.

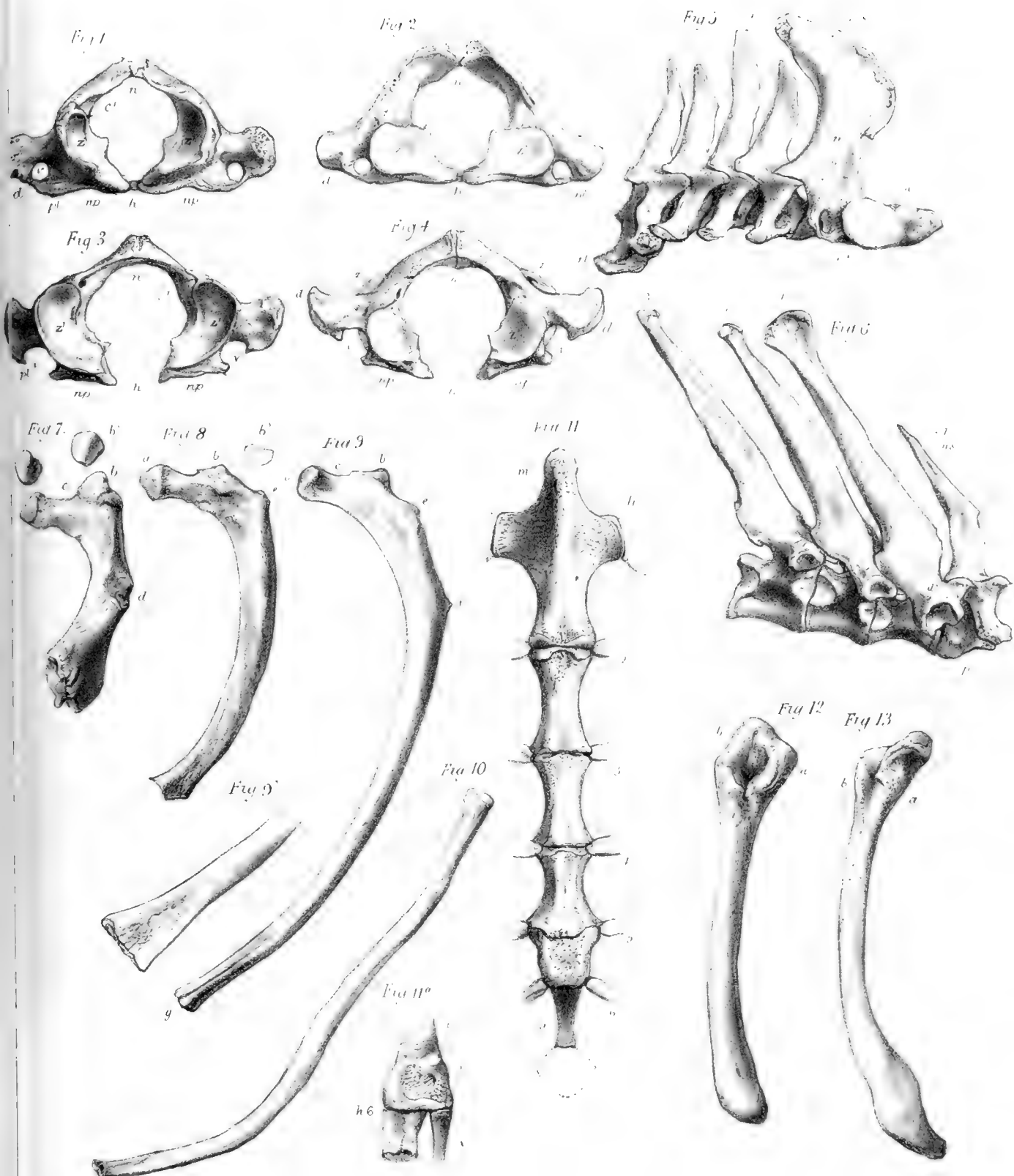
Fig. 1. Front view of left femur, *Phascolomys latifrons*.

Fig. 2. Back view of left femur, *Phascolomys latifrons*.

Fig. 3. Proximal end of left femur, *Phascolomys latifrons*.

- Fig. 4. Distal end of left femur, *Phascolomys latifrons*.
Fig. 5. Tibial or inner side view of left tibia, *Phascolomys latifrons*.
Fig. 6. Fibular or outer side view of left tibia, *Phascolomys latifrons*.
Fig. 7. Front view of left tibia, *Phascolomys latifrons*.
Fig. 8. Proximal end of left tibia, *Phascolomys latifrons*.
Fig. 9. Distal end of left tibia, *Phascolomys latifrons*.
Fig. 10. Outer side view of left fibula and fabella, *Phascolomys latifrons*.
Fig. 10'. Distal end of left fibula, *Phascolomys latifrons*.
Fig. 11. Tibial or inner side view of left fibula and fabella, *Phascolomys latifrons*.
Fig. 12. Proximal end of right humerus, *Phascolomys latifrons*.
Fig. 13. Distal end of right humerus, *Phascolomys latifrons*.

All the figures are of the natural size.

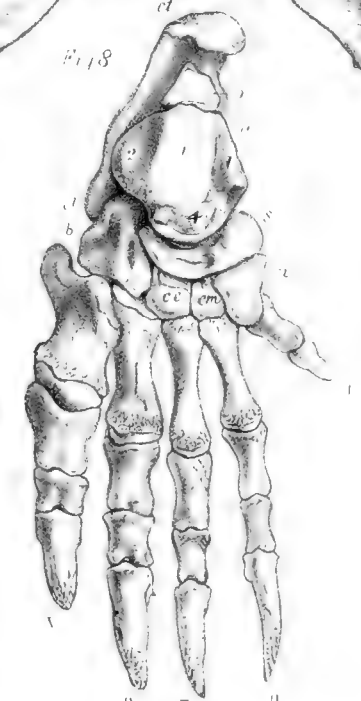
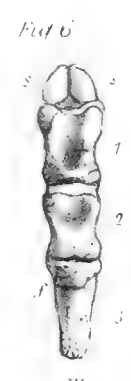
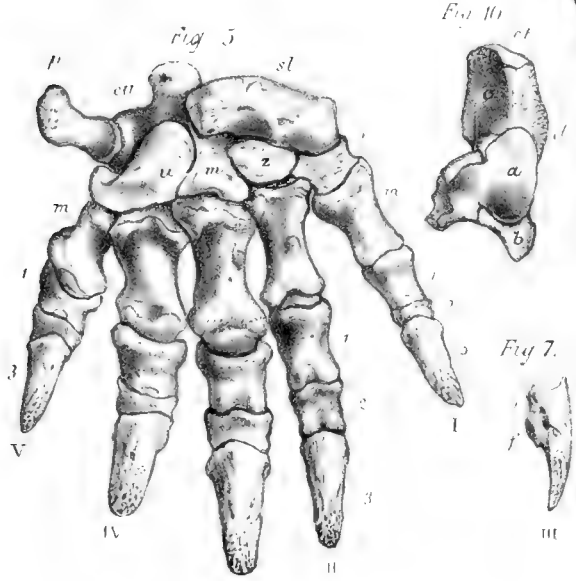
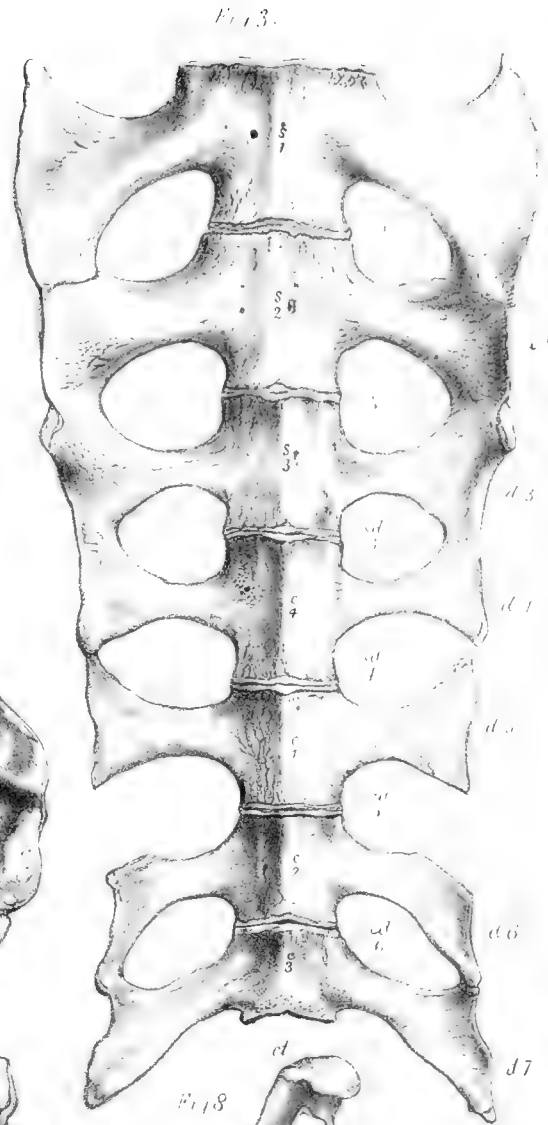
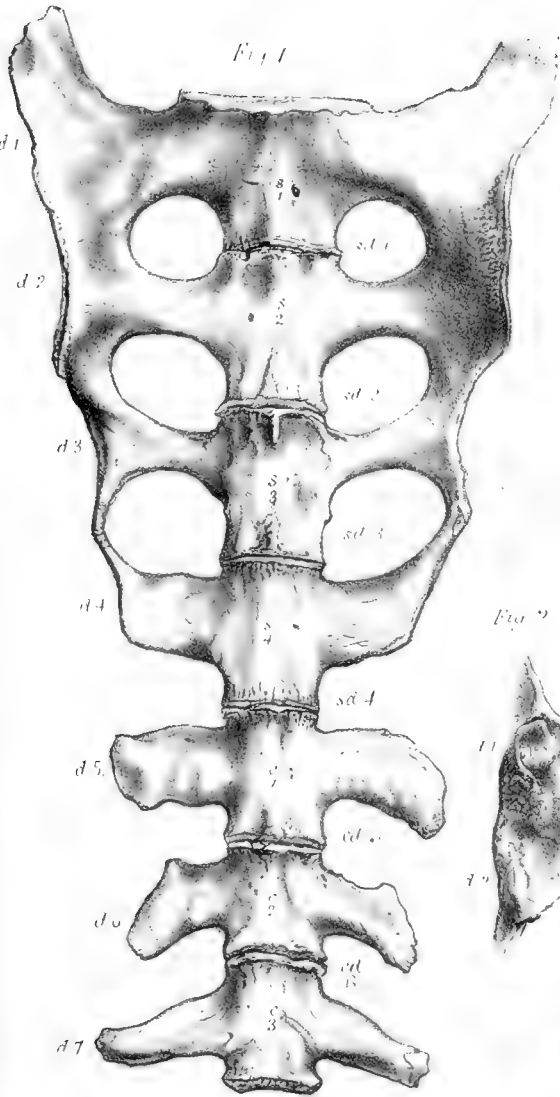


J Smit lith.

M & N Hanhaert imp.

Figs. 1. 2. 5 12 PHASCOLOMYS LATIFRONS Figs 3 4. 13 PHASCOLOMYS PLATYRHINUS.





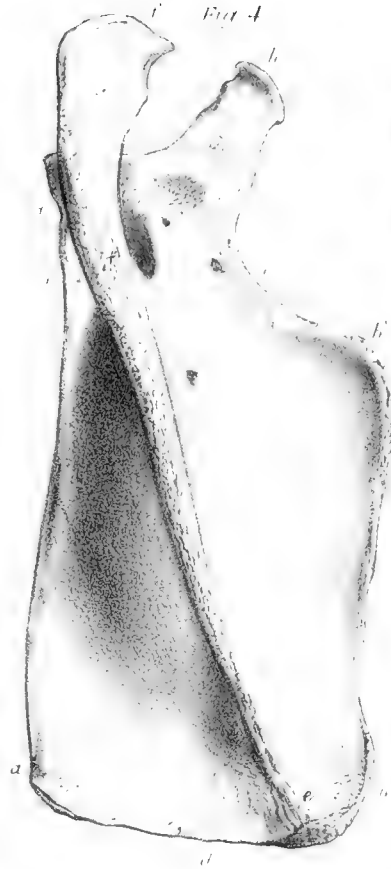
J Smit lith

M & N I anhare me

Figs 1.2.3. 10. PHASCOLOMYS LATIFRONS

Figs 3.4. PHASCOLOMYS PLATYRRHINUS



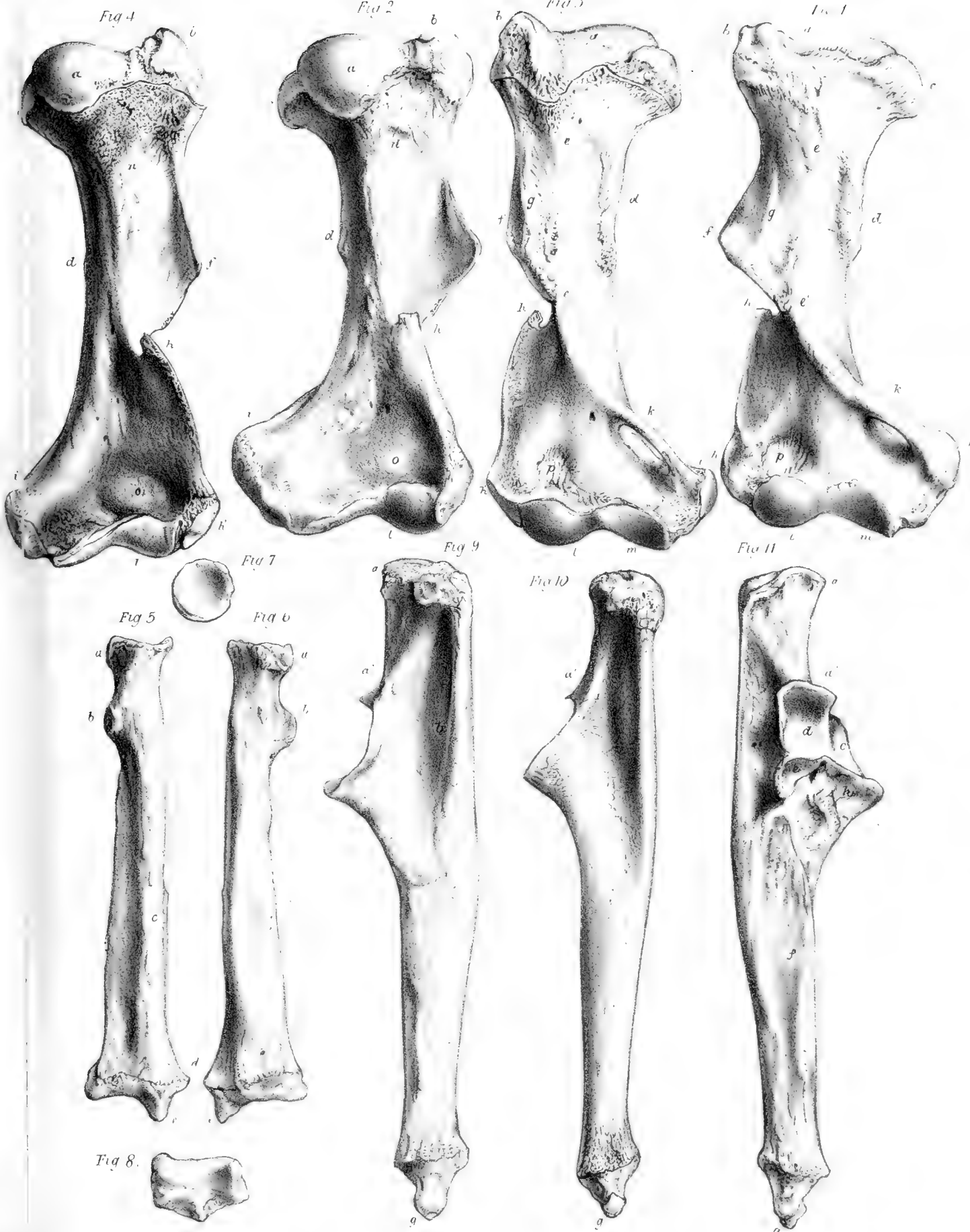


J. Smith lith.

McCoy del. et imp.



Phasc. Latifrons





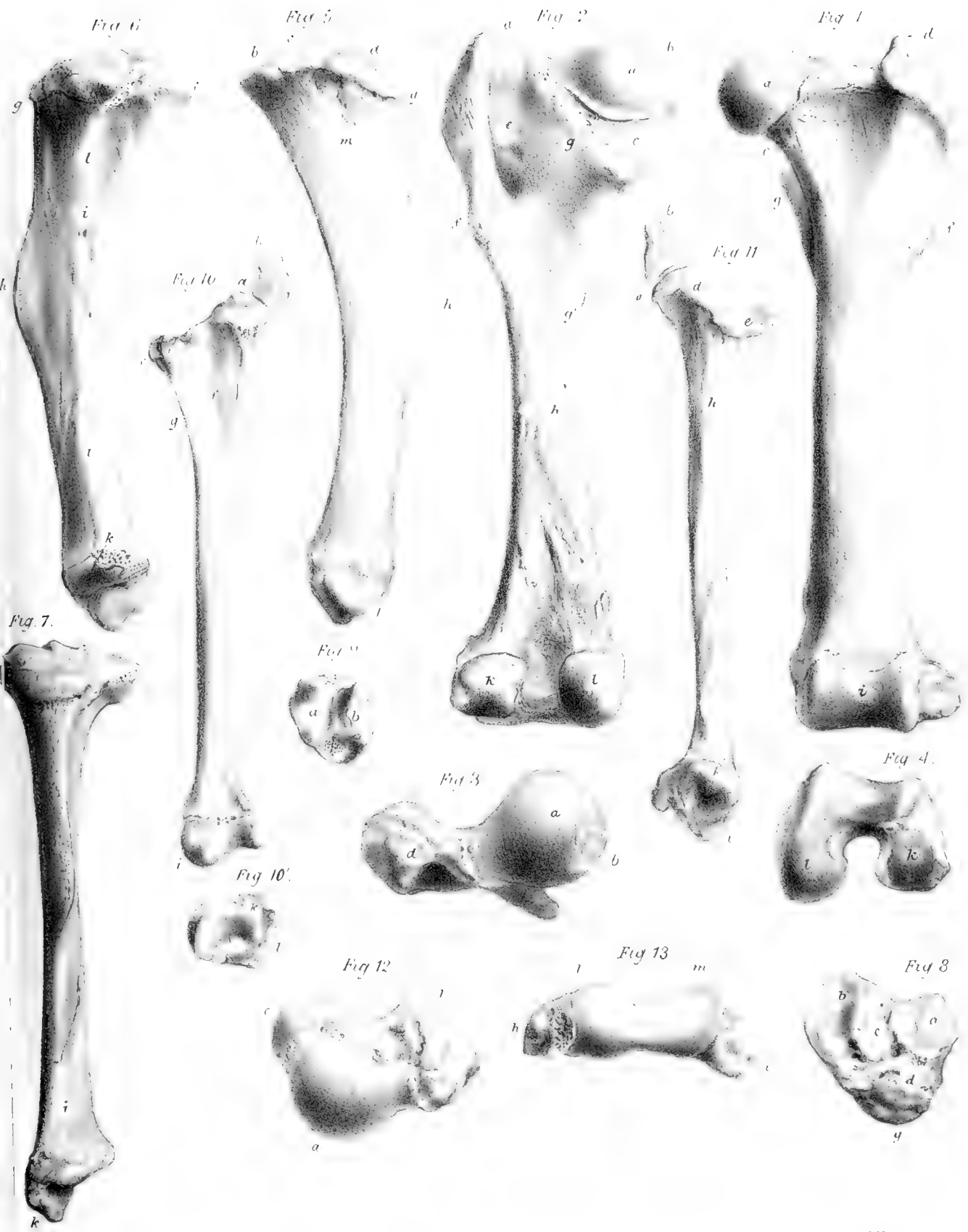


J. Smith del.

M.H. 1861. 1. 1.

Figs 1.3.5. PHASCOLOMYS LATIFRONS 2 4 6 & 7. PHASCO PLATYRHINUS.





J. Smit. lith.

M & N Hanhart sculp.



XVI. *Researches upon the Anatomy of the Pinnipedia.*—(Part III.) *Descriptive Anatomy of the Sea-lion* (*Otaria jubata*). By JAMES MURIE, M.D., F.L.S., F.G.S., &c., late Prosector to the Society.

Read December 6th, 1870.

[PLATES LXXV.—LXXXII.]

CONTENTS.

| | |
|--|---|
| I. The Skeleton and Cranial changes, p. 501. | V. Hyolaryngeal and Respiratory Organs, p. 546. |
| II. The Nervous System, p. 517. | VI. The Digestive System, p. 553. |
| III. Sensory Apparatus, p. 534. | VII. Urino-generative Organs, p. 567. |
| IV. The Vascular System, p. 535. | VIII. Description of the Plates, p. 573. |

HAVING in the first part of this Memoir treated of the exterior, of the fleshy body, and of the ligaments knitting the osseous frame of the Sea-lion, it follows that I next take the skeleton into consideration. H. M. Ducrotay de Blainville, in his magnificent 'Atlas of Osteography,' has figured the skeleton of our Otary, and that of the Walrus and the Common Seal; but neither of the two former is placed in the peculiar and distinctive attitude these animals assume on land. For this reason I have refigured that of the Sea-lion, and added separate illustrations of each of the carpal and tarsal bones—a decided want in his great work. The series of crania figured by me I shall refer to *en passant*.

I. THE SKELETON AND CRANIAL CHANGES.

1. *The Skull.*

a. *General aspects.*—Seen in profile, the skull of the Society's young or nearly adult ♂ specimen of *Otaria jubata* exhibits a remarkable flattening of the upper cranial surface; the base of the cranium from this view also appears pretty level, and is nearly parallel with the horizontal plane of the vertex. From the nasals anteriorly the skull slopes considerably; and posteriorly the occipital truncation is interrupted by the projecting condyle. In old age, as subsequently to be shown, the skull of this species does not retain the above-mentioned features; but these evidently hold good in a certain stage of growth.

Three segments or regions are readily mapped off in this side-view. The first or naso-maxillary one occupies rather less than a third of the entire length of the cranium, and includes the nasal, the intermaxillary, the maxillary bone, and the teeth as far as the fourth premolar. The anterior or inner margin of the orbit bounds this segment

behind. The second, orbito-frontal or middle region is chiefly formed by the orbit itself. It embraces, moreover, a portion of the vacuity of the temporal fossa, externally is guarded by the malar arch, is bounded above by the frontal bone and supraorbital process, and below and within is defined by the pterygo-palatine wall. Its length is almost an exact third of the long diameter of the cranium.

These two anterior segments or provisional boundaries together comprise the facial region, which here bears a proportion to the entire length of the skull as 6 is to 10. The third, hinder and largest segment, the temporo-occipital, is nearly as deep as it is long, and it thus has a marked rectangular configuration.

The upper cranial surface exhibits even more definitely the three regions just spoken of. That portion containing the brain is broad, and more particularly so at the exoccipitals. The frontals are deeply scooped out opposite the zygomatic arch; and this narrowing contrasts with the prominent postorbital processes. Each malar arch has an external flattened aspect, and only slightly veers inwards anteriorly. At the maxillary bones the skull is narrower; and quite in front these and the premaxillæ form an unevenly rounded muzzle; four bosses (see fig. 1) indicate the relative positions of the outer incisors and canine teeth.

b. *The Cranial Bones.*—Anfractuous low ridges chiefly indicate the occipital elements, which otherwise are more or less coalesced. The basiocciput inferiorly is somewhat oblong in shape, and rather longer from before backwards than across; the foramen magnum is nearly circular in figure. The condyles form, posterior to the opening, an inferior projecting and thickened semilune of bone; but the upper margin of the foramen magnum, composed of the inferior hinder border of the supraoccipital, is thin. A large exoccipital canal¹, or condyloid foramen, pierces the bone just within the articulating surface. The supraoccipital forms a well-defined arch, bounded by a broad moderately raised lambdoidal crest. The surface of the supraocciput is very uneven, being marked mesially by a sharp crest, on either side of which are deep hollows for the nuchal muscles.

The parietals are narrow, flat-topped, and short; suturally they are firmly connected with each other, and interossified with the squamous portion of the temporals. The squamous element of the temporal bone is broad and flat. The mastoidal surface is rather prominently ridged just behind the external auditory meatus, or with a moderate-sized paramastoid process; rearwards it is sunk flat, and joins a narrow, scarcely appreciable paroccipital process. The tympanic bone is fair-sized, but not inflated. It is directed obliquely inwards, backwards, and downwards, ending in a sharp margin; superficially (*i. e.* inferiorly) it is broadly grooved and indented on its inner face. A slight ridge is all that indicates a styloid process; but there is a short tooth-like cusp projecting forwards in front of the tympanic, and overlooking the carotid foramen. The glenoideum is narrow antero-posteriorly, but broad transversely, and moderately

¹ A term proposed by Mr. H. N. Turner, see P. Z. S. 1848, p. 75.

scooped; the jugal extension is a tapering rod. The jugal bone is not very stout, though at its middle high, in an upward angle. Bifurcate in front, it forms a firm union with the maxillary retrovert process.

A considerable part of the face or muzzle is taken up by the intermaxillary, so that, excepting the canine eminence, each maxillary chiefly outflanks the cheeks only. The basal segment of the maxilla rises high, is flatly convex, and of fair breadth. Behind, the canine eminence is deeply and widely grooved, where lie the thick infraorbital nerves and vessels. There is a small but distinct antorbital prominence. The maxillary orbital surface is moderate, and tolerably vertically concave forwards. The palatine region of the maxillary is of fair breadth, and terminates in a long spear-shaped palatine strip guarding the palatine plates of the palate-bones almost to the posterior nares. Each premaxilla is flattish and truncate anteriorly towards the alveolus, and rises therefrom in a narrowing outspread arch enclosing the anterior nares. The narial orifice in front is heart-shaped, $1\frac{1}{2}$ inch deep and $1\frac{1}{4}$ inch at its upper widest part. The upward strip of the premaxilla is inserted between the nasal and maxillary bone as a narrow wedge. The large turbinals are much convoluted and almost occlude the narial passages, but within the maxillary area. The vomer is in great part hidden, and has no connexion with the horizontal palatine plates.

The nasals in some respects are like the premaxillaries in being wide below and narrow above. Each is 1.8 inch long, and about half an inch at widest or below. They are suturally connected nearly their whole length, posteriorly divaricating; the forks fit into the frontal. One half of their outer margin abuts against the maxilla, the remainder in front lies upon the premaxilla.

The frontal bones are peculiar from their length, postorbital processes, and great constriction behind these. Their upper surface is smooth and flat anteriorly, and widely convexly arched behind. Their orbital surfaces are of great length, considerably scooped out, and but moderately deep, a long vacuity existing between them and the maxillo-palatines.

The palatine plates of the palate-bones, as has been noticed by many authors, are uncommonly long and broad—in this case fully $2\frac{1}{2}$ inches in antero-posterior, and above $1\frac{1}{2}$ inch in transverse diameter. Their hinder margins are transversely abrupt, and the posterior nares constricted. Laterally and exteriorly the palatine walls reach high, and present a great pterygo-sphenoidal surface.

The basisphenoid is short, but wide. The pterygoid processes stout, and with a sharp recurved hamular process. The alisphenoids are fair-sized, distinguished by a square boss where they join the postfrontals. There seems, however, to be a large orbital plate: but this is mainly composed of the postfrontal; for the orbito-sphenoidal area is very narrow and small.

c. *The Mandible*.—The two halves of the inferior maxilla have no bony ankylosis, but are united to each other by synchondrosis. This separation is not merely the result of

age; for I find such symphyseal cartilaginous union obtains, not only in the adult specimens of *Otaria jubata*, but even in undoubted old animals of the same species. Each body possesses a shallow curve, the concavity of which looks inwards; and the halves together thus form a tongue-shaped arch, ending in front in the broadish deep symphysis. Immediately beneath the well-marked incisor-fossæ and foramina, the edges of the symphysis pout forwards in a low but distinct median mental crest, some half an inch in vertical depth. Below this the rami gradually diverge from each other, inclining downwards and backwards as they each form a thickened posterior symphyseal angle.

The extreme length of the lower jaw measures 7·25 inches; the greatest diameter (which is at the condyles) is 5·3 inches.

A row of foramina as numerous as the molar teeth on the left side, and less by one on the right, occupy a line trending downwards from the alveolus, opposite the last molar, to below the middle of the bone, and anteriorly vertical between the first and second molar teeth. The most anterior of these is the largest, and may represent the mental foramen of Man; but here, in the Sea-lion, the vascular supply is great, and accordingly supplied with an increased number of nutritious channels. A narrowing and thinning of the bone distinguishes or separates the body from the ramus; this nearly median contraction has the effect of giving the side of the jaw a somewhat long and irregularly bordered figure-of-eight contour. At this narrowest part, just behind the last molar, there is a breadth or vertical depth of 1·2 inch, and a thickness of 0·4. From it the ramus commences, and very gradually widens, its thin coronoid lamina rising at an obtuse angle to the body. The angle, a flattened rhombic plate, is inflect, with a deepish emargination in front. The condyloid neck is compressed antero-posteriorly.

d. *Foramina of Lower Base*¹.—The anterior palatine are fissures of some magnitude. Marked postpalatine foramina do not obtain; but instead a linear series of minute openings reach from opposite each penultimate tooth back to the end of the maxillary splint, in apposition with the lengthened palatal arch. There is an alisphenoid canal perforating longitudinally the base of the pterygoid, and communicating with the sphenoorbitary region. A Vidian canal, admitting a fine bristle, can be traced along the inside of the pterygoid root. A fair-sized foramen ovale lies behind and outside the alisphenoid canal; and exterior to it is the postglenoid foramen. Directly posterior to the ovale, and in a somewhat irregular transverse recess, there are close together the lacerum medium, anterior opening of the carotic canal, hiatus Fallopii, and fissura Glasseri—the said recess, moreover, being surmounted posteriorly by the tubercle developed in front of the tympanic. The orifice of the meatus auditorius externus is sunk in a conical hollow between the mastoid eminence and the tympanic bulla, the large stylo-mastoid foramen being situate close to its rear. Still further back, and more towards the

¹ Compare respectively the interesting researches on this subject in the Carnivora by H. N. Turner, as cited, and Prof. Flower, P. Z. S. 1869, p. 4; also Prof. Owen's pithy descriptive remarks on specimens in the Hunterian Museum.

median line, is the very great horseshoe-shaped jugular vacuity. At its fore border, partially hidden within the bone, is the entrance of the carotid canal, which pursues a course through the tympanic, opening, as aforesaid, at the lacerum medium. A shelf of bone divides the postcarotic foramen from the deeper-placed aquæductus cochleæ. Lastly, to the rear, and a trifle within the jugular fossa, is the basal opening of the anterior condyloid foramen.

e. *Interior of the Skull.*—As regards peculiarities in the form of this cavity, allusions will be found under the description of the encephalon; here I confine my remarks to the osseous superficies and foramina. Laterally the walls of the calvarium are exceedingly thin—anteriorly, or in the frontal region, excessively thick and cancellous—occipitally equally porous but very moderate in thickness, and with capacious venous channels. The bony tentorial plate, necessarily broken on removal of the vertex, as displayed in fig. 10, is uneven, and pitted with minute and larger-sized foramina. The anfractuositities of the canopy of the skull, and the irregular cerebral-pitting depressions are most unusually well marked; and, moreover, innumerable minute and larger-sized foramina bear evidence of the great vascularity of the osseous structure. The longitudinal venous groove is very deep and well pronounced; and so are the furrows lodging the meningeal arteries &c.

The floor of the cavity (somewhat bluntly boat-shaped) possesses numerous irregularities and vacuities; but the orbito-frontal parietes are smoother and incline to the perpendicular. The olfactory fossæ are narrow, high, and deep, the cribriform plates of the ethmoid assuming the vertical, with a retroverted spinous partition. Immediately behind the latter is a single low-arched perforation for the optic nerves, each nerve escaping into the back of the orbit through the orbito-sphenoid bone, the perforation drilling the median wall (fig. 5). Along the solid mid-basilar plane, successively from before backwards, the noteworthy points are:—adjoining the optic arch a transverse cleft, through non-ossification of præspenoid suture; a full broadish processus olivarius, comparatively deficient in mid clinoid processes; a deeply excavated sella turcica, whose bayed front margin carries relatively large angular postclinoid processes; a scooped basi-sphenoid lodging the pons Varolii; to the rear of this, in the basioccipital, a great lopsided hollow (possibly a vascular recess), chiefly to the left, though shown on the right in the reversed fig. 9.

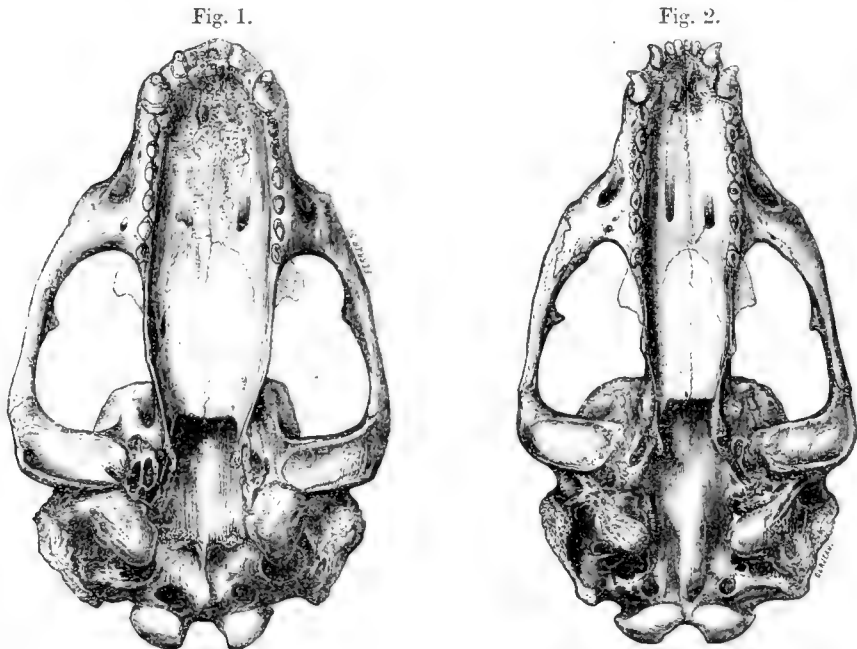
At the sides defined areas correspond to the orbito-parietal and temporal lobes of the cerebrum, whilst that which receives the cerebellum and lateral sinuses is markedly characterized by its depth, prominent nodular periotic, and large jugular orifice.

Of other fissures and visible foramina, that agreeing with the lacerum anterius extends half an inch antero-posteriorly, an outer eaved bony plate partly overriding it; a groove about another half inch leads back and outwards to a large foramen ovale, these and an inner adjoining space (in the fresh subject) being occupied by the Casserian ganglion and fifth-nerve divisions. What apparently answers to the lacerum medium (giving ingress to the internal carotid artery) and the foramen spinosum is a widish perforation and

adjoining minute accessory tiny open fork, situate behind but to the inside of the ovale, and immediately in front of the periotic. The latter nodular bone dominantly projects, a concavity of the cerebellum at the flocculus resting thereon. Anteriorly the aquæductus Fallopii is barely visible in this view; neither is the meatus auditorius internus, which looks towards the median line; and the aquæductus vestibuli similarly occupies a recess on the posterior face. Below the last is the carotid canal, behind the large jugular perforation. An anterior condyloid foramen pierces the corner betwixt basi- and exoccipitals, running nearly vertically towards the jugular groove.

For a description of the longitudinal vertical section of the aged skull, viz. that in Pl. LXXVII. fig. 22, I refer to Prof. Owen's notice in the *Cat. Coll. Surg.*, specimen No. 3971. It is sufficient for my purpose to call attention to the great occipital crest, thickness of frontal, position of ethmoid and turbinals, maxillo-palatine cleft, and osseous tentorium, as all more fully pronounced in character than what obtains in younger skulls which, nevertheless, in other general respects agree.

f. *Sexual differences.*—In a previous communication to this Society, I directed attention to certain visual distinctions extant between the male and female skulls of *Otaria jubata*, and gave figures of the same, hereunder reproduced. I was not then aware that Owen had commented on the same fact, and therefore now append his remarks in a footnote¹.



Palatal views of adult male (fig. 1) and female (fig. 2) skulls of *Otaria jubata*. To scale $\frac{1}{3}$ nat. size.

From P. Z. S. 1869, p. 103.

¹ "It differs from that of the male in its inferior size, but agrees with it in all essential or modifiable characters. The more feeble bite and smaller temporal muscles have not required the elevation of the temporal

They apply to the skull figured by me in Pl. LXXVII. figs. 16, 17, which is that numbered 3968, Cat. Coll. Surg. Besides the points here displayed in palatal views, a comparison of the crania in the accompanying Pl. LXXVII. further bears out statements concerning said differentiations¹.

g. *Progressive Cranial changes.*—Although writers previously had incidentally adverted to an alteration in the form of the skull with age in some of the Eared Seals, yet no one has so forcibly pointed this out as Dr. Gray². In one of his papers on the *Otariadæ* he justly remarks³:—“The skull of these animals changes so much in form as the animal arrives at adult and old age, that it is not always easy to determine the species by it, unless you have a series of them of different ages and states to compare.” So much do the parietal crest and other osseous prominences shoot forth in the Sea-bear or Great Sea-lion of some travellers (*Otaria jubata*), that between young and old specimens changes as great and characteristic as obtain in the cranium of the Gorilla occur in them.

In tracing the development of the skull of this species of *Otaria*, I have had the advantage of comparing side by side a large number of both sexes and various ages. I tabulated a series of proportional measurements of the relative growth of different regions, but refrain from introducing the table in this place. Instead I have illustrated, in Series Pl. LXXVII., examples of five different stages of the development, to each of which I append remarks. My figures have been drawn to a uniform scale, quarter natural size; I nevertheless subjoin, in inches and tenths, the absolute length, breadth, and height of each, for greater precision.

| Crania of <i>Otaria jubata</i> . | 1st stage. 15 to 20 days. | 2nd stage. Yearling. | 3rd stage. ♂ ad. (nearly), ♀ ad. | | 4th stage. ♂ old. | 5th stage. ♂ very old. |
|---|---------------------------------|-------------------------|--|-------|----------------------|------------------------------|
| Nos. in Cat. Coll. Surg., except sp. 3rd column | 3971 c. | 3971 b. | Z. S. sp. | 3968. | 3971 a. | 3971 e. |
| Greatest length, premaxilla to condyle | 6.5 | 8.5 | 10.6 | 11.0 | 12.8 | 14.3 |
| Greatest breadth | 3.9 | 4.6 | 6.5 | 5.8 | 7.5 | 9.4 |
| Greatest height, without mandible line cutting } mastoid } | 3.6 | 4.0 | 4.6 | 4.7 | 6.0 | 8.2 |

First stage. In the young skull of a few weeks old the brain-region is in prepon-

ridges into a parietal crest, nor any considerable development of the occipital ridge. The boundary of the large mastoid is well shown in this skull, together with the share which the paroccipital takes in this rough muscular ridge external to the petrosal. The middle surface of the basioccipital is less carinate than in the male. The entry of the carotid canal in the petrosal is more distinct from the jugular vacuity. The broad superorbital processes of the frontal are less angular. The canines and external incisors of the upper jaw are smaller in comparison with the molars. The first and second incisors have bifid crowns. The angle of the lower jaw is produced and bent inwards more than in the male.”

¹ I may also refer to a most valuable communication “On the Eared Seals,” by Mr. J. A. Allen, Bull. Mus. Comp. Zool. Camb. U. S. vol. ii. no. 1 (1870-71), wherein the author, with occasionally sweeping criticism, has most adroitly woven together many facts concerning sexual variation and changes of the skull in the North-Pacific species.

² P. Z. S. 1859, p. 360, and Cat. of Seals and Whales in B. M. ³ Ann. & Mag. Nat. Hist. 1868, i. 100.

derance. It occupies about half the total length, the other half being divided betwixt the orbital region and the face proper or maxillo-premaxillary parts. The entire skull is low, broad, and flat on the top. Superiorly, from occiput to nasals, approaches an equal-sided triangle. The breadth of the mid frontals is not only relatively but absolutely a trifle greater than in the aged animal. On the other hand, the prefrontal processes scarcely extrude. The jugals have but slight arching. The occiput is altogether full, flat, and vertical; the condyles project little. Premaxillæ comparatively short and high; speno-orbital vacuity shallow, height proportionally great to length. Palate shallow and short. Basioccipital and sphenoid parts smooth, and all other processes small. Mandible with shallow shelving symphysis; a wide ramal arch; condyle short-necked and low-set.

Second stage. In this cranium, authenticated as a yearling, there is a sensible change of cerebral to facial and prefrontal areas. Maxillæ and premaxillæ begin to lengthen. Mid frontals narrow relatively to increase of prefrontal processes. The brain-region becomes somewhat quadrangular; occiput rougher and begins to shoot backwards. Temporal groove deepens; jugal arch increases. The permanent teeth in place give more character to the mouth; lengthening and deepening of palate obvious; the hamular processes approach. Eminences of speno-occipital and other regions show indications of growth, but are not prominent. Condyles and coronoid processes of lower jaw exhibit a tendency to vertical elevation; mental portion of symphysis inclined to become tuberoso.

Third stage. Face, orbito-frontal, and brain-division now bear more equal proportion; that is, the two former have increased in a greater ratio than the latter. The mid frontals appear more scooped by reason of prefrontal development. By elongation of condyles and concomitant increase of basi- and exoccipitals, the occiput acquires a reverse obliquity to the first stage. The outline of the brain-cavity remains in abeyance, whilst temporal and occipital crests become apparent, though yet moderate. Mastoid and preoccipital eminences acquire a certain prominence. Orbito-jugal arch wider; premaxillæ decidedly elongate. Teeth, especially canines, enlarged. Palatal grooving deepened, the pterygoid processes nearing, hence postnares less open. Muscular impressions on basioccipital well scooped, basiocciput turning upwards behind. Symphysis lengthened; upward tilt of ascending ramus. In this stage sexual distinction becomes evident, although there is still considerable resemblance between them.

Fourth stage. Here the changes become very notable. The excessive growth of the canines of the male produce rounder, fuller premaxillæ. Brain-expansion is arrested. Mid-frontal width retrogrades, while prefrontal progresses. The jugal arch expands, its orbital segment deepens, its post upper angle rises; the maxillary surface of orbit gets fuller. Parieto-occipital crests and processes acquire importance; and this causes the after part of the top of the skull to be elevated and no longer smooth and broad. Moreover on each side, at the fronto-parietal suture, bony projections appear. Arching

of palate and lengthening of pterygoids go on apace. The tympanic bones descend and become laterally compressed, whilst the carotic canal assumes a more vertical direction posteriorly. Meantime the basisphenoid shelves upwards and forwards, the paramastoids roughly bulging out. Growth of the occipital crest alters the back of the skull to a kind of trefoil outline. Increment of the teeth widens the premaxillary region and anterior nares. There is an upturning of the ascending ramus and an inflection of the angle. The bones altogether become more massive and rugose.

Fifth stage. As the skull ripens to old age, particularly in the male, all the characteristic points of the fourth stage are carried out by excessive growth of processes, crests, and other superficial developments of bony lines, spicules, and nodules. The cavity of the eye looks forwards; the space behind for the temporal and masseter muscles enlarging as fleshy bulk preponderates over cerebral character.

It follows that all the aforesaid changes are an exact counterpart of what obtains in the Gorilla. In early youth the brain is functionally predominant. Then the teeth assume importance with a corresponding facial accession. Lastly, whereas brain-increment is apparently arrested, the muscles of mastication, those of the throat and neck, indeed all connected with the head, and therefore involved in the organs of offence and defence, paramountly swell in bulk and strength; nerves and blood-vessels augment proportionally. Thus from the featureless skull is evolved the rugged, immense, and terrible-looking carnivorous cranium peculiar to this and certain other genera of the Eared Seals¹.

2. *Spinal Column and Thorax.*

a. *Vertebræ*.—Restricting myself to the Society's male specimen, its vertebral elements were as follows:—7 cervical, 15 dorsal, 5 lumbar, 4 sacral, and 8 caudal; or a total of 39 pieces.

The cervicals are all large relatively, the largest of the series. The first 5 or 6 dorsal, from their greater spines and transverse processes, also seem large. The remainder of the dorsals decrease in size as regards height and breadth. The lumbar vertebræ appear of moderate size, the three hindermost being rather the stoutest. The 1st sacral is of fair size; the remainder, with the caudal, form a graduated series, none of which are large. The spinal column (46 inches long) does not seem to hinge on any particular vertebra, all being equally movable by the thick cartilaginous intervertebral disks.

The axis is the only cervical with a long spine. The first four retrovert neural spines of the dorsal are longest and subequal; there is no other prominent spine behind. All the inferior processes of the cervical vertebræ, as De Blainville² has depicted, are stout

¹ See Allen, as cited, for the genera *Eumetopias*, *Zalophus*, and *Callorhinus*. Dr. Gray, also, in several communications to the Society's Proceedings, has shown cranial alterations in some rarer forms, since the present memoir was read.

² 'Ostéographie,' plate vii. Atlas, part 2.

but short. The dorsal vertebræ present no striking difference from those of Seals generally. Gradually narrowing, the dorsals merge into the lumbar vertebræ, which are likewise larger, but not specially characterized from other Phocine genera. In computing the presence of four sacral vertebræ, I am guided partly by the nervous distribution and partly by the fact that the said number bears closest resemblance to each other of the series. Together they are distinguished by their raking neural arches and spines, subequal in length, and lying upon each other almost in an imbricated manner. The foremost has the largest body, the modified great flat-surfaced transverse processes forming a sacro-iliac synchondrosis, a facet of the second assisting. The bodies of the 2nd, 3rd, and 4th are carinate, but, nevertheless, have not the depth of the 1st. The pedicles of their transverse processes are uncommonly squat, a retral bar, however, enclosing an intertransverse foramen.

In our adult male animal under consideration, there are eight caudal vertebræ remarkably movable upon each other by the intervention of thick interarticular fibro-cartilaginous disks. The vertebræ diminish regularly from the first to the last, which is of very small size, and but incompletely ossified. The first two have each backwardly directed spinous processes. The third has two imperfectly formed thick laminar elevations, but no spine. All three of these vertebræ have well-developed transverse processes. From the fourth to the eighth caudal element there are no spinous or transverse processes, slightly raised elevation of the bone alone representing these structures.

b. *The Ribs*.—Of the fifteen pairs of ribs, the 1st, 2nd, and 3rd are the shortest, then follows the 15th. From the 4th backwards to the 9th and 10th, there is a gradual increase in length, from which they decrease as they go backwards.

The subjoined Table gives the respective costal lengths in the young and adult animals. The measurements in each are from the angle to the costal tip:—

| Ribs. | Young. | Adult (Z.S. sp.). | Ribs. | Young. | Adult (Z.S. sp.). |
|-----------|--------|-------------------|------------|--------|-------------------|
| 1st. | 1·5 | 2·7 | 9th | 6·5 | 10·0 |
| 2nd | 2·1 | 3·5 | 10th | 6·2 | 10·0 |
| 3rd | 3·2 | 5·2 | 11th | 6·2 | 9·9 |
| 4th | 4·1 | 6·8 | 12th | 6·0 | 9·4 |
| 5th | 4·7 | 7·8 | 13th | 5·7 | 8·6 |
| 6th | 5·3 | 8·9 | 14th | 5·2 | 7·7 |
| 7th | 5·9 | 9·1 | 15th | 3·9 | 6·1 |
| 8th | 6·1 | 9·5 | | | |

The first rib has a stout roundish straight body, with a very slight antero-posterior compression. The neck, set almost at a right angle to the body of the rib, is thick, and markedly grooved in front and behind. The capitulum is of moderate size; it articulates with the anterior part of the body of the first dorsal vertebra, barely impinging against the intervertebral cartilage. The prominent tubercle, and its articular

facet, together nearly $\frac{1}{2}$ an inch long, in this and the succeeding rib, shoot upwards nearly in the line of the axis of the body itself. Indeed these processes seem almost to form the true termination of the ribs, from which the neck and head proper seem but forked offsets.

The second rib diverges slightly from the pattern of the first, inasmuch as it is rather longer, thinner, and possesses a wider sweep or curvature from the angle to the neck. There is just a perceptible indication of a bending backwards or semi-twist at the angle, but not the same flattening and bulging which obtains in the succeeding ribs. The scalene tuberosity, tolerably well marked in the first rib, is diminished and well-nigh obsolete on the second.

The third, fourth, and fifth ribs are fashioned not unlike each other, and with but slight individual variation. They present different yet scarcely appreciable degrees of curvature and twist, the body altering in such a manner that what was the anterior surface in the first and second ribs becomes in them the outer flattened surface. Their sternal extremities are more compressed and elliptical in outline than the ribs in front or those immediately behind. The angles of the three ribs in question are better indicated than the others in the series, but none have it well pronounced. The fork-like head and elongated tubercle distinctive of the first two ribs undergoes a gradual change in the third, fourth, and fifth. The neck becomes vertically deeper, less constricted, and consequently appears shorter, although not in reality so. The tubercle diminishes in length, and its articular facet acquires a more backward direction. The anterior groove at the angle lessens from the third to the fifth. The enlarged capitulum of each assumes an obliquity of condition, and with a fore-and-aft articulating face abuts upon the posterior surface of the body of the vertebræ in advance and the anterior surface of its own numerical vertebra. From the sixth to the twelfth costal elements there is a very gradual progressive change in the amount of curvature, and in reduction of the tubercle. The differences between the intervening ribs will be best comprehended by comparing, say, the sixth with the twelfth, rather than attempting to describe the next to insensible modifications which the ribs seriatim undergo.

The sixth rib, then, with similitude to the fifth, is long, of moderate breadth and thickness, narrowed and slightly triangular in transverse section about its middle, but flatter and compressed from within outwards, below. It joins the sternal cartilage by a truncated somewhat bulbous end. The outer surface from the angle downwards is plain and smooth, the front and hinder edges gently rounded. The unequal arch of the body is deepest at the angle. The latter is not protuberant but definable, the more readily so as the rib at this part as well as the neck and head is compressed antero-posteriorly. The tubercle is of fair size; the neck and head large, but uniform in diameter. The most notable changes in the twelfth rib are little or no antero-posterior compression, no defined angle, the rib from one end to the other presenting a wide, low, regular arch. The head, neck, and tubercle have decreased in ratio, the division

between them being less pronounced. The rib at the angle has lost the semi-twist possessed by the sixth; but instead there is a more regular spiral, so that the outer surface has a somewhat backward inclination below. The sternal extremity is thinned. Surface within and without body biconvex, with sharp antero-posterior edges.

The 13th, 14th, and 15th ribs have little or no distinction between head, neck, and tubercle; they are elliptical in their long diameter, weak, slightly concave in arch, the free extremities tapering. They all articulate, with but a single vertebral body. The zygapophysial articulating surface is on their inner sides. Instead of a convex angle there is a shallow concavity in its place, which is very slight in the 13th, a little more so in the 14th, and distinct in the 15th.

c. *Sternum*.—De Blainville's representation of this bone ('Atlas,' i. ii. pl. vii.) calls for a few remarks on my part. These refer to the intersternal and superadded cartilaginous elements. As the above authority shows, there are eight sternal bones, the manubrium being prolonged beyond the first rib; but the attached rib-cartilages are nine in number. In these respects the Society's specimen agrees. De Blainville's more aged animal and dry skeleton, however, have misled him—first, in assigning too limited an area for the intersternal cartilages; secondly, in the abutment of the eighth and ninth sternal ribs against the seventh bone instead of behind it on the cartilage; and, thirdly, in the xiphoid cartilage being narrow and straight, instead of spatulate. These omissions, through a defective skeleton, have to some extent been already rectified from the present specimen, by my friend Mr. Parker¹. The manubrium has a flat dorsal and carinate ventral surface, the anterior broader segment terminating in a forwardly projecting blunt cartilage an inch long. The posterior segment is much narrower, stouter, and vertically deeper than the anterior portion. The second, third, fourth, fifth, and sixth meso-sternal elements range about one size, and differ from each other chiefly as regards breadth and thickness. From being round, with bulbous extremities, they gradually alter, becoming broader, thinner, and flatter. The seventh piece is unlike the sixth in having an arched instead of truncate posterior extremity, the rounded edges thus giving greater space to the intersternal cartilage, whereby, as aforesaid, the eighth and ninth sternal ribs join it.

The "metosteon" of the xiphoid precisely resembles one of the phalanges of the manus, but is thinner; the xipho-cartilage has a short narrow handle, ending in a broad rounded extremity, not quite pyriform, as Parker remarks, and certainly entirely different from De Blainville's figure.

The several bones from the præ- to the xiphosternum measure respectively 2·8, 1·6, 1·4, 1·3, 1·4, 1·5, 1·9, 2·5 inches long. In a young female of the same species which I have had an opportunity of comparing, these bones had the following long diameters

¹ A Monograph of the Structure and Development of the Shoulder-girdle and Sternum in the Vertebrata (Ray Soc. 1867), p. 216, pl. xxx. fig. 7. Witness also fig. 25, pl. lxxii. of pt. ii. of my own memoir.

=2.0, 0.9, 1.0, 0.8, 0.8, 0.95, 1.1, 1.6. Thus these bones present the same relations as regards size in the young and older animal. It is not so, however, with the cartilages, which in the young Otary are each equal to half the length of the bone, but in the adult no more than a third.

The sternal cartilages are thick, long, and flexible; but the last three are shorter than the others, and comparatively free. The first cartilage articulates with the præsternal bony facet. The second, third, and fourth are attached to the middle of the intersternal cartilages. The fifth, sixth, and seventh join the intersternal cartilages more obliquely, and are inserted chiefly into the hinder corners of the 4th, 5th, and 6th sternal bones. The eighth cartilage is fixed to the rounded postero-outer border of the seventh bone; the 9th to the middle of the cartilage.

The cavity of the thorax and abdomen enclosed by the ribs, is long, deep, and narrow, according as the ribs are expanded or otherwise, heart-shaped, =22 inches long. The ribs either stand out or are flattened. This is chiefly permitted by the looseness of the cartilaginous and ligamentous union, also length and flexibility of the sternal cartilages.

3. *Bones of the Extremities.*

a. *Pectoral Limb.*—*Scapula.* This has not the arched or semilunar shape of the Common Seal, but is a broad irregularly trapezoidal thin bone. It measures in our specimen 6.5 inches from the glenoid head (the cartilage *in situ*) across to the middle vertebral or posterior border, and it is 8 inches in diameter between the superior and inferior angles. The spine is of moderate nearly uniform height, and possesses a downward slant, overarchng very slightly the infraspinous fossa. It is carried onwards to within $\frac{1}{2}$ an inch of the glenoid cavity, whence an acromion process rather broader than the spine itself reaches almost to the articular fossa. In the recent state a ligament converts this acromial arch into a foramen. The glenoidal cavity is shallow and more oval in shape than in *Phoca vitulina*. The neck is very short, broad, and stout. Only a rudiment of the coracoid process is present. The supraspinous fossa occupies the upper three fourths of the bone¹. A slightly raised ridge proceeds from the upper third of the neck backwards and towards the superior angle, dividing the supraspinous fossa into two shallow concavities. The narrower, but deeper, infraspinous fossa has the oblique ridge and groove for the *teres major* distinctly marked. The space lodging the *infraspinatus* muscle is hollow, and not convex.

Humerus. Figured in three different views by De Blainville (*op. cit.* pl. viii.), is short, stout, and peculiar-looking from the great development and prominent nature of the deltoid eminence. The greatest length of the bone in a straight line is $6\frac{1}{2}$ inches, being $\frac{1}{4}$ of an inch less than the radius, and $1\frac{3}{4}$ inch shorter than the ulna. The

¹ *Vide* Cuvier, 'Ossemens Fossiles,' tom. v. pt. i. p. 224, and De Blainville, *op. cit.* text, tom. ii. p. 23, Atlas,' vol. ii. pls. iii. & viii.

axis of the three-faced shaft is nearly perpendicular, though at first sight it does not appear so, the deltoid projection giving it outwardly somewhat the contour of the letter S. The latter forms a thick anterior projecting and somewhat laterally compressed plate of bone extending from the root of the unusually greater tuberosity downwards, mesially, four fifths the length of the shaft. Head and neck sessile. Condylloid ridges short, but giving great lateral breadth to the lower half of shaft. Inner condyle most marked; eminentia capitata and inner trochlear eminence the reverse. The further positions of the bones of the elbow-joint, and their singular gliding movements upon each other, I discussed when treating of the ligamentous system (consult pt. ii. vol. vii. p. 581).

Ulna and Radius. Throughout the Pinnipedia the ulna is hatchet-shaped, altogether flattened, especially the olecranon (as the blade). Slight modifications distinguish the different families and genera (witness Cuvier and De Blainville's illustrations &c.). In *Otaria jubata* the outer extensor surface of shaft is gently convex in its axes, the inner flexor is concave; distal epiphysis conical. The even-surfaced greater sigmoid notch is almost vertical, with the exception of a small inferior projection (=the coronoid process) upon which the inner knuckle of the humerus plays; and on the radial side of this projection an oblique shallow concavity represents the lesser sigmoid notch. A widish inward scoop separates the humeral articulation from the top of the olecranon process, which latter, thinning, sweeps backwards, terminating in a dependent angular process. The radius has a well-defined neck, short but large and wide shallow head. From the upper third the roundish shaft widens and flattens to its massive lower extremity, $2\frac{1}{2}$ inches broad, with thickness in proportion.

Carpus, Metacarpus, and Phalanges. Of the seven carpal bones the amalgamated scapholunar is the most remarkable, on account of its great size and of its claiming the major share of the articular surface of the first row of bones. It is in opposition with all the bones of the second row, the cuneiform, and radius, in all six; but it plays against these virtually by three faces. The radial is large and convex; the face in contiguity with the os magnum and unciform is somewhat vertically scooped, a mesial ridge defining the province of each bone, whilst the cuneiform impinges against the posterior corner of the latter; lastly, the trapezio-trapezoidal is extensive, rhomboidal-outlined, concave from without inwards, and convex from above downwards. It is this peculiar disposition of the latter, in unison with a certain oblique or excentric movement of the parts, which enables the animal to use its fore flipper on land as a foot; for the proximal carpal row is then raised from the horizontal basal line, as in a great measure is the unciform. Thus the wedged-in magnum, the trapezoides, and the trapezium of the carpals form the base of support; and that also accounts for the singular radial flop with which the manus is laid down in walking. According to the amount of bend of the wrist-joint, so does the cuneiform in a lesser or greater degree come into connexion with the bones. Its postero-outer face receives the pisiform and point of the ulna in a

wide hollow; the inner glides upon the radius; a narrow corner of the anterior impinges against the scapholunar, its remainder articulating with the unciform; and an outer facet partly accommodates the fifth metacarpal as the manus is twisted outwards. The pisiform is a small bean-shaped bone, its free end directed outwards, its attached end lying upon the epiphysis of the ulna and the cuneiform of the four articular surfaces presented by the trapezium; that towards the second metacarpal is a mere corner facet. The trapezoidal is smaller than the trapezium, its palmar surface being very considerably narrowed. It just touches the third metacarpal, besides its ordinary facets for scaphoid, magnum, trapezium, and first metacarpal. The os magnum is the least-sized bone of the distal row, and, reversely from the last, has a narrow dorsal and broader palmar surface. It appears not to come into contact with the second metacarpal, and sinks in obliquely and below the scapholunar. Thus when the manus is planted on the ground the latter bone overrides it in great part. The unciform is about equal to the trapezoides in magnitude. It is surrounded by five bones, the fifth metacarpal more usually constituting its outer boundary.

The metacarpals are of most unequal dimensions, that of the pollex being of inordinate proportions. The lengths from 1st to 5th are as follows:—4·25, 3, 2·3, 2, and 1·9 inch. The first is by far the broadest, thickest, and flattest; the third thinnest and roundest. The fifth differs from the fourth in being a wider bone. The proximal ends of the outer four are enlarged and tuberoso; the width of the innermost (first) subdues its otherwise bulky character.

The phalanges, of normal number, bear a relation to the size of the metacarpals; that is, the innermost is largest and longest, the fifth digit a trifle stronger though shorter than the fourth. The proximal phalanx of the thumb is powerful, its distal one a short flat figure of eight; respectively they are 3·9 and 1·5 inch long. The lengths of the remainder of the series are:—second digit 2·7, 2·2, 1; third digit 1·9, 1·6, 1; fourth digit 1·5, 0·8, 0·3; fifth digit 1·3, 0·3, 0·2 inch. The spatulate cartilages and that extraordinary one of the pollex, which form the digital extremities, I drew attention to and figured in my former anatomical contribution.

b. *Pelvic Limb.*—*Pelvis.* The long axis of the entire pelvis is almost identical with that of the spinal column, and even in the strange attitude of walking it accords with the lumbo-caudal region¹. Ilio-pubic and ilio-ischial angles cannot be said to obtain. Each innominate bone approaches posteriorly so as to produce a long narrow V-shaped pelvis, and with such variation in the thickness of the bones that the brim is lozenge-shaped. The ischium and pubis are narrow bars uniting in a thin rounded plate the tuberosity, and enclosing a lengthened oval obturator foramen. Their acetabular ends thicken; the acetabulum itself is large but not deep. The ilium is a broader strip of bone, slightly outturned anteriorly, its sacral border inturned, and with moderate sacro-

¹ Cuvier (*l. c.* p. 226) briefly distinguishes between the pelvis of the Earless and Eared Seals, a point which Allen in his paper (*l. c.* p. 27) with justice lays great stress on as characteristic of the two groups.

iliac synchondrosis. Measurements:—Extreme pelvic length 7·3 inches, ilium 3·1, pubis 4·2, as is also ischium to mid-acetabulum; the latter 1·3 long, anterior iliac angles 3·3 apart, mid iliac breadth or depth 1·2, line cutting acetabulum 1·7, mid ischio-pubal 1·3. Diameters of brim—conjugate 4·7, transverse 1·5, oblique 3·3. Diameters of outlet—antero-posterior 1·4, transverse 0·4.

Femur and Patella. The former, at its upper end, has head and trochanteric eminence on a level simulating one another—and neither prominent, from the antero-posterior flattening and breadth of the short shaft. The intercondyloid fossa is shallow, the innermost knuckle largest, and both rather square in figure from being truncate below. Femur is 4 inches long. Patella small, rounded, and with a flat articular surface.

Tibia and Fibula. The straight rodlike fibula usually stands quite behind the tibia; its narrowed shaft is sharply triangular. Head badly defined, smaller end more expanded. The tibia has a forward bend, a somewhat laterally compressed stoutish shaft, and subequally enlarged extremities. The articular end opposed to the femur is smooth and pretty equal-surfaced; but it shelves downwards, backwards, and outwards. This posterior inclination is most serviceable, and, indeed, enables the femur to be bent on the lower limb at a very acute angle without depriving the muscles of their power of action in walking. Moreover, along with unusual freedom of the femur, it contributes to the limb being thrown back and up in a line with the tail as in the act of swimming. There is a short inner malleolus; and the adjoining astragaloid face has double facets. Extreme length of tibia 8·2, of fibula 6·5 inches.

Hind Foot. When the animal is on all fours the tarsal bones, of the normal number, offer perhaps less striking and fewer, but as singular points worthy of notice as the carpus. The entire sole (and not a segment of it) is laid on the ground plantigrade-fashion in walking. Both astragalus and calcaneum are low. Cuvier's words (*l. c.* p. 226), so applicable to *Otaria jubata*, will bear quotation. He says:—"L'astragale des phoques est très-extraordinaire, en ce qu'au lieu d'une poulie plus ou moins creuse dans son milieu il offre à la jambe une poulie convexe formée de deux faces, qui font ensemble un angle saillant comme un toit, et dont l'une répond au tibia, et l'autre, qui est plus grande, au péroné. Cet os n'a pas seulement une apophyse en avant pour le scaphoïde, mais il en a une autre en arrière terminée par une tubérosité et formant une sorte de talon interne, de manière qu'en voyant l'astragale isolé on croiroit que c'est le calcaneum." I may note more particularly of the present specimen that the horizontally ovoid fibular facet looks backwards and inwards, and there is a certain amount of the same obliquity apparent in its tibial concavo-convex facet. These dispositions concurrently adapt themselves to the peculiarities of tibia and fibula. The plantar surface of the os calcis is roughened and moderately convex; the short calcaneal process seems to have an inward tilt. It is not altogether, as Cuvier observes, that the calcaneum is placed outside the astragalus, but rather that the two bones have a

constricted X-position to one another, or together are semirotated, lying slanting inwards on their short axes. These anomalies have a most important bearing, inasmuch as mechanism for swimming and diving are concerned: and they well explain, religated with musculo-tendinous¹ accessories, how it is that the hind foot acts like a pivot on the heel when walking or running. It is in fact an adjustment of instrument for terraqueous locomotion. The awkward pedal defect colloquially known as "flat-footed" in man is a kind of first stage towards the Otary's condition, though through ligamentous rather than osseous conformation in his case. The Earless Seal's incapacity to use the hind foot on land depends more on the different proportion of femur to leg-bones, and lowered attachment of tegumentary caudal expansion, than to absolute difference in the construction of the bones forming the ankle-joint. In the Sea-lion the cuboid, naviculare, and entocuneiform are each fair-sized, the meso- and ectocuneiform small and very much laterally compressed, particularly the latter, which is indeed a diminutive bone.

With respect to the metatarsals, the hallucial is longest and strongest, the fifth a shade less, the three intermediate much slenderer and a trifle shorter. Not taking into account apical cartilages, the bones of the digits terminate somewhat subequally—the first, however, being shortest, the fifth next, and the third by a grade the longest. It results that the three middle digits have altogether the longest phalangeal bones: but the proximal phalanx of the hallux is in itself decidedly the longer and stouter bone compared with the proximal of the other digits. The second, third, and fourth ungual projections are best marked.

II. THE NERVOUS SYSTEM.

1. *Remarks on the Extraction of the Brain and Membranes.*

THE strong fibrous pericranium having been divided, the bone of the cranial vault was carefully sawn through in a nearly horizontal line, extending on each side from the upper arch of the foramen magnum forwards, close to the postfrontal prominence. At the latter part the saw was again used vertically and transversely, so as to cut the anterior points of the horseshoe-shaped horizontal incision. When the calvarium had thus been loosened in its osseous circumference, it still remained firmly fixed by the bony tentorial lamella. This latter was then broken through by manœuvring in a wriggling manner backwards and upwards, and the brain-pan removed. The great difference between the thick osseous protection afforded to the cerebral mass above, and the thin side walls, became strikingly evident on the calvarium being raised (see figs. 9 and 10). It would appear as if the powerful temporal and masseter muscles, besides being massive fleshy engines of mastication, must also, with their fatty and

¹ For corroborative testimony refer to the various paragraphs in pts. i. & ii. of these researches, on the Walrus and Sea-Lion.

cutaneous coverings, act as buffers to the delicate temporal walls, which, in some places, do not exceed a line in thickness. Thus, while the brain is provided against lateral concussions, the very utmost limit is given it as regards breadth, and this without diminishing the space necessary for the muscular apparatus, or increasing the width of the hinder portion of the head, which altogether is comparatively narrow and elongate.

On the dura mater being longitudinally divided and laterally reflected, a sketch was made of the brain *in situ*. In this way the upper convolutions, sulci, and general relation of parts previously to change of position were secured. After this the brain and a small portion of the upper part of the cord were carefully removed in the usual way, then weighed with the membranes, and preserved in spirit.

The dura mater of the base being left within the cranium, and the calvarium replaced, an accurate model of the interior was obtained by filling the cavity with plastic material. From this a mould was formed, and, lastly, a plaster of Paris cast derived therefrom. As is well known, the recent brain immediately on removal alters in shape; and still more so, as Marshall¹ has accurately noted, does the preserved encephalon change remarkably in the relations of its parts. A photograph could not conveniently be taken at the moment. The figures here given, therefore (figs. 38, 39, & 40), of the lateral, upper, and basal views, are rigorously measured outlines, by my friend and artist Mr. Berjeau and myself, of the intercranial cast, filled in their details from the shrunken brain, corrected by the sketches made of the organ in its fresh condition. If not perfect counterparts, the figures will be found close approximations to the natural aspect of each view in question. The longitudinal and horizontal sections (Pl. LXXIX. figs. 44, 45) are from the preserved hardened brain, very slightly modified by reference to a similarly divided soft intracranial model.

It is but proper for me to express my sense of obligations to recent workers on cerebral anatomy, among whom more particularly may be mentioned Leuret², Gratiolet³, Dareste⁴, Owen⁵, Huxley⁶, Flower⁷, Marshall⁸, Turner⁹, and Rolleston¹⁰.

2. *The Dura and Pia Mater.*

The most external fibrous cerebral envelope, the dura mater, is firm and of moderate thickness. Its upper surface is very irregularly indented, corresponding as it does to the greatly convoluted brain, and more particularly to the unequally hollowed and ridged bony vault. Minute vascular channels exist plentifully over the greater part of

¹ Nat. Hist. Review, 1861, p. 298.

² Anat. Comp. d. Syst. Nerv. Paris, 1839-57.

³ Mém. sur les Plis céréb. de l'Homme &c.

⁴ Ann. Sc. Nat. 4th ser. iii. 1855, p. 73.

⁵ Trans. Zool. Soc. vol. i. 1833, "Cheetah;" and his 'Anat. of Verteb.' vol. iii. &c.

⁶ Brain of *Ateles*, P. Z. S. 1861, p. 259: his Hunterian Lectures, &c.

⁷ Phil. Trans. 1852, p. 185. Trans. & Proc. Zool. Soc., various papers.

⁸ Phil. Trans. 1865, p. 501.

⁹ Proc. Roy. Soc. Edinb. 1865-66, vol. v. p. 578, &c.

¹⁰ Nat. Hist. Review, 1861, p. 201.

the superficies, especially at its hinder portion. The venous sinuses are prominent, and fit into the remarkably deep grooves already mentioned in the description of the interior of the cranium. There is a considerable thickening of the dura mater as it passes out of the foramen magnum backwards towards the spinal canal. Vascularity also distinguishes the pia mater, otherwise of an ordinary character.

3. *The Brain.*

a. *Its outward aspects and dimensions.*—The general characteristic feature of the brain of *Otaria*, looked at on its upper surface, is its comparative squareness—in this respect differing from the more common ovoid form of mammals generally, as well as from the somewhat circular contour which it assumes in *Phoca* and particularly in Cetaceans. This quadrilateral configuration is chiefly produced by the abrupt truncation of the frontal and occipital lobes respectively, their outer corners being considerably angular, or but very moderately rounded. The lateral margins are deeply indented about their middles; and the fronto-parietal portions are less prominent than the temporo-occipital ones; nevertheless they, on the whole, still lend something to the general quadrilinear aspect of the entire encephalon. Notwithstanding what has been said, each cerebral hemisphere superiorly presents a reniform outline, the deeply indented Sylvian fissure being equivalent to the hilus, and the straight-edged longitudinal fissure to the dorsum. The olfactory bulbs are large, and mesially project considerably forwards. The posterior lobes of the cerebrum are tolerably equal in dimensions: the left may be slightly longer than the right; but this was not clearly appreciable by measurement, though appearing so to the eye.

Unlike some of the so-called higher forms of Carnivora, the posterior cerebral lobes all but overlap the cerebellum laterally, as Huxley has recorded is also the case in the allied genus *Trichechus*. The actual amount of backward projection of the outer cerebellar lobes is little more than 0·1 inch. Mesially, however, the superior vermiform and superior posterior lobes of the cerebellum are more exposed, have a triangular form 1·1 inch long and 1·3 inch broad, and reach slightly further back than the external lobes.

The cerebral convolutions are numerous and well developed, giving this upper surface quite a sinuous appearance. There is a certain amount of asymmetry between the halves; but this shall be described hereafter. The brain is highest behind, or at the junction of the occipital with the parietal lobes; and from this it inclines downwards and forwards, as also more steeply outwards.

Measured from the anterior extremity of the olfactory lobe backwards in a straight line to the most projecting part of the cerebellum, the total length is 4·6 inches. The diameter across the parietal lobes is 3·2 inches. The extreme longitudinal axis of each moiety of the cerebrum is 4 inches. The greatest transverse diameter of the brain, which is about the middle of the occipital lobes, is also about 4 inches. Thus the length of

each hemisphere exactly corresponds to the breadth of both, taken at the hinder half of the brain. And although the frontal half is, as shown, somewhat narrower, yet the above measurements bring out what is the impression at first sight conveyed to the eye—namely, that the brain altogether approximates to an equal-sided figure.

The lateral aspects are as remarkable as the superior one, and more clearly demonstrate the infracerebral position of the cerebellum. In this view the entire brain possesses somewhat of an oval shape, the anterior portion of the frontal cerebral lobe narrowing rather angularly, while the rounded, bulbous olfactory surface projects beyond; and together they have considerable vertical depth. Each occipital lobe tapers backwards with a semicircular outline, the inferior border being the straighter of the two. The temporal lobe is broad, tolerably vertical, or only inclined moderately forward; in front of it a wide and deep depression exists, the Sylvian fissure with its marginal convolution. As in the upper view, the hemispherical segment behind the aforesaid depression or constriction is seen, when viewed sideways, to be decidedly convex, the most protuberant point being the upper part of the temporal lobe; but on the contrary the anterior or frontal segment is remarkably flat and perpendicular. A vacuity corresponding to the osseous elevation of the petiotic occurs behind the temporal lobe and cerebellum, partially exposing the pons Varolii.

The contour of the base of the brain agrees pretty well with its upper surface. The olfactory lobes are broadish and bulbous in front, narrower at their middles, and widen and flatten behind, as they divide in an arched manner into the short inner and longer external roots. The anterior segment, or orbital region, is flat.

The Sylvian fissures are deep; and behind them the temporal lobes form a well-marked arch, the keystone of which is the roots of the optic nerves. The optic commissure is large and long, the nerves not separating from their single investing sheath till they arrive at the foramen opticum.

The accompanying table represents a series of measurements of the Cerebrum and Cerebellum, *corrected by the intracranial cast*, with the ratios of the same. They correspond to what obtains in the (European) human brain, taking the latter as a standard of comparison in units—namely that given by Marshall, Phil. Trans. p. 554. I reserve comparisons and other remarks on the brain of the Pinnipedia for a future occasion, restricting this part of my researches to anatomical description.

Cerebrum.

(*Otaria jubata* ♂.)

| | Dimensions in inches. | Ratio. |
|---|-----------------------|--------|
| <i>a.</i> Greatest breadth (viz. at the temporo-occipital lobes) | 4·0 | 0·58 |
| <i>b.</i> Ditto length, antero-posteriorly | 3·8 | 0·80 |
| <i>c.</i> Ditto height ditto ditto | 2·9 | 0·64 |
| <i>d.</i> Length (or oblique height) of the orbital surface | 1·4 | 0·60 |

| | Dimensions in inches. | Ratio. |
|--|-----------------------|--------|
| <i>e.</i> Greatest vertical depth of the fronto-parietal lobe (<i>i.e.</i> in a line cutting the postero-parietal gyrus) | 2·4 | 0·68 |
| * Ditto diameter at the frontal lobes (the point) | 2·4 | — |
| ** Ditto diameter at the posterior ascending parietal lobes | 3·1 | — |
| <i>f.</i> Length from the front of the middle lobe to hinder end of brain | 2·5 | 0·52 |
| <i>g.</i> Cerebral radius, occipital | 2·4 | 0·73 |
| <i>h.</i> Ditto, frontal | 3·0 | 0·70 |
| <i>i.</i> Ditto, temporo-parietal | 2·6 | 0·66 |
| <i>j.</i> Ditto, vertical | 2·6 | 0·56 |
| <i>k.</i> Projection of the cerebrum <i>beyond</i> the <i>cerebellum</i> does not obtain. | | |

Cerebellum.

| | | |
|--------------------------------|-----|------|
| <i>l.</i> The greatest breadth | 3·9 | 1·08 |
| <i>m.</i> Ditto, length | 1·5 | 0·62 |
| <i>n.</i> Ditto, depth | 1·8 | 1·28 |

Measurements of several parts of the brain taken *from the preserved specimen*, with the ratios as in the preceding Table.

Medulla oblongata.

| | | |
|----------------------------|------|------|
| <i>o.</i> Greatest breadth | 0·85 | 0·12 |
|----------------------------|------|------|

Corpus callosum.

| | | |
|---------------------------------------|------|------|
| <i>p.</i> Length (in a straight line) | 1·5 | 0·48 |
| <i>q.</i> Average thickness | 0·17 | 0·39 |

Corpus striatum.

| | | |
|--------------------------------------|------|------|
| <i>r.</i> Length of the visible part | 0·65 | 0·72 |
| <i>s.</i> Width of ditto | 0·4 | 0·80 |

Optic thalamus.

| | | |
|--------------------------------------|-----|------|
| <i>t.</i> Length of the visible part | 1·1 | 0·84 |
| <i>u.</i> Width of ditto | 0·4 | 0·80 |

Pons Varolii.

| | | |
|--|------|------|
| <i>v.</i> From the upper to the lower border | 1·05 | 1·05 |
| <i>w.</i> Thickness | 0·8 | 0·50 |

b. The Cerebral Lobes.—Of the five lobes of the cerebrum which most modern anatomists recognize in the mammalian brain generally, four are tolerably well defined in *Otaria*—the fifth or central lobe being much less so, if at all distinct. The frontal lobes are short, but of moderate breadth and height; their orbital surfaces

possess considerable vertical depth, and incline obliquely downwards, with an aspect corresponding to that of the orbital plates. The parietal lobes are long from before backwards, and broad from below upwards, or are of considerable height. The Sylvian fissure gives them a sharp and deep line of demarcation behind and at their outer margin; but in front they blend with the frontal lobes. Each temporal lobe, as seen on the base of the brain, has a long-elliptical form; viewed laterally it appears shorter, but of medium thickness. The occipital lobes sweep round the truncated posterior hemispheres. Thus they have great proportional breadth, but, on the other hand, are shallow from above downwards, the cerebellum occupying much of the vertically deep occipital region.

c. Clefts and sulci of Cerebrum, outer face.—In general pattern these and the gyri offer agreement with what obtains in the Common Seal (*Phoca vitulina*) as depicted by MM. Leuret and Gratiolet¹. What may be considered distinctive between the Otariadæ and Phocidæ I shall not stop to inquire. In the nomenclature I follow as much as possible that applied to the human cerebrum, with only incidental comment on the counterpart of the smoother-brained Carnivora, *e. g.* Felidæ. My descriptions refer only to the right cerebral half of my specimen, unless where otherwise expressed. With regard to the great longitudinal fissure or intercerebral cleft, it is of moderate depth, the opposite lips approximating rather closely for the anterior half, but diverging widely behind, thus exposing the vermiform process or middle lobe of the cerebellum. On gently separating the central hemispheres the corpus callosum becomes visible; but the corpora quadrigemina are hidden by the anterior rostrum of the cerebellum (=incisura cerebelli anterior).

Orbito-frontal fissures.—The inferior surface of the frontal lobe or supraorbital region is grooved by three parallel longitudinal sulci, which trend slightly inwards anteriorly. The outermost is shortest; the innermost lodges the external root of the olfactory nerve. On the upper and outer surface of the same lobe the sulci are more irregular. The so-called crucial sulci of Carnivora² are appreciable, though relatively neither long nor deep. From each hemisphere they converge rearwards and together form a V-shaped figure, placed quite at the fore extremities of the great marginal convolutions. The presence of infero-frontal sulci is indicated by a couple of short transverse and oblique indents, situate outside and above the supraorbital angle. Curved midorbital sulci are better marked and in part continuous below and exteriorly with the antero-parietal fissure. The supraorbital are broken, somewhat radiate grooves, located in proximity and at right angles to the fore end of the great marginal gyri.

Spheno-parietal fissures.—The well-defined Sylvian fissure forms a notable landmark equally on the base and outer superficies. It ascends vertically or with only a slightly

¹ Anat. Comp. Syst. Nerv. pl. 11.

² Consult Leuret, "*Phoca*," *l. c.* p. 392; Owen, "*Cheetah*," *l. c.*; and Flower, "*Proteles*," P. Z. S. 1869, p. 480.

retrovert obliquity, the upper end nestling in a fork beneath the lobule of the supra-marginal convolution, which latter band-like gyrus forms its anterior lip. There appears, moreover, to be an additional long straight sulcus derived from the upright Sylvian cleft. It strikes backwards and upwards, at an acute angle, starting about an inch above the brain's base. The relations of this to the temporal sulci &c. I shall presently have occasion to refer to, but take this occasion of mentioning that M. Gratiolet¹, in the Green Monkey, and Prof. Turner², in the Chimpanzee, both record an occasional backward offshoot from the primary Sylvian fissure.

The latter anatomist has besides specially called attention, and given the name intra-parietal³, to a sinuous fissure of considerable length, which forms a line of demarcation betwixt the postparietal gyrus and the supra-marginal with its lobule. A sulcus corresponding to this, and bearing identical relations to the said convolutions, can readily be traced in the brain of *Otaria*. It here springs just in front of the anterior or supra-marginal lip of the Sylvian fissure, quite at the spheno-parietal base. Thence ascending laterally, it accompanies and bounds anteriorly and superiorly the much inflected supra-marginal gyrus, its lobule, and the angular gyrus towards the upper temporal projection. Both in advance and to the rear of the lobule it exhibits secondary spurred grooves; one of these with a semilunar sweep cuts into the turn of the ascending portion of the postparietal convolution. Posteriorly the intraparietal fissure ceases at a bridge connecting the angular gyrus with the postparietal lobule; but virtually it seems to go on to the supraoccipital region, in connexion with a sulcus equivalent to an external perpendicular fissure.

At its commencement below, on the lateral aspect of the spheno-parietal lobule, the fissure of Rolando holds rather an indefinite position towards the intra- and antero-parietal sulci; but about halfway up its windings are more easily followed. It first ascends perpendicularly, but in an *f*-shaped direction, to the fronto-parietal eminence. Thence, wheeling backwards, it constitutes a longitudinal midhemispherical fissure. The latter traverses the vertex to the occipital region; and what with an accessory frontal furrow in communication with an antero-parietal fissure, that of Rolando may be said to stretch the entire length of the summit in a second lengthened *f*-shaped manner, with subsidiary curt incisions.

Though the representative of the antero-parietal fissure is better distinguished at its spheno-orbital or subfrontal origin, yet as it mounts to the lateral and upper aspects of the hemisphere its actual course is only recognized by snatches. It appears, however, by linear and stellate depressions, to wind round between the fronto-parietal areas, somewhat beyond the middle and top of the hemisphere.

Temporo-occipital fissures.—On its inferior or basal aspect the temporal lobe is clearly furrowed by three main sulci. On its exterior these continue to run nearly

¹ Mém. Plis cérébraux, p. 29.

² P. R. S. Edinb. vol. v. 1866, p. 583.

³ Turner, *l. c.* p. 581; Brain of Common Seal, *l. c.* vol. ii. p. 392.

parallel and equidistant from each other, being divided by single folds. Their course is only moderately sinuous, and throughout follows the long axis of the lobe—that is, have considerable upward tilt. Besides these a fourth sulcus, not ordinarily visible below, is met with laterally behind, or close to the occipital border. These fissures undoubtedly represent the three temporal ones recognized in man and the primates. The foremost, and possibly the one behind that, may be considered equivalent to the parallel or antero-temporal. The third or second and third may be regarded as mid-temporal; and they both merge into, and become continuous with, what I have described as the long limb of the Sylvian fissure. The fourth sulcus divides the post-temporal from the inferior occipital gyrus; it sweeps well round towards the upper back part of the hemisphere. As regards other occipital sulci I did not take accurate note.

d. *Convolution of the outer face.*—Frontal.—Under these come those situated below, or the orbital series. They are simple folds lengthwise to the long axis of the brain, and three in number, viz. external, middle, and internal. The inferior frontal gyrus almost appears to be a continuation upwards of the external orbital. It chiefly forms the outer front lower angle of the hemisphere. and comprises a somewhat vertical and transverse loop-shaped fold. The midfrontal stage has similarly an upright and bent division. The suprafrontal tier lies alongside the margin of the hemispherical fissure, constituting a zigzag convolution, which appears to go back well nigh to the middle of the brain. Both mid- and suprafrontal gyri are in continuity; and each posteriorly joins the recurrent longitudinal folds of the first ascending parietal convolution. The short hammer-shaped crucial gyrus crops forwards on the inner anterior aspect of the suprafrontal convolution.

Parietal gyri.—Three in number, each possessing an ascending plication, as obvious a longitudinally directed one, and folds which have a lobular character terminating towards the posterior summit of the hemisphere. The antero-parietal begins about the speno-parietal region, where no clear line of demarcation separates it from the second ascending plication. At the outer fronto-parietal prominence separation becomes clearer, the antero-parietal passing upwards behind the midfrontal, and, as above stated, becomes involved with the latter and the suprafrontal gyri. At the suprafrontal prominence a double fold wends backwards; and this, the antero-parietal convolution in proximity to the great marginal gyrus, continues rearwards to the internal perpendicular fissure, in front of which it forms a kind of lobule indented by one or two secondary short sulci.

The postparietal convolution, as it rises from the base, is a single broad smooth fold which, on the side of the lobe behind the infero-frontal gyrus, has a forward knee-like bend. It then sweeps obliquely towards the Sylvian fissure, goes upward and parallel to this; and where the supramarginal gyrus turns, it again bends anteriorly. Here, gaining the upper surface, it wheels backwards, presenting a broad mass and subsidiary grooves above the supramarginal lobule; thence it continues to the occipital region,

and forms a curved lobule, which joins that of the antero-parietal at the internal perpendicular fissure. It, moreover, is in continuity with the extremity of the angular gyrus.

The third ascending parietal appears as a band sunk within the Sylvian fissure, and constitutes the anterior lip of the latter, or becomes what in man has been termed supramarginal. Its upper loop embraces the top of the upright Sylvian fissure, a descending wedge-shaped turn serving as a division between the latter sulcus and its long posterior branch. The continuation of the supramarginal gyrus and lobule is equivalent to the angular convolution, which bounded above by the intraparietal fissure, below by the 2nd Sylvian parallel fissure and temporal lobes, strikes obliquely upwards to the summit of the occipital region. A lobular expansion is manifest outside that of the postparietal, a narrow bridge connecting these, and another joining it to the posttemporal convolution.

Temporal and occipital gyri.—The anterotemporal is an inversely U-shaped fold. Its short upper limb sinks into the middle of the Sylvian fissure; the longer lower limb curves forwards below the lobe, and partly bounds the Sylvian cleft behind. The middle temporal gyrus is a single sinuous S-shaped fold which above abruptly ends or dips into the post-Sylvian fissure. The posttemporal convolution goes parallel to the latter as far as the post-Sylvian sulcus, meantime exhibiting greater tortuosity. Above the mid-temporal it doubles or is transformed into a lobule which stretches up to the supra-occipital region and is there connected with the occipital gyri. As above mentioned, a narrow bridge unites the posttemporal to the angular gyrus, and breaks the upward continuity of the post-Sylvian fissure.

An infraoccipital gyrus of a simple band-like character is well marked behind the posttemporal. Mid- and supraoccipital convolutions are less easily defined, or are represented by those post upper and inner strips which overhang the cerebellum and outwardly blend with the lobular terminations of the posttemporal and angular gyri.

e. Sulci and Gyri of the inner face.—The great marginal convolution extends to about opposite the middle of the corpus callosum, has but moderate depth, and is broken into several lozenge-shaped folds by short secondary sulci. The calloso-marginal fissure is interrupted thrice by upward intrusive folds; nevertheless it can be followed to nearly above the splenium. The convolution of the corpus callosum presents a lower straightish plication and upper diverticula. A posterior downward loop rounds the corpus callosum, forming a callosal lobule in proximity to the upward fold of the uncinata gyrus. A second loop above and in front of that mentioned reaches forwards and lies subjacent to a third and horizontal loop, representative of a quadrilateral lobule. This is bounded behind by a somewhat forward, shelving, internal, perpendicular fissure, which dips into a fold or ridge leading to the relatively large internal occipital lobule. The latter lobule has a rounded exterior border approaching close to the occipital edge, a marginal occipital sulcus intervening, which sulcus has communication in front with the internal perpendicular fissure. Inferiorly the internal

occipital lobule divides the rearmost gyrus, bending round a backward spur of the collateral sulcus to blend with the lower occipital and temporal convolutions. The anterior division of the lobule proceeds by an inflexion to the calcarine gyrus. The collateral sulcus is deep and somewhat X-shaped. Its two posterior furrows embrace the lower post-segment of the occipital lobule; its two anterior similarly enclasp the posteriorly directed calcarine loop, but have a more horizontal plane; and the lowermost is the longer. The calcarine sulcus is L-shaped: the lower backward limb courses between the calcarine and uncinata gyri; the upright limb is prolonged between the representatives of the uncinata, the internal occipital, and the callosal lobule. It meets the internal perpendicular fissure above, where a triradiate arrangement of the sulci obtains. What coincides with the calcarine gyrus is a prolongation of the extremity of the lower anterior limb of the occipital lobule. This fold, at first with a slight anterior bend, turns horizontally backwards, and again curves forwards in a parallel line below—that is, forms a loop becoming without division, or is continuous with the uncinata gyrus. This latter convolution widens somewhat in front, and sends up and round the cerebral crus the fold agreeing with the uncinata lobule. A well-defined dentate sulcus runs between the crus and the fore border of the dentate lobule. The upper border of the latter gyrus is in proximity to the duplicature of the callosal lobule, whilst a narrow wedge or horn slants upon the splenial knee of the corpus callosum.

f. *Folds and Furrows, left half of the Cerebrum.*—I intimated there being a certain amount of asymmetry on the two sides of the brain; and fig. 38 partially displays that want of harmony in the furrows and ridges. With regard to the outer face of the left hemisphere, the more prominent and characteristic gyri and fissures as described on the right segment also obtain, the variations depending on minor duplications and incisions. For example, the Sylvian fissure has its perpendicular and oblique posteriorly directed one; but the latter divaricates at the angular and posttemporal lobules and mounts towards the occiput, forming an island or separated fold of that between the external perpendicular fissures. Again, the mid-temporal gyrus seems to have a second division, or, rather, the anterior V-shaped knuckle of the posttemporal constitutes a descending isthmus alongside, and rivals the mid-temporal in size. The mid-frontal gyri are less sulcated; but the superofrontal has fully more indents and superficial sculpturing, rather than clearly defined induplications of gyrus. The lobule of the supramarginal convolution is fuller, the first vertical sulcus above and behind being insulated, the second deepened and, as it were, taking the place of the first. The anteroparietal gyrus has imperfect continuity with the postparietal at its commencement; but the great *longitudinal f*-shaped fissure of Rolando clearly separates them above, as on the right half. The suprafrontal has a well-marked duplicature or loop where it joins the anteroparietal at the great marginal gyrus. The anteroparietal presents behind a trifurcate arrow-headed wedge; and instead of a single continuous loop with outward turn to the internal perpendicular fissure, two longitudinal but obliquely directed folds connect it with the termination of postparietal and angular gyri.

What for convenience of description I have termed lobules of the antero-, post-parietal, angular, and posttemporal gyri on the right face thus notably differ. Moreover it becomes a moot point whether in the area in question parts of these so-called lobules are not of a verity representatives of "plis de passage" of the French, "connecting" or "annectant" gyri of English authors, as found in man and monkeys. In MM. Leuret and Gratiolet's grouping of mammals according to brain-convolutions, they give the Seal a high place, and separate it from the Carnivora by the Edentata, Marsupialia, and Ruminantia. But some of the Ursidæ lead towards the Pinnipedia in their gyral condition; so that the series from the smoother, simpler-brained Felidæ is really less interrupted than their arrangement would warrant¹.

g. Interior structures.—On removing a horizontal section, about half an inch in thickness at deepest, from the upper face of the left hemisphere, the so-called *centrum ovale minus* of Vicq d'Azyr was exposed. The white matter of the brain here presented an elongated and transversely narrowed surface, deeply indented externally by the sulci and convolutions, and somewhat less so internally by the fold bordering the interhemispherical fissure. In the preserved brain in which the section above described was made, the central substance was not pure white, but of a pale yellow hue, while the cortical grey matter had a fawn tinge, shading in some places insensibly into the yellowish centre. The darkness of the white matter, though in part due to the brain having been soaked in spirit, was not entirely so produced; for in the fresh condition I observed that the variation between the central and cortical substance was less marked than in a human subject of the Caucasian variety. The layer of grey matter had a relative depth of $\frac{2}{30}$ of an inch; and, excepting a limited area, there was little appreciable deviation between the different regions.

A second, deeper horizontal slice laid open the lateral ventricle. This cavity, compared with the size of the brain, is large, and has a very marked *f*-shape. Its total length in a straight line is 2·2 inches; but measured curvilinearly, the body of the lateral ventricle is 1·1 inch long, the anterior cornu 0·6, and the posterior cornu 0·9 inch. As regards the relative position of the extremities of the lateral ventricle to those of the hemisphere, the posterior cornu approaches within 0·7 inch of the occipital lobe, the anterior cornu 0·8 inch from the anterior end of the frontal lobe. Thus the ventricle is situated nearly equidistant between the front and back of the cerebrum.

The anterior cornu has an obtusely rounded boundary in front, and is a fossa of moderate depth. The corpus striatum is smooth-surfaced and slightly convex; it measures in the opened ventricle 0·65 inch antero-posteriorly, and 0·4 inch transversely. Proceeding from the foramen of Monro, the choroid plexus, as usual, traverses the lateral ventricle in an oblique direction, externally and behind dipping into the descend-

¹ The most admirable investigation of Prof. Gervais, "Mém. sur les Formes Céréb. propres aux Carniv. Viv. et Foss.," *Nouv. Archiv.* tom. vi. 1870, is well worthy of reference. Coming late to hand, I could not avail myself of its contents as I could have desired.

ing cornu. The *tænia semicircularis* is hidden by the choroid plexus; but when the latter is raised it appears to be well-developed though flat. That portion of the thalamus opticus which is exposed in the lateral ventricle has a very elongated and acutely pointed diamond-shape, its greatest length being 1·1 inch, and the extreme breadth 0·4 inch. Its outer posterior border is the highest part, from which the surface gently shallows inwards and forwards.

In the horizontally opened ventricle, the middle or descending cornu is hidden. But on a vertical and transverse section being made behind the thalamus, through the temporal lobe, or the same parts opened up as is shown in fig. 46, the middle cornu is observed to curve downwards perpendicularly, then forwards and inwards to the tip of the temporal lobe. This remarkably vertical descending cornu has a depth or length of 1·25 inch. The hippocampus major which forms the anterior wall is of considerable size. Its surface, at the vertical upper portion, is flattened behind, and with a narrow and compressed outer margin; but as it extends inwards and forwards it becomes altogether more equally rounded and convex. Superficially it is smooth, and devoid of a *pes hippocampi*. The *corpus fimbriatum* and the continuation of the choroid plexus, both of fair size, lie in the deep sulcus in front, and are in great part concealed by the outstanding body of the hippocampus major. The posterior cornu stretches backwards and outwards with a very regular sweeping arch, and goes well back into the occipital lobe, terminating in a shallow tapering extremity. The *eminentia collateralis* is not distinctly defined; but what appears to represent the outwardly bulging hippocampus minor has a length of 0·7 inch, and at widest is 0·3 to 0·4 broad.

In the section under consideration, I measured the cerebrum, after the manner of Mr. Flower, with a view to compare the dimensions of the anterior and posterior regions. It yielded the following results: the front or anterior median region from the point of junction of the hippocampi is equal to 2·1 inches, whilst the posterior region from the same point is 1·55 inch long. This gives a proportion of 100 to 74.

In the longitudinal, median, vertical section of the brain, the divided *corpus callosum* is observed to occupy a nearly horizontal position slightly inclining downwards in front, or with a very little tendency to a flattened arch. Relatively to the size of this median face of the hemisphere it appears to be long and tolerably uniform in depth. The rounded anterior genu possesses no special increment, as obtains in the Primates, but is rather indented behind. The splenium or posterior fold, continuous with the fornix, is likewise deficient in breadth, and turns abruptly at right angles downwards. The extreme length of the *corpus callosum* in the preserved brain is 1·5 inch, its greatest thickness 0·2 inch, and its least thickness 0·1 inch. The anterior commissure is remarkable on account of its diminutive size, having a circumference no greater than a pin's head. The pineal gland, on the other hand, is relatively large; the *corpora quadrigemina* intermediate as respects their volume.

h. *Basal Parts and Cerebellum*.—A portion of the great marginal convolution appears between the outer and inner olfactory roots. The locus perforatus is narrow; the corpora albicantia full but not unusually prominent. The pituitary body was not removed with the brain; but I noted its dimension as being moderate.

The pons Varolii has a somewhat elliptical outline, and seems not particularly elevated; but the large roots of the 5th nerves may help to mask its real prominence. Otherwise it is thick or deep, and, indeed, within a trifle as large as that in the brain of the Bushwoman so ably described by Mr. Marshall (*l. c.* p. 523). The medulla oblongata likewise is proportionally very wide, having a breadth absolutely as great as in the human brain above exemplified. Its pyramidal bodies are well-marked though low.

Among the distinguishing peculiarities of the cerebellum of *Otaria jubata* are its great breadth and depth to its length, the fact that it is well nigh overlapped by the cerebral hemispheres behind, and the presence of a deepish excavation below and exterior to the flocculus. The entire organ on its three faces, upper, lower, and posterior, presents a semilunar contour. Its lateral hemispheres from behind are abruptly truncate; its base unequal but most pronounced rearwards; its top lightly arched, shelving sharply downwards and forwards. Hidden as it were under the eave of the cerebral mass, it ordinarily does not appear massive; yet its proportional, and, in fact, actual size is very considerable. Compared with that of two races of man tabulated and treated of by the above author, it exhibits deficiency in length, surpasses in greatest depth, and is intermediate between that of the European and Bushwoman in breadth. In proportion, therefore, to magnitude of the entire brain, the Otary's cerebellum is exceptionally preponderant in volume. The superior vermiform process is long, narrow, and well-defined; portions of it and the upper posterior lobes are uncovered by the cerebrum, as heretofore mentioned. The tonsil or amygdaloid lobe bears a narrow, compressed character. The pneumogastric lobe or flocculus is circumscribed, and, although raised much higher than the last, is not remarkably prominent or free. A most singular appearance of this lower basal aspect of the cerebellum is a large oval depression or hollow, which fits upon the periotic eminence on the posterior fossa of the interior of the cranium. This causes the anterior inferior and partly middle cerebellar lobe to be sunk, while from the flocculus backwards and outwards, with sweeping semilunar turn, a steeply raised bank, including a portion of the middle and post-inferior lobes, abruptly guards the rear of the base of the cerebellum. The said horn-like ridge widens outwards, or is pyriform; and from its projecting bulbous contour both exteriorly and posteriorly the massive breadth of cerebellum accrues, in spite of the very perpendicular superficies of the hinder face. These peculiarities in shape are simply adaptations to the osseous case, and to the still more remarkable provision made for the great venous blood-channels situated in the region in question.

i. *Weight of the Brain*.—My memorandum of the weight of the fresh brain and its membranes having been mislaid, I endeavoured to make good in part the omission

when the specimen had been soaked and hardened in spirit, although I did not attempt to follow out the relations of cerebrum to cerebellum, pons, &c. The organ, minus its membranes, in its preserved condition, altogether weighed 9.45 ounces. If, as Mr. Marshall avers, the loss of weight in specimens of brains preserved in spirit averages $\frac{7}{24}$ of their original weight (*l. c.* p. 506), this loss would, moreover, require to be added. We may estimate the deficiency in this instance as somewhere about 2.75 ounces. The latter, therefore, added to the former amount, yields a total brain mass=12.20 ounces.

As recorded by me in a former section of this memoir (Pt. ii., p. 534), the weight of the entire carcass of the animal was 159 lbs. From these data, then, it follows that the ratio of the weight of the brain of the nearly adult male Sea-lion (*O. jubata*) to that of its body is as 1 to 208. Such a calculation is virtually but an approximation to the truth; still less can it be held up as a standard of relation in the species, though in other ways it may serve a useful purpose.

4. *The Nerves. Main Branches of Head and Limbs.*

a. *Cranio-facial.*—As in most of the Carnivora, the olfactory bulbs of *Otaria* are large. Seen from below, they are two elongate-pyriform, partially constricted bodies, in close apposition, and projecting more than $\frac{1}{2}$ inch beyond the frontal lobes. In the lateral aspects each bulbous part of the nerve of smell appears as deep as it is protuberant beyond the cerebral extremity; and in this view their anterior truncation, slightly horizontal upper, and more shelving lower border are evident. The two roots of the first nerve are very unequal in length—the inner, which dips into and arises from the inter-hemispherical fissure, being short, and the outer broad, long and curved.

The large optic nerves, after a course from and round the thalamus, pass to the middle of the cerebral base in an almost transverse direction, being there nearly on a level with the inwardly pointed tip of the temporal lobe, and just in front of the tuber cinereum. Mesially they decussate, and form a remarkable long broad flat commissure (1 inch or more), which does not split into the right and left nerves of the eye until within the confluent optic foramina.

The origin of the 5th or trifacial nerve is very large, and, with the Casserian ganglion, which fills the fossa on the side of the basisphenoid, truly massive. Both superior and inferior maxillary divisions are great cords. The most remarkable branches of the former are its infraorbital. These as they pass forwards from the sphenoidal region, constitute a broad and flattened bundle lying upon the palato-maxillary plinth. On emergence from the infraorbital foramen they proceed in thick funiculi chiefly to the muscular structures and roots of the vibrissae of the muzzle. In the face they are covered by the levator muscles of the nose and lips. The inferior maxillary division has both external and internal trunks. The magnitude of the inferior dental branch

as it enters the mandibular canal is noteworthy, in agreement therefore with the vascular supply to the teeth-sockets and lower lip.

The 6th and two branches of the 7th nerve are slender compared with the 5th, and the facial nerve barely as thick as the 3rd at its origin.

The three nerves which together embrace Willis's 8th, spring distinctly separate from the medulla and cord. The pneumogastric is of very considerable calibre beyond its ganglion. Several pharyngo-laryngeal branches are distributed behind the hyoid, the superior laryngeal being of good size. It pierces the constrictor muscles along with the artery at the cleft or angle between the middle and inferior layers. The main trunk of the pneumogastric, as usual, proceeds to the thoracic cavity in company with the carotid artery and jugular vein. Pulmonary, cardiac, and gastric nerves are all remarkable on account of their magnitude, those to the stomach particularly so,—easily accounted for in an animal whose powers of rapid digestion are almost incredible.

b. *In Fore Limb.*—Of the brachial plexus the external cutaneous nerve sends a subdivided branch to the middle third of the belly of the biceps. Another sent off from the same point goes beneath that muscle, and, curving round the great aponeurotic tendon of the cephalo-humeral, pierces both bellies of the brachialis anticus. A nerve apparently connected with the above goes to the inner side, and supplies the lowermost triceps muscular head, and region above the elbow.

The muscular spiral nerve is of great size; at the middle of the humerus it winds round the shaft as usual, but in a very shallow and ill-defined groove. The nervous filaments are here broadly flattened, and lie between the bellies of the second and third triceps muscles. Nervous twigs supply each of these muscles; one, longer than its neighbours, goes down to the olecranon between their fleshy fibres. As the nerve reaches the outer side of the arm, just above the condyloid ridge, it divides and supplies the supinator longus muscle on its outer surface, the extensor carpi radialis covering the nerves. Another large radial branch goes down to the under surface of the pronator radii teres muscle, thence towards the wrist on the pollicial aspect.

The ulnar nerve passes round behind the internal condyle between it and the coronoid process, over the internal lateral ligament, and under cover of the internal anconeus. Below the joint it sends muscular branches to the flexor carpi ulnaris, and twigs to the upper head of the sublimis. The ulnar nerve continues on to the ulnar side of the wrist-joint, and there divides like the ulnar artery to the 5th and 4th digits.

From the median nerve at the middle of the upper arm a twig is sent off, which partly goes to the flexor sublimis and partly to the adjoining muscles. Another lower branch supplies the pronator teres and flexor carpi radialis, piercing their bellies opposite the elbow-joint. Still lower (above the condyle) the anterior interosseus is derived. Then the main nerve, situate externally to the radial artery, continues down the middle of the forearm, sending twigs to the long flexors and ultimately (at the wrist) subdividing like the palmar artery.

c. Of Loins and Hind Limb.—Lumbar plexus. Hidden entirely by the psoas muscle and not lying upon but issuing from behind the quadratus lumborum, the lumbar nerves partly are superimposed and partly dip beneath the iliacus, but, relatively to the sacral nerves, are small.

The external cutaneous nerve sends filaments to the rectus femoris, vastus internus, and crureus, and passes down transversely over the thigh; superficial to the pectineus and adductors longus and magnus it is distributed to the fascia and skin at the middle and inner side of the shaft of the tibia.

The muscular branches of the femoral nerve in the groin are distributed to the crureus, vastus internus, and both divisions of the adductor longus and magnus. The femoral nerve accompanies the artery through the opening in the adductor magnus muscle. With regard to the obturator nerve, I include it with the sacral plexus, to which in this case it more properly belongs.

Sacral Plexus.—This (with junction to lumbo-sacral) is composed of three large trunks, which emerge from as many of the anterior sacral foramina. The first of these trunks immediately on its exit sends off a branch which joins the posterior deep nerves; the main trunk then goes backwards to opposite the next sacral foramen, where it splits into two nearly equal-sized branches: the shorter one (0·2 inch) unites with the second sacral nerve; the longer one forms the obturator nerve, which proceeds under cover of the pelvic fascia to the anterior border of the obturator internus, and pierces it. The second sacral nerve is rather thicker than the first; it unites with the third at the narrow portion of the pelvis, and there forms a thick single trunk, which passes through the great ischiatic notch. From each sacral nerve a small branch is sent inwards and backwards, which communicates through a *ganglion impar* with a twig from the sympathetic sacral nerves. The nerve is continued backwards from the ganglion, and, with the other minute caudal twigs, supplies the muscles and viscera within the pelvis.

As the sacral plexus passes round and out of the great ischiatic foramen (here considerably narrowed) it bears relation to the parts as follows:—From within outwards it lies upon the gemellus inferior, the hinder part of the quadratus femoris, the long adductors and the semimembranosus. Above or dorsally it is covered by the levator caudæ externus, the first and the second portions of the gluteus maximus, the sacro-peronæus muscle, and the broad biceps. The gluteal artery and vein, as usual, accompany the nervous plexus.

The lesser ischiatic nerve comes off at the outer border of the quadratus femoris, after traversing the great sacro-ischiatic notch with the great ischiatic nerve and vessels. It afterwards lies on the semitendinosus and on the surface of the soleus, being covered by the semimembranosus, the sacro-peronæus, and second portion of the biceps. It proceeds as far as the heel.

The external popliteal or peroneal nerve proceeds in a slanting manner outwards and

slightly backwards under the gluteus maximus secundus and upper portion of biceps to the peroneal margin of the soleus, where, dipping between it and the peroneus longus below the head of the fibula, it divides into several branches. The uppermost one, the anterior tibial, pierces the upper origin of the peroneus brevis muscle, and runs on the neck of the fibula in a shallow groove underneath the peroneus longus and the fibular origin of the extensor communis. It there subdivides, sending a twig to the knee-joint and to the extensor longus, a larger one outwards to the head of the tibialis anticus, and another to the extensor hallucis.

The musculo-cutaneous nerve, or long branch of the above, goes down the leg deeply between the peroneus longus and extensor communis digitorum to the ankle-joint, where, just above the outer malleolus, it emerges, and is ultimately distributed to the dorsum of the foot.

The internal popliteal nerve, the continuation of the largest cord, or the great ischiatic, leaves its neighbours at the middle of the fleshy belly of the quadratus femoris, and, pursuing a course backwards and downwards to the middle of the lower leg, divides into a number of branches on the inner or tibial side of the adductor magnus muscle. Thus, from the peculiar position of both the upper and lower part of the hind leg, it does not traverse the popliteal space, but becomes in a manner the posterior tibial, almost in what appears, on cursory inspection, to be the region of the groin, which here, however, is wrenched upwards, and so clothed with muscles as to be with difficulty recognizable. As the internal popliteal reaches the sacro-peronæus muscle it sends a branch subdividing peripherally on the deep surface of the gastrocnemius. Another branch similarly divides and enters the semimembranosus &c.

The posterior tibial nerve, of considerable size, passes downwards beneath the gastrocnemius and upon the surface of the long flexors to the ankle, where its component parts, diverging, form the internal and external plantar nerves. The latter goes beneath the plantaris tendon as it reaches the sole of the foot, and sends muscular twigs to the abductor ossis metacarpi quinti, the abductor and flexor brevis minimi digiti. One branch, furthermore, goes to the outer side of the fourth digit, in company with the digital branch of the external plantar artery; another branch goes between the fourth and fifth digits, splitting into an ulnar twig to the fifth, and a radial twig to the fourth digit, besides twigs to the short palmar muscles and lumbrici. The former (internal plantar) divides into two at the proximal end of the foot, the plantar artery running between. One nerve, the inner one, proceeds to near the distal end of the proximal phalanx, there splitting into two branches, one for the hallux, the other for the tibial side of the second digit. The second division of the internal plantar nerve is more medianly situated, and at the proximal extremity of the metatarsal bones divides—one branch subdividing into the ulnar and radial twigs of the second and third digits, the other branch similarly subdividing into the radial and ulnar twigs respectively of the third and fourth digits.

III. SENSORY APPARATUS.

1. *Organ of Vision. The Eye and its Appendages.*

In treating of the external characters generally, the peculiarities and appearances of the outward portions of the organ of vision have been described in Part ii. It here remains for me to take into consideration the contents of the orbit. The osseous orbital cavity, as has been shown, is deficient in its posterior bony marginal ring. This deficiency as regards the orbital contents, however, is made good by a bridge of fibrous tissue stretching between the postorbital process of the frontal bone and the fronto-orbital spur of the malar bone, the fleshy fibres of the temporal muscle, moreover, materially strengthening this otherwise weak boundary. Circumferentially the eyeball and its muscles are well cushioned with fat; but a small hemispherical separate mass surrounds the optic nerve and middle of the back of the eye. The latter portion doubtless relieves pressure on the optic nerve and vessels during contraction of the choanoid and other ocular muscles.

a. *Eyeball.*—The globe of the eye is of good size in proportion to the body of the animal. It is not perfectly spherical, but slightly wider across than from before backwards, the average diameter being about $1\frac{1}{2}$ inch. The sclerotic is altogether remarkably dense and strong, and, as in the Earless Seals, of very unequal thickness. As in them, the middle portion or zone immediately behind the iris is thinnest, namely about a line deep, while in front, between this and the cornea, it increases to fully more than 0.1 inch. Behind (Pl. LXXIX. fig. 49), the sclerotic bulges in a crescentic manner, both above and below the optic nerve. The portion above the nerve is slightly the longer and thicker of the two, being 1.08 inch thick at its middle, but only 0.1 at the level of the optic nerve¹. To the naked eye or with an inch lens, the sclerotic tunic in the preserved specimens is seen to be composed of an interlacement of fine white glistening fibro-elastic tissue, resembling that of a thick tendon. At its junction with the cornea the network-like arrangement ceases, the cornea itself appearing as a continuation of the outermost of these, but in a compact linear series. The cornea is nearly circular in outline, 1 inch in diameter, and ranging from $\frac{1}{30}$ to $\frac{1}{20}$ of an inch in thickness, the centre being the thinnest portion. It is only moderately convex.

The choroidal portion of the middle tunic is a thin uniform layer, very vascular, and with an abundance of dark pigment, overlain internally by a large iridescent tapetum. As Leydig has observed in Carnivora, the tapetum is composed of irregularly shaped cells and granular matter.

In the live animal the pupil is subject to great variations of size and shape (as illustrated by the previous diagrams); but in the dissected eye it is found to be pyriform, the narrow end below. The so-called sphincter of the pupil is very distinct

¹ See Dr. Lightbody's remarks on these structures in *Mammalia*, *Journal of Anat.* Cambridge, 1867, i. p. 15.

posteriorly, and about $\frac{1}{20}$ of an inch wide. The fibres are not perfectly circular, but are seen to be derived from the radii of the dilator, and as they approach the pupil to interlace and proceed to the edge obliquely. The ciliary muscle is well developed. The venous meshwork constituting the canal of Schlem has considerable volume. The ciliary processes of the iris are between 90 and 100 in number. The crystalline lens, half an inch in diameter, is nearly spherical or with a very limited antero-posterior flattening. The capsule and suspensory ligament are both strong and well developed. The optic nerve pierces the eyeball 0·2 inch below its centre.

b. *Orbital Muscles*.—Of these a retractor, or what may represent the levator palpebræ and tensor tarsi, is a broadish thin sheet in intimate union with the superior rectus; it separates at the fore part of the eyeball, passes over the superior oblique, and then is lost among the circular fibres of the orbicularis palpebrarum. A few of its fasciculi join with the superior oblique and internal rectus. Four recti are present; and, as usual, the obliqui are two in number. The superior one of these is of moderate size, wanting in tendon and pulley, and fleshy almost to its ocular termination. It runs obliquely, as a broad band enclosed anteriorly between the rectus superior and palpebral retractor; it then turns downwards, outwards, and forwards, to be inserted into the middle of the eyeball. At the latter attachment it is overridden by the internal rectus, while it covers a slip of the choanoid muscle. The inferior oblique is thin and narrow, it is fixed into the globes of the eye, $\frac{1}{4}$ of an inch below the superior oblique. The choanoid or retractor oculi muscle is split into four unequal-sized segments. The internal inferior one of these is the most delicate and separated slip. Its insertion is below the inferior oblique muscle, just behind it and the lobes of the Harderian gland. The upper inner slip is slightly thicker than the former; it passes to the back of the globe, and behind the insertion of the superior oblique muscle. The two outer portions are much broader muscular sheets, and together in close approximation cover the globe for a third of its posterior circumference.

IV. THE VASCULAR SYSTEM.

1. *Cardiac Receptacle*.

When the muscular organ of the heart is fully distended, or, say, filled with plaster of Paris, it appears to be of great proportional bulk to the body; more especially both auricles and the right ventricular cavity seem unusually large and protuberant. In the flaccid condition it is only of moderate dimensions, namely $6\frac{1}{2}$ inches in longitudinal, and 5 inches in transverse diameter. The left ventricle measures 5 inches from its root to the apex. The form of the heart as a whole is flat, broad, and obtusely pointed, the apex, indeed, presenting a tendency to bifurcation. The median longitudinal and auricular furrows are shallow. The strong fibrous pericardial investment is attached to the aorta, 2 inches above its root on the right side, but considerably lower on the left.

The right auricle is thin-walled and capacious, the large triangular appendix protruding well forward. There is no internal valve at the opening of the inferior vena cava; but the aperture, nevertheless, may be influenced or diminished in circumference by what appears to be an oblique or spiral band of supernumerary fibres, situate near the orifice in question. The tuberculum Loweri is an unusually thick and deep free crescentic fold, such as must divert the current of the blood returned by the inferior cava. The fossa annulus ovalis is deep, but perfectly closed. The margins of the wide-mouthed coronary vein are thickened by an addition of fibro-elastic tissue; the approximation of which no doubt partially if not entirely closes the opening during contraction of the auricle. Delicate but numerous muscoli pectinati are confined to the auricular appendix; otherwise the internal walls are smooth. The auriculo-ventricular opening has a diameter of $1\frac{1}{2}$ inch. The right anterior segment of the tricuspid valve is by far the largest of the three. Its thick flat columnæ carneæ spring chiefly from the apical portion of both walls of the cavity; and there is moreover a strong broad intertwined transverse band, reaching from the median to the anterior wall at their middles. The pulmonary veins, above eight in number, unite so as to pour the blood by four channels into the left auricle. This cavity is smaller-sized than the right; and the only peculiarity possessed is a small semilunar valvular fold overarching the closed foramen ovale. The lower thickened border of the obliterated foramen also exhibits traces of a similar fold. From these it may be inferred that during the fœtal condition the sanguineous current would be directed downwards into the auricle or even at times checked in its flow. The mitral and semilunar valves present nothing remarkable.

2. Arterial Distribution.

a. Aorta and branches to Neck and Head.

Immediately above its commencement from the left ventricle, and having given off the coronary arteries, the aorta has a circumference of $4\frac{1}{2}$ inches; its calibre continues about the same to the hollow of the arch. From the summit of the vessel and 5 inches distant from its origin, the innominate artery is given off; to the left of this, rather behind, but in close proximity, the left carotid is derived; one tenth of an inch further to the left springs the wider left subclavian artery. Directly beneath this last, at the concavity of the arch towards its front edge, is the ductus arteriosus. Beyond the derivation of the above vessels, where the aorta bends downward, it narrows considerably; and a few inches below, as the thoracic aorta, it is barely over 2 inches in circumference. Thus the arch presents a considerable relative dilatation to its descending trunk, as occurs in other Pinnipedia.

The arteria innominata is 1 inch in length, and about 2 in girth; it splits, as normally is the case in Man, into the right carotid and right subclavian, the latter being about twice as wide as the former. The common carotid artery of the right side of the neck

proceeds forward with a usual course outside the trachea; its subsequent distribution will be included with that of the left side, which it resembles.

Common carotid and branches.—The left common carotid, as thick as a swan's quill, springs, as mentioned, from the middle and back part of the aortic arch, and crossing over the left bronchus continues alongside of the trachea for a distance of 9 inches, when it gives off the superior thyroid. This is a small branch, less than 2 inches long, which curves inwards below the internal jugular vein, opposite the posterior inferior angle of the cricoid cartilage, and splits into three branchlets. One of these runs down the surface of the œsophagus, and sends four short arched twigs to the diminutive thyroid body. The second passes deeply between the thyroid gland and the trachea, supplying the latter. The third divides immediately beyond its origin, a twig entering the upper end of the thyroid gland, another being sent to the outer side of the sterno-thyroid muscle as it lies on the cricoid cartilage. Besides, minute vascular twigs pierce the muscular wall of the œsophagus, and are also freely distributed to the tissues intervening between the latter and the trachea, and also partly to the crico-thyroid and inferior constrictor muscles. The superior laryngeal artery is derived directly from the trunk of the common carotid, and is not a branch of the superior thyroid, as is more usually the case in Man. It leaves the common carotid about 2 inches apart, or anterior to the superior thyroidal branch, and from the opposite side of the vessel. At its origin the superior laryngeal artery is placed upon the outer aspect of the thyro-hyoid muscle, and, crossing a portion of the inferior constrictor, gains the interspace between that muscle and the middle constrictor, where it accompanies the superior laryngeal nerve. The hindermost of the parotidean arteries is another small offshoot from the common carotid instead of the external carotid. It springs from the inner or lower side of its parent trunk, an inch distant from the superior laryngeal artery, and, running across the middle constrictor muscle, penetrates the parotid gland posteriorly and on its inner surface. The second and anterior parotidean twig is as long but scarcely so large as the posterior one; it is derived from the angle of division of the common into internal and external carotids, as noted below.

External carotid artery and its subdivisions.—The common carotid $\frac{3}{4}$ of an inch beyond the first parotidean twig above described, just below and posterior to the osseous stylo-hyal and stylo-pharyngeus muscle, divides into two main trunks of equal calibre, the external and internal carotid arteries. At the angle where these divaricate several small arterial branches, muscular and glandular, are given off. The former supply the middle constrictor, stylo-pharyngeus and adjoining muscles; the latter is the second parotidean twig mentioned above.

The lingual artery, of moderate thickness, arises about an inch from the commencement of the external carotid, and, pursuing a course parallel with and crossed by the lingual nerve, supplies the tongue from its body to the tip. At first it lies on the superior

constrictor, then on the hyoglossus muscle, giving branches to both. As it traverses the latter it is covered by the styloglossus muscle, then, dipping underneath both, it enters the substance of the tongue, distributing its branches to the genio-hyoglossus, lingualis, &c., while the main trunk of the artery corresponding to the ranine proceeds onwards to the frænum, and inosculates with its fellow of the opposite side.

The trunk of the external carotid beyond its lingual branch continues towards the cranium, and between the tympanic and condyloid eminence divides into several branches near each other. The facial artery traverses the groove of the mandibular angle under cover of the digastric muscle, and loops round the ramus, being freely distributed to the oral muscles. The occipital branch, diverging beneath the sternomastoid muscle near its paramastoid attachment, supplies the occipital parts, overlain, however, by the great sheet of the cephalo-humeral muscle. As to the temporal branch, which is comparatively small, it reaches the surface of the temporalis muscular layers in front of the outer flexible tube of the auditory apparatus. The internal maxillary artery is by far the most important of the ectocarotid divisions. In the emargination beneath the neck of the condyle at the rear of the pterygoid muscles it sends down a large inferior dental branch. The main vessel, thence continuing obliquely forwards and inwards, penetrates the alisphenoid canal at the root of the pterygoid. Anteriorly it pursues a course on the surface of the palatine arch; and then it becomes the superior maxillary accompanying the infraorbital plexus of nerves, its peripheral divisions being distributed to the parts around the mouth, muzzle, and nose. Within the large spheno-palatine and orbital space various muscular, superior dental, and nasal derivatives are sent off. The marginal vessels appear to enter the foramen lacerum medium; but they may nevertheless find entrance to the cranial cavity by the interior minute cleft spoken of as representative of foramen spinosum.

Internal carotid artery.—This strikes deeply backwards, and, rounding the internal groove of the tympanic in close relation to the jugular vein, traverses the canal of the periotic, crosses the foramen lacerum medium, lies in the carotid groove, and joins in the circle of Willis.

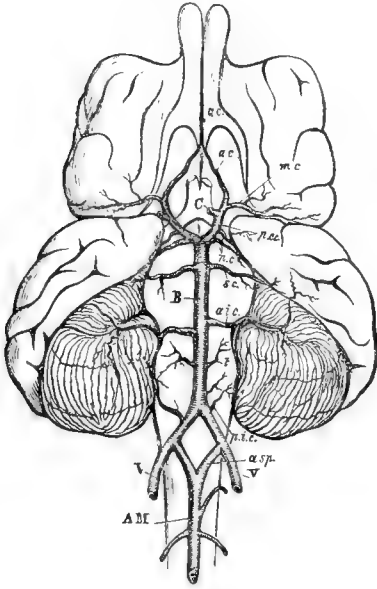
Arteries of the base of the brain.—Within the spinal canal and previous to forming the basilar artery, two large anterior spinal arteries converge backwards into a single vessel of considerable magnitude, which becomes the anterior median artery of the cord.

Much smaller-sized inferior cerebellar arteries are also derived from the front of the vertebral. The basilar artery is about 2 inches long, relatively large, and sends off, almost at right angles, the usual transverse, superior cerebellar and posterior cerebral branches. The two latter are situated rather widely apart. The "circle of Willis" is complete. The posterior communicating branches of the internal carotid are short and wide, with the internal carotid of but moderate size placed in their middle, and not so close to the anterior and middle cerebral as in the human brain.

Subclavian trunks and branches derived therefrom.—The right subclavian artery, on

leaving the innominate and common carotid, arches outwards, and at $1\frac{1}{4}$ inch from these sends off from the upper side its first branch, the vertebral, a vessel of considerable thickness, almost equalling in this respect the common carotid.

Fig. 3.

Diagram of the arteries of the Base of the Brain. *O. jubata*.

C. Internal carotid, severed close to posterior communicating vessel. *B.* Basilar. *V.* Vertebral cut short. *A.M.* Anterior median and *a.sp.* anterior spinal arteries. *a.c.* Anterior cerebral. *m.c.* Middle cerebral. *p.co.* Posterior communicating. *p.c.* Posterior cerebral. *s.c.* superior cerebellar. *a.i.c.* Anterior inferior cerebellar, and *p.i.c.* posterior inferior cerebellar arteries of left side. *t.* Transverse branch.

The vertebral artery proceeds but a short way forwards between the scalenus anticus and longus colli muscles, then enters the foramen of the sixth, and continues within the channel formed by the remaining cervical foramina situated at the roots of their transverse processes. Emerging from the atloid vertebral foramen the artery winds round the root of the superior articular process, and passes through a second foramen in the atlas, which perforates the bone in front of the neural lamina; thence it reaches the interior of the spinal canal, to unite with its fellow of the opposite side.

The left subclavian artery has a calibre as great as the trunk of the innominate. It continues forwards and outwards towards the left, without branching, for 2 inches or rather more; then the internal mammary shoots from its pectoral border. Three quarters of an inch to the left of the internal mammary branch the subclavian trunk divides into three. The largest vascular channel is the continuation of the subclavian into the axillary. The upper smallest branch, but, moreover, relatively a large vessel, is the left vertebral artery, which here, with a rather longer course in the neck than the right vertebral, proceeds onwards to the skull as on the opposite side. The third division is of intermediate size, and springs somewhat from above and behind the subclavian trifurcation. It is equivalent to the thyroid axis, and through large transverse

cervical and suprascapular branches distributes, as on the right side, a copious supply of blood to the great muscles of the neck, and those in front of and around the shoulder.

b. *Arteries of the Pectoral Limb.*

Axillary artery.—The arbitrary divisions of the subclavian trunk and line of demarcation between the axillary and brachial artery, which are useful in a surgical point of view in Man, here lose their significance from the absence of a clavicle and the altered condition of the parts. What may be regarded as the axillary artery is little more than one and a half inch long, though of considerable calibre. Several thoracic branches are distributed to the pectoral muscles and to the glands in the axilla. From a quarter to half an inch beyond where these diverge the main artery bifurcates into two equal-sized divisions—respectively the subscapular and brachial arteries. The former relatively large division gives off the circumflex arteries and many muscular branches.

The subscapular artery pierces the tissues at the root or origin of the subscapularis muscle, and not far from the inner insertion of the episcapularis muscle. After a short course it subdivides into three groups of branches which, respectively, are spread over the surface of the subscapularis muscle, corresponding to the areas of its trifid, fleshy segments. The *dorsalis scapulæ*, a large branch, proceeds from the subscapular, opposite the neck of the scapula, and goes under the bone between the heads of the dorso-epitrochlear and triceps, giving branches to these muscles near their origin, after which it joins in front the posterior scapular arteries which supply the parts round the joint. The posterior circumflex pierces the posterior margin of the second division of the triceps—namely, between its small tendinous scapular portion and that arising from the outer neck of the humerus. The anterior circumflex is small, and is distributed to the long portion of the episcapularis muscle.

Brachial artery.—Corresponding to the diminished length of the brachial region in *Otaria*, this artery is short; moreover it is relatively small; for the great sanguineous channels supplying the enormous muscular masses of the shoulder are derived higher up than the region in question. The artery is, as usual, accompanied and surrounded by the brachial plexus of nerves and large veins, maintaining a position to the inner side of the median nerve.

The inferior profunda and the *anastomatica magna* appear to be derived from one offshoot, which comes from the brachial below its middle, and at half an inch distance divides into two. The upper branch, representing the former, pierces the small triceps muscle. The lower and longer branch, equivalent to the latter, also pierces the same division of the triceps; but just above or rather deeper than the internal anconeus, it dips deeply beneath the lower (short) triceps and sends a branchlet to the side of the joint behind the internal condyle, the main artery continuing round and above the olecranon to the external anconeus and neighbouring tissues.

The ulnar artery.—From the main artery below the elbow-joint a short flange proceeds ulnarwise, and at a quarter of an inch distance splits into three. One slants across the ulnar head of the flexor sublimis and goes down the arm as the ulnar artery to the wrist, there splitting into three small digital vessels. These three vessels are distributed to the fifth and fourth digits. The outer one, given off highest, runs along the ulnar side of the fifth digit; the next goes a short way single and then divaricates, one branchlet supplying the radial side of the fifth digit, the other the ulnar side of the fourth digit.

From the short trunk above spoken of the anterior ulnar recurrent diverges upwards toward the joint. The posterior ulnar recurrent is derived immediately below the above, and at an angle from the ulnar. It enters the substance of the flexor carpi ulnaris and the palmaris longus muscle.

Radial artery.—This, the chief continuation of the brachial into the forearm, passes downwards over the biceps and brachialis anticus muscles in front of the inner condyle, and afterwards beneath the pronator radii teres and the flexor carpi radialis. In the forearm it is situated nearly in the middle of the broad radius, superficial to and partly on the ulnar side of the radial head of the conjoined flexor profundus and pollicis. The tendon of the palmaris longus secundus obliquely crosses the artery above the wrist-joint. Dipping beneath the superficial palmar fasciæ, it then, at the proximal end of the metacarpals, splits into three divisions which form the main portion of the palmar arch. The largest pollicial branch crosses the radial side of the second metacarpal and subdivides into two twigs which proceed respectively to the ulnar side of the pollex and radial side of the second digit. The second middle branch similarly subdivides into a couple of twigs, which run along the ulnar side of the second and radial side of the third digit. The third branch comes off the highest of the three, and, subdividing at the proximal end of the proximal phalanx, bifurcates, one twig going to the ulnar side of the third, and the other to the radial side of the fourth digit. This palmar arch is superficial to the nerves.

Below the elbow and in the upper part of the forearm the radial sends off a recurrent branch, chiefly distributed to the muscles on the humerus and radial side of the joint. Other muscular branches are distributed in the forearm.

Interosseous vessels.—Immediately below the derivation of the ulnar the common interosseous artery strikes off and is about half an inch long, it then splits into two branches. One of these, the posterior interosseous artery, dips between the radial and ulnar heads of the deep flexors above the oblique ligament. It is distributed to the pronator teres, extensor ossis metacarpi pollicis, &c. The second branch forms the anterior interosseous artery, from which, an inch below the commencement of the posterior interosseous artery, a muscular offshoot of moderate size diverges radially and goes to the long muscles of the radial side. A small branch, representing the recurrent, goes upwards to the elbow-joint beneath the external lateral ligament.

c. The Visceral Arteries.

Bronchial, œsophageal, and intercostal vessels are duly given off within the thorax. Each and all of these are large; but the latter do not form retia as in Cetacea.

Small phrenic arteries which penetrate the muscular diaphragm come off from the abdominal aorta below and between the crura. About half an inch lower two diminutive branches are also derived, one on either side of the aorta; these go to supply the suprarenal bodies.

The Cœliac axis, the first large trunk, proceeds from the abdominal aorta, half an inch below the last, or about one inch beyond the diaphragm. It has a large calibre, and is one and a half inch long. It ultimately splits into two equal-sized branches, that to the right being the hepatic, and that to the left consisting of a single stem furnishing the gastric, the splenic, and their branches.

The single left branch derivative from the cœliac divaricates at about an inch from its origin. Its right division, that to which the name of gastric or coronary artery is applicable, proceeds along the lesser curvature for two inches or thereabouts, and then divides into a large anterior and as considerable-sized posterior vessel. Each of these pursues nearly the same course, but on opposite sides of the stomach. Their direction is straight, but oblique to the long diameter of the stomach, parallel with and to the cardiac side of the cleft of the lesser curvature. Both the anterior and the posterior coronary or gastric vessels subdivide into twenty or more branches, which are emitted at oblique or right angles on either side; and these again, towards the greater curvature, subdivide into secondary and tertiary dichotomous branchlets. Thus the greater part of the surface of the stomach receives a vascular covering disposed in a series of dichotomous radii, which inosculate at the greater curvature with their fellows of the opposite side, and anastomose with branchlets of the œsophageal and splenic arteries.

The large splenic artery is not tortuous as in Man, but sweeps in a curvilinear manner across the middle of the stomach, from the summit of the lesser to rather beyond the middle or towards the pyloric moiety of the greater curvature. A considerable-sized branch is given off from the top of the stomach; and this, like one of the branches of the gastric, is directed towards the extremity of the viscus and there freely anastomoses with the œsophageal vessels. The vasa brevia belie their name, inasmuch as here they are large long branches, some three or four in number. They proceed beneath the spleen towards the fundus and border of the great curvature, splitting dichotomously like the coronary, and, as before said, inosculating with them. The gastro-epiploica sinistra, or continuation of splenic, as usual, follows the curved outer border of the stomach to the pylorus, and joins the gastro-epiploica dextra.

The hepatic trunk, one and a half inch from its derivation, sends off its hepatic branch. This lies on the surface of enlargement of the vena cava, and beneath the pancreas; as it reaches the Spigelian lobe of the liver it splits into two main divisions, that

to the left being slightly the larger one. The right hepatic division, three quarters of an inch from its origin, subdivides into two. One branch, directed outwards, supplies the first and second lobules to the right of the liver; the other strikes more upwards and slightly to the left, being distributed to the third hepatic segment, viz. the right moiety of the cystic lobe. The left hepatic division is longer and straighter than the right, and furnishes several branchlets. About an inch and a half from its origin one or two small twigs are sent to the Spigelian lobe and what represents the transverse fissure. An inch beyond these a branchlet goes upwards, which gives offshoots to the minute lobule(*fig.72) and to the IV. or left half of the cystic lobe. The main left hepatic division proceeds onwards for above two inches, and splits into several terminal segments distributed to the V. and VI. lobes, or left half of the liver.

The cystic artery is a very long and narrow branch. It accompanies the cystic duct as far as the neck of the gall-bladder, where it penetrates the coats of that reservoir. In its course it lies to the left of the duct, and is superficial to the pancreas and hepatic artery. The arteries of the liver, excepting the cystic branch, have a position beneath the gall-ducts and above the veins and hepatic plexus of nerves. I observed a peculiarity in the first portion of the hepatic artery previous to its dividing into right and left branches. This consisted in its possessing a median septum, apparently produced by a splitting of the inner coat. I could not well satisfy myself, however, whether this might not have been the result of injection rather than a natural condition.

The gastro-duodenal branch of the hepatic is of good size. About one inch from its commencement it gives short offshoots to the pancreas and first part of the small intestine, the latter distant two inches from the pylorus. Thence continuing beneath the duodenum it runs along the outer pyloric border of the stomach as the gastro-epiploica dextra, inosculating in the ordinary manner with the sinistral epiploic extremity of the splenic.

The superior mesenteric artery springs from the abdominal aorta one and a quarter inch below the cœliac axis, has a calibre equal to that vessel, and indeed is relatively little inferior in size to the aorta itself, where they are divergent. In forming the mesenteric arch it is enclosed and hidden within a double, long, narrow, continuous strip of lymphatics, the mesenteric glands. The so-called vasa intestini tenuis are derived from the trunk of the mesenteric by about twenty very short but wide branches, which divide and subdivide into primary, secondary, and tertiary forks, ultimately ramifying on the intestinal surface. Of the named branches of the superior mesenteric artery the ileo-colic is well marked and of moderate size.

The renal arteries, derived posteriorly, strike off opposite one another and at right angles to the aorta. They are each 2 inches long.

The spermatic vessels and the inferior mesenteric trunk spring separately and to the rear of the preceding. Sigmoid and hæmorrhoidal branches of the latter obtain in well-defined arches; and lymphatic glands lie towards the main vessel.

d. *Arteries of the Pelvic Limb.*

The distribution of these in most respects resembles what obtains in *Phoca*, slightly modified to correspond with the altered relations of the fleshy parts, agreeing therefore more closely with *Trichechus*, where also caudo-calcaneal bands knit the heel well towards the spinal termination. The continuation of the abdominal aorta upon the inferior aspect of the tail, *arteria sacra media*, is noteworthy chiefly on account of a plexus vasculosus coccygeus or so-called coccygeal gland. This structure is represented in the Otary by an elongated somewhat cylindrical, yellowish, glandular-looking body, almost an inch long and 0.2 broad. It is situate between the converging long median tendons of the pubo- and ilio-coccygeal muscles, and is covered in part by the junctional raphe of the levator ani.

External iliac and tributaries.—The epigastric is a large artery, which underlying the external and internal oblique muscles upon the surface of the transversalis and outside the rectus, traverses the abdominal parietes and forms a free inosculation with the equally capacious internal mammary.

The femoral artery, of very moderate calibre, on leaving the ilium, crosses outwards almost at a right angle from it, and in this way traverses the groin to the inner and here posterior edge of the femur. The artery, with its companion vein and nerves, have the following relations before penetrating the adductor magnus muscle. The psoas tendon is superficial to it; the rectus femoris and sartorius lie anteriorly, the pectineus behind. These altogether form an elongated triangular space, the artery crossing this diagonally from before backwards. Deeply the vessel lies on the tendon of the iliacus, and then passes over the the adductor longus. At the lower third of the shaft of the femur it goes through a small opening in the upper border of the adductor magnus and reaches the posterior surface of the bone.

The popliteal artery is very short, and, as usual, lies in the popliteal space; but its relations nevertheless are different, as the hamstring muscles are shifted downwards and do not approach the knee-joint, while the gastrocnemius has but one inner broad head of origin. On the inner side, then, it is enclosed superficially by the adductor magnus, and deeply by the gastrocnemius, these two muscles stretching from the condyloid ridge of the femur to the head of the tibia. On the outer side is the remarkably low insertion of the obturator externus, the upper portion of the biceps femoris, and the soleus. Having reached the inner side of the head of the fibula, the popliteal divides into anterior and posterior tibial arteries.

This last-mentioned vessel rests on the popliteus and tibialis posticus, the long hallucal and digital flexor muscles in part covering it to the turn of the heel. The internal plantar artery appears to be that which furnishes the digital branchlets, or what here represents the plantar arch. It results that the distribution of the plantar is uncommonly like that of the palmar vessels. The innermost artery runs alongside the hallux

to the distal end of the metatarsal, splits, and supplies the adjoining sides of the first and second toe. At the proximal end of the second metatarsal, what in *Otaria* is equivalent to the external plantar in Man, springs from it, then a little way on again divides, a third outer branch coming off still further on. These three bifurcate and give twigs to the second and third, the third and fourth, and the fourth and fifth toes respectively. The outside of the fifth toe receives a separate twig derived from the peroneal near the calcaneum.

Internal Iliac.—Its divisions within the pelvis were not noted with sufficient exactness. One artery, however, has very unusual relations, if, as seems the case, it is the homologue of the sciatic and its derivative *comes nervi ischiadici*. This vessel, of considerable calibre, accompanies the sacral plexus through the sciatic foramen, and afterwards follows the course of and bears relations similar to the lesser sciatic nerve, already described. It yields branches to the large lymphatic gland in the tibio-caudal space, to the semitendinosus, membranosus, sacro-peronæus, and other muscles of the back of the leg, and proceeds on to the outer ankle.

3. *The Venous Blood-channels.*

The veins derived from the interior of the cranium, the head, face, tongue, and fauces, combining, form the external and internal jugulars. Small veins come from the thyroid gland, the omohyoid, and neighbouring parts below the cricoid cartilage; these unite into a common vein, which joins the internal jugular opposite the lower posterior extremity of the thyroid gland.

The recurrent venous channels from the hind limbs and pelvis forming the posterior vena cava are of great calibre, and particularly so after receiving the renal veins. These latter emulgent veins are of unequal length, the left being the longer of the two: compared with the kidney itself, they are of inordinate capacity.

The portal vein, on reaching the flat portion of the liver or bridge connecting the Spigelian and right lobes, divides into two great main trunks. The short one of these supplies the right or I lobe. The other, which is set at a wide angle from the last, proceeds upwards and to the left, sending off wide branches and smaller divisions to the several large lobes, viz. II, III, IV, V. Each branch is accompanied by a derivative twig from the hepatic artery; the veins, however, are by very far the larger.

By far the most remarkable point in connexion with the venous system is the enlargement of the posterior vena cava or great hepatic sinuses so admirably depicted by Barkow¹ in the Common Seal, *Phoca vitulina*, and similar to those of the Walrus. It is in fact but a simple expansion of the vena cava within the precincts of the liver, and

¹ Professor Barkow's magnificent illustrations of the vascular system contain several devoted to *Phoca vitulina*, *P. annellata*, and *Halichoerus griseus*; but a comparison with these is beyond the limits of the present paper. 'Die Blutgefäße, &c.' Breslau: see plates x. to xiii. and xxix.

in this case occupying a volume, one might almost say, greater than the glandular hepatic organ itself. As I have shown in *Trichechus*, there is a mid septum interiorly, with a free opening, however, between; and each sac has diverticular pouches in communication with the various segments of the much divided liver. The capacity of the two chambers is such that, on being injected, I was utterly astonished and confounded as to where the material was being sent to. Subjoined is the memorandum taken when at work; and the drawings, figs. 48 and 72, supplant lengthened description.

“Hepatic sinuses 14 inches across in a straight line; that of the right side alone is 8 inches, interspace 1 inch; hence left, above, 5 inches long. There is a deep and wide fissure behind; and each from this view is semilunar or stomach-shaped, the cardiac and pyloric curvatures being represented by the veins that enter the different lobes of the segmented liver. In front, *i. e.* below, there is scarcely any fissure; but a strong white fibrous band, an inch broad, runs up the middle, being derived from, or a duplicature of the abdominal surface of the diaphragm. Circumference of right half when distended 11 inches, the left being half an inch less.”

The *hepatic plexus of nerves* lies beneath the portal trunks; and twigs of these ramify around the vein while being sent to the numerous hepatic lobes. Minute branches of nerves are also derived from the hepatic plexus, which accompany the bile-ducts, and lie superficial to the portal vein, and even to the arterial trunks.

Fig. 4.

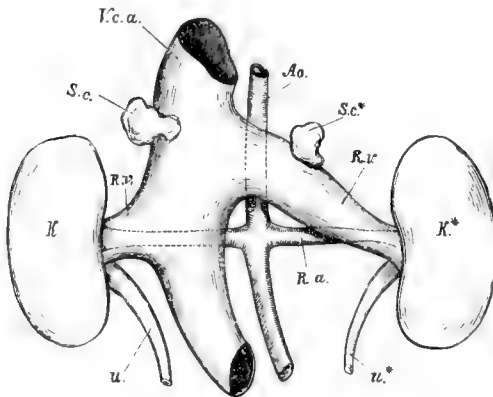


Diagram of the Renal Vessels, &c.

*K, K**. Kidneys. *u, u**. Ureters, cut short. *Ao.* Aorta. *R.a.* Left renal artery; the dotted line shows position of the right, behind cava. *R.v., R.v.* Renal veins. *V.c.a.* Vena cava ascendens. *Sc, Sc**. Suprarenal capsules or Glands.

V. HYOLARYNGEAL AND PULMONARY SYSTEMS.

1. *Components of Hyoid and Larynx.*

a. *Hyoid arch.*—This arch is built up of nine osseous and four cartilaginous elements. A taper pointed cartilage 0.4 inch long articulates the arch with the tympanohyal of the skull. The stylohyals united with these cartilages are subcompressed, digit-shaped bones, each 1.2 inch long, and with a knobbed extremity distad from the skull. These

stylohyals are connected by fibro-cartilage to separate osseous elements, the epihyals; each of the latter bones is longer than the stylohyal, *i. e.* 1.4 inch, somewhat stouter, dilated at both extremities and laterally compressed in the middle. Another fibro-cartilaginous synovial hinge-joint passes between the epihyal and the much stouter, equally lengthened adjoining bone. This, the ceratohyal, is subtriangular on transverse section, a broad surface or border being ventrally situate, and the angular edge deeply placed. The end of each bone which lies in apposition with the basihyal is enlarged and slightly depressed or grooved internally. The single basihyal, 2.1 inch in length, is developed as a stout bar of solid bone, with wide flattened extremities, possessing a superior and inferior or anterior and posterior broad facets; with these the ceratohyals articulate above, and the thyrohyals below. The middle or body of the basihyal is somewhat narrower than the extremities, and is compressed in an opposite direction to the ends. Each thyrohyal is knobbed at its basihyal end, and tapers to a narrow cartilaginous point at the thyroid extremity. It is subcompressed laterally, slightly bent or arched forwards, roughened or with a median prominence in front, and rather sharper-edged behind. Length 2.2 inches. At their narrowed cartilaginous tip is a free triangular nodule of cartilage 0.4 inch long, the so-called *cartilago triticea*. This is connected by strong fibrous tissue to the thyrohyal and is also attached by the lateral thyrohyoid ligament to the superior or anterior cornua of the thyroid cartilage.

b. *Cartilages of the Larynx*.—Thyroid Cartilage. The two alæ as they approach together in front are deeply incised anteriorly and posteriorly (or above and below), leaving only a narrow but nevertheless thick and strong septum of communication (*pomum Adami*). The anterior notch is an inch deep, the posterior no more than half that. Each lamella is somewhat rhomboid in form, the superficial and deep borders (anterior and posterior in Man) being convex, the anterior somewhat and posterior (upper and lower) decidedly concave. There is no prominent oblique line or ridge; but on the lateral surface and near the middle of the posterior (inferior) concavity is a large-sized roughened tuberosity to which the arytenoid and thyro-arytenoid muscles are attached. The posterior (inferior) cornu is half an inch long, ending in a rigid thickened pointed extremity; the posterior crico-arytenoid muscle being fixed thereon. The anterior (superior) cornu is much smaller, thinner, and elastic. Internally, the surface of the thyroid lamella is perfectly smooth. The connecting bridge between the alæ, much stouter than they, is smooth externally, but has an elevated cartilaginous median papilla within, from which the vocal cords arise. Measured from the septal junction to the deep free margin, each thyroid lamella is $2\frac{1}{2}$ inches; from the summit to the cricoid end 2 inches, the distance between the extremities of the cornua being nearly the same. At the narrowest part, between the anterior and posterior convexity, it is $1\frac{1}{4}$ inch in diameter.

The cricoid cartilage forms a solid ring some 6 inches in external circumference.

Behind it is 2 inches in extreme (antero-posterior) depth; in front, or superficially, which is the narrowest part, it is 0·9 inch; the diameter from the ventral to the vertebral superficies is 2 inches. The elevated smooth ventral aspect is, as noted, moderately deep and with biconcave margins. The œsophageal surface has a raised mesial line, with lateral, wide, shallow excavations between it and the thyroid cartilages, the posterior crico-arytenoid muscles completely filling these depressions. Where the arytenoid cartilages are attached the cricoid on each side is very much thickened and projects in a rounded manner, leaving a median deep cleft or notch, which is filled with fibro-fatty tissue. The tracheal end of this same œsophageal surface has a thin spatulate cartilaginous plate 0·3 inch long, and fully as much broad at its widest part. On each side of this the borders are incised semilunarly, and form a slight angle posterior to (or beneath) the thyro-cricoid articulation.

Each pyramidal or trihedral, but round-margined arytenoid cartilage is of the following dimensions—0·7 inch in extreme height, an inch in basal width, and 0·6 inch in thickness, or from the internal to the external surface. Its crico-articulating facet is large, shallow, and with a synovial membrane. The inner mesially connecting spur is the thinnest and most elastic portion, and possesses a rounded recurved point to which the interarytenoid ligament is fixed. The true and false vocal cords have a firm and strong bond of union. The posterior crico-arytenoid ligament loosely but powerfully connects the cartilages in the interval.

Fixed to the summit of the arytenoid cartilage by a close, movable, but not synovial joint, is a smaller and softer V-shaped cartilaginous body, which, as a whole, includes the cartilages of Santorini and Wrisberg.

c. Laryngeal Membranes and Ligaments.—The thyro-hyoid membrane, or middle thyro-hyoid ligament, forms a strong, wide, and very elastic connecting bridge between the basihyal, thyrohyals, and thyroid cartilage. It contains in its centre, or midway between the basihyal and the fore part of the thyroid shield, a firm, well-developed, cartilaginous nodule. This nodule of cartilage has a short figure-of-8 shape, smooth on the ventral surface, and rougher or somewhat carinate anteriorly on its deep aspect. It is 0·8 inch long, and 0·5 broad at its anterior segment. It is deeply imbedded in the fat and fibrous tissue at the root of the epiglottis; and between the latter and its internal projecting anterior point there passes a strong fibro-elastic band—the *hyo-epiglottic ligament*.

The lateral thyro-hyoid ligaments are two narrow bands of fibro- and yellow elastic tissue, which pass between the tip of the thyrohyals and each cartilago triticea to the short anterior cornua of the thyroid cartilage.

The crico-thyroid membrane, divisible by human anatomists into a mesial and two lateral crico-thyroid ligaments, is, in *Otaria*, a well-developed strong fibro-elastic structure, the median portion containing abundance of yellow elastic tissue, which is thickened and forms a projecting ridge. The lateral portions of the crico-thyroid membrane,

from the great size and thickness of the thyro-arytenoidei muscles, are partially excluded from the formation of the true vocal cords.

The capsular ligaments encircling the synovial articulation between the posterior (inferior) cornua of the thyroid and the postlateral facet of the cricoid cartilage are short, and limit considerably the motion of the joint. The crico-arytenoid ligaments, on the contrary, are wide, loose, and permit great freedom of motion of the arytenoid cartilages, especially in an antero-posterior direction. The more elastic and resilient cartilages of Santorini and Wrisberg do not possess any definite articulation or ligaments, but pass indefinitely the one into the other by cartilaginous union. There is, moreover, a small but strong ligamentous union uniting the inner points of the arytenoid cartilages (interarytenoid ligament), and a less distinct, by reason of the intermixture of muscular and fatty tissue, posterior crico-arytenoid ligament or connecting membrane.

The superior thyro-arytenoid ligaments, or false vocal cords, are so much interwoven with the submucous tissues, fat, and muscular fibres of the thyro-arytenoideus secundus as to prevent their special dissection. The true vocal cords or inferior thyro-arytenoid ligaments, however, are much better expressed. They pass in the usual manner from the elevation behind the junction of the thyroid alæ backwards to the inward or anterior projection of the arytenoid cartilages and adjoining portions of the cornicula laryngis.

The upper end of the trachea is firmly lashed all round the interior of the cricoid cartilage by a very strong membrane, which, however, from its elastic nature, allows of a certain amount of up and down movement.

d. *Muscles of the Os hyoides and Larynx.*—The most superficial layer, in this case long massive muscles connected with the hyoidean region—to wit, the omo-hyoid, sterno-hyoid, and sterno-thyroid, forming a great part of the thickness of the neck and being involved with the structures at their origins, have consequently been described in Part II.

Thyro-hyoid.—The direction of the fibres of this muscle are at an obtuse angle inwards from those of the sterno-thyroid; therefore there is a clear line of demarcation between them. The thyro-hyoid is of considerable thickness, 2 inches long by 1 broad, and trapezoidal in shape. It rests upon the fibres of the inferior constrictor muscle, outer ala of the thyroid cartilage and the thyro-hyoid membrane; and it is itself covered by the omo-hyoid muscle. Its origin is the curved line and prominence of the thyroid cartilage, and its insertion the inferior (posterior) border of the osseous thyrohyal and the thyro-hyoid membrane. On the right side a slip of the inferior constrictor was observed to pass across the thyro-hyoid just behind its middle.

In *Otaria jubata* the Crico-thyroid is represented by a large and broad plane of muscle, as a whole, quadrilateral in shape, though rather irregular in outline. It comes from nearly the whole outer moiety of the cricoid cartilage, and covers the crico-thyroid

membrane. The two crico-thyroid muscles converge medianly in front, but leave a triangular interval exposing the crico-thyroid membrane behind.

Posterior crico-arytenoid.—This is of considerable size and thickness. It covers the posterior surface of the cricoid cartilage, with the exception of the spatular appendix. The fibres expanding outwards and forwards from the above origin are inserted into the outer protuberance of the arytenoid cartilage. As in Man, the outermost fibres are nearly vertical, and the upper or anterior ones nearly transverse to the antero-posterior axis of the larynx. The posterior margin of the thyroid cartilage partially hides the outside curved edge of the posterior crico-arytenoideus. This muscle is a retractor of the arytenoid cartilage and dilater of the glottis.

Lateral crico-arytenoid.—A short, triangular-shaped muscle lying outside inferiorly, but in close connexion with the last mentioned. It occupies the space anterior to and below the crico-thyroid joint, and is fastened to the prominent protuberant angle of the arytenoid cartilage. The action of this pair of muscles is to drag downward the arytenoid cartilage, and close the posterior lip of the glottis. No *ceratocricoid* slip of Merkel was observed.

Thyro-arytenoid.—Divisible in this species of Eared Seal into at least two well-defined bundles:—(a) The larger inferior one is a strong broad plane of muscular fibres which arise from the front and middle of the interior junction of the thyroid alæ. Passing towards the arytenoid cartilage the fleshy fibres are inserted in front of (or below) the arytenoid protuberance. A few of the fibres run over the surface of the arytenoid muscle. (b) The superior smaller division in some respects may represent the so-called aryteno-epiglottidean muscle of human anatomy. This portion commences partly by fascia and partly by muscular fibres from the interior of the thyroid cartilage in front of the laryngeal pouch. Splitting so as to lie on either side of the sac and again uniting, the muscle is finally inserted into the arytenoid cartilage and cartilage of Santorini, anterior, however, to the arytenoid muscle. The superficial division of the thyro-arytenoid in great part covers this second segment. Concerning the function of the foregoing, the large inferior planes (a) of both sides drag forwards the arytenoid cartilages, and therefore approximate the true vocal cords. The superior divisions (b), fixed more behind the arytenoid cartilages, compress the laryngeal sacculus; but they possibly also drag forwards the Santorine cartilages and close the aperture of the glottis.

The arytenoidei muscles do not decussate obliquely and pass right across as they do in Man. In the larynx of *Otaria* the arytenoid is thick, short, and alone fills the concavity of each arytenoid cartilage.

Appertaining to the hyoid and thyroid region, I may in this place institute record of a thick fleshy muscle, somewhat of a long parallelogram in figure, and situated immediately beneath the posterior end of the hyoglossus and anterior portion of the superior constrictor when the parts are in natural position. The muscle in question has attachments to, and bridges or connects the cerato- and thyrohyal bony segments,

posteriorly impinging on what appears to represent a stylo-pharyngeus. In some of its aspects it agrees with the interhyoideus or hyokeratic and partly hyo-epiglottic muscle of Cetaceans.

2. Vocal Passages, Respiratory Organs, and Glands.

a. *Cavities of Larynx and Trachea.*—Figures 57 and 59 are devoted to an exposition of the interior of the larynx, showing it from above and in section. To these the following description specially applies. The free surface of the epiglottis is smooth, thick, short and heart-shaped, the posterior median depression rising into an elongated fold within the rima. The superior aperture of the larynx, 1 inch long, has a trefoil outline, the hinder longitudinal limb being the longest. The fissure is bounded laterally by two smooth rounded elastic eminences (fatty cushions surmounting the cartilages of Santorini), and continuously behind by the projecting, clothed portion of the arytenoid cartilages. Two elastic, membranous aryteno-epiglottic folds connect the epiglottis with the rearward rounded prominences; and outside these are wide and moderately deep reticular pouches. Behind and surrounding the parts in question are the inner longitudinal wavy plications of the pharynx and œsophagus. The laryngeal cavity itself is of moderate capacity. The ventricles anteriorly are well defined, but leave an open passage behind, which surface is dotted with mucous glands. Between the false and true vocal cords the narrow elliptical slit of the ventricle, which is directed obliquely backwards towards the pomum Adami, leads into a small flask-shaped sacculus or laryngeal pouch having a reversed direction, or towards the epiglottis. Besides a general converging of fatty tissue, the neck of the sacculus is surrounded by fibres of the thyro-arytenoidei, as above described. The smoother surface of the lower larynx is tumid to the cricoid, where it is slightly wider, diminishing gradually to the trachea. Before dissecting the intrinsic muscles and structures of the larynx, I examined and made diagrammatic outlines of the superior aperture in three different stages of tension, purposely comparing the same with the designs given by Czermak of the laryngoscopic appearances in the living human being. Consult fig. 58, where (1) a reduction shows that ordinarily the fissure is relatively narrower forwards than in man; when more opened (2), and even when forcibly distended (3), a similar condition is exhibited. In other respects the aperture, as a whole, presents considerable resemblances, whatsoever may be said of the widely different powers of vocalization, betwixt *Homo* and *Otaria*. As regards voice, this male animal had no soprano notes. Its more usual cry commenced with a liquid but guttural and tremulous tone, increasing in volume and terminating by a loud and deep-bass roar or growl. At other times, when pleased, or fondling with the keeper, Leconte, a shorter subdued grunting whine was emitted. Lastly, a quicker, shorter, and sharper-sounding call was issued, apparently as a note of surprise or intimation of apparent danger. What has been compared to the bleating of a sheep, by voyagers and others, in the young and female Eared Seals, is doubtless the above tremulous cry

given forth by a weaker and more metallic voice than is possessed by the adult male Sea-lion.

In the trachea the uppermost cartilaginous rings are wide and subequal; they do not meet behind, the interspace being occupied by membrane. Moreover a dense layer of fibro-elastic tissue unites the trachea to the gullet, and, passing over both, ensheaths the thyroid gland and the vessels and nerves distributed thereabouts. This strong membranous investment or layer of deep cervical fascia appears to contain much yellow elastic fibre in its composition, and while surrounding the trachea tends powerfully to bring the cartilaginous rings together, a needful provision to the remarkable flexible neck of the creature.

b. *Lungs*.—The lungs have great capacity, and when inflated are unusually long in shape. In this respect they correspond to the form of the very mobile thoracic walls. As has been previously mentioned, the Sea-lion alters remarkably in the rotundity, length, depth, and flatness of its body, according as the animal walks on all fours, swims, or lolls on the ground. This plasticity of the chest is due chiefly to the loose manner in which the ribs are articulated to the bodies of the vertebræ, and also to the amount of intervertebral, costal, and sternal cartilages present, all more or less acted upon by the large thoracic muscles.

The right lung rises slightly highest in the chest. It is divided into four lobes, or is composed of three considerable-sized lobes and the so-called *lobulus impar*, in this case tolerably free. The upper or anterior lobe is of a trihedral form, and rather flattened at the edges; the lower angle descending and covering the right side of the root of the heart. Its lower margin is slightly concave at the posterior third, allowing the bronchus and the second lobe to fit into the hollow. This upper or anterior lobe has a separate or third bronchial division, which is derived from the usual right bronchus 6 inches below the bifurcation of the trachea. The second or middle lobe of the right lung is long, narrow and spatulate. The third inferior (posterior) lobe is the thickest and slightly larger than the anterior or first lobe; it is triangular in shape. The fourth, or *lobus impar*, is derived from the cardiac side of the root of the last, but receives a separate extension of the right bronchus, so that it forms an individual lobe. Single and pedunculate at the base, it divides distally in a trefoil manner, each spur being three-sided.

The left lung is composed of three main lobes: the first one is deeply cleft at its uppermost corner. The second, middle, smaller one is attached to the lower end of the first; it is short, narrow, flat and broad at the free extremity. The third lobe is the largest of all; it is triangular, the upper margin being slightly concave. The sternal free margins of all the lobes of both lungs have an irregular somewhat crenated border; this is most notable in the middle, spatulate lobes.

c. *Glands in proximity to Air-passages*.—The thyroid bodies, relatively to the size of the animal, are small. They are situated widely apart, without any connecting isthmus,

upon the sides of the trachea close behind (below) the cricoid cartilage and immediately adjoining the œsophagus. Each gland is of a narrow elongated form, about $1\frac{3}{4}$ inch in length, and 0.4 inch wide at its broadest part; it extends from the first to the sixth tracheal ring. Anteriorly what may be considered the head or broader end is roundish, or well defined; but posteriorly the gland mingles with the thick layer of yellow elastic and fibrous tissue (deep cervical fascia), which encompasses the trachea and connects it with the œsophagus as well as with the vessels of the neck. The surface of the thyroid body is smooth, and of a yellowish or orange colour; section demonstrates its substance to be compact, with only a few vascular channels on its œsophageal side. There is no fibroid or muscular band representing a levator thyroideæ.

As regards thymus gland, no remnant of this fœtal organism was noticed.

VI. THE DIGESTIVE SYSTEM.

1. *Parts and Organs within the Mouth.*

a. *The Teeth and Palate.*—In this male animal the dentition presented the normal number accorded to the adult of *Otaria*, the formula being

$$I. \frac{3-3}{2-2}, C. \frac{1-1}{1-1}, Pm. \frac{4-4}{4-4}, M. \frac{2-2}{1-1} = 36.$$

The hard palate is as usual covered by firm periosteum, and by a lining of mucous membrane of a pale tint; but these are only of moderate thickness. The openings of the anterior palatine canals are two long slits placed nearly behind the incisor teeth. They have an antero-posterior direction 0.15 inch apart in front, and diverge slightly from before backwards. The front portion of the palate to as far back as the anterior premolars is tolerably smooth. From between the premolars backwards to about opposite the hindermost molars, there is a series of transverse ridges. These elevations are low, and somewhat flat on their summits. The most of them do not traverse entirely the palate from one side to the other, but are irregularly interrupted in the median line. Each half slants inwards and backwards in such a manner that if continuous they would form a series of low arches, the convexity of which is directed backwards. The interspaces or hollows are less than half the breadth of the raised portions of membrane; and the median longitudinal one is somewhat wider than the transverse ones, especially as it meets these. Behind the teeth the surface of the palate is smooth.

b. *Lingual Organ superficially considered.*—The tongue in *Otaria jubata* is a thick fleshy body, which dorsally at the root is greatly arched both transversely and longitudinally, and becomes somewhat flatter towards the narrower anterior bifid extremity. Looked at laterally, when it has been removed from the mouth, it presents an elongated wedge-shape, with roundish margins. A marked lateral row of large papillæ defines the smooth under surface from the opposite upper roughened dorsum. As seen above,

the tip, fully an inch broad, has a central incision 0·2 inch deep; and this divides the extremity into two rounded halves, which are roughened by a multitude of strong, erect, warty papillæ. A median longitudinal shallow furrow, the raphe, runs backwards from the cleft for $1\frac{1}{2}$ inch, behind which the dorsum becomes very convex (as noted above).

The whole of the upper surface of the tongue has a very roughened rasp-like aspect, but not the retroverted acicular spines which obtain in some Felines, *e. g.* the Lion and the Cat. The papillæ differ considerably at the tip, the middle, and the root of the tongue. The margins and upper surface of the bifid tip are covered with short, semierect, conical, and triangularly flattened soft papillæ. They are longest and most numerous at the free edge, where they form a kind of brush. On the dorsum and raphe they are shorter and overlap each other less. These representatives of the human filiform papillæ, at the sides and summit of the dorsum, insensibly alter into uniform, flat, and broadish fungiform papillæ. Laterally they are closely set together in a tessellated manner, but are rather more open towards the middle line. The summits of nearly all of them appear rounded, but they nevertheless contain a small central depression. The wide horseshoe-shaped root is overlaid with larger circumvallate papillæ; these are irregular in contour, many elongate, others roundish; but all are granular and deeply pitted superficially. Behind the tongue there is a long deep cleft, the soft wrinkled faucial tract presently to be described.

c. Faucial folds, Tonsils, and Oral Glands.—When the mouth and fauces are examined in the live animal, the anterior pillars of the fauces, uvular curtain, and retracted root of tongue so close the faucial aperture as to hide the textures between the proper base of the tongue and the epiglottis. Even in the dead animal with opened mouth, when the parts remain *in situ*, there is a difficulty in making an accurate examination of these posterior structures, because of the peculiarly long and narrow postpalatine formation.

When, however, the parts have been carefully removed *en masse* from the skull, their configuration and relation are more easily made out. Figure 52 (in Plate LXXX.) represents the tongue and anterior two thirds of the isthmus faucium thus exposed. The raised floor of the postfaucial tract already spoken of is deeply divided medianly, the cleft or sulcus reaching from the root of the tongue to the *velum palati*, *viz.* a distance of $2\frac{1}{2}$ inches. On each side of the groove there is a long transversely arched ridge, the apparent continuation of the forks of the tongue's root. These are covered by loose rugose mucous folds, which at intervals are studded with elongated soft filiform papillæ. Anteriorly the papillæ are short and small, but posteriorly, near the *velum palati*, of considerable size and length. In fact, the latter are so distributed as to give the sub-uvular parts quite a rough shaggy aspect. The intervening longitudinal cleft is smoother than the side ridges; but, nevertheless, filiform papillæ are not wholly absent. The lining membrane of the postbuccal envelope, as it spreads upwards or overarches

the root of the tongue, possesses plications which correspond to the curve; and these partially interdigitate with one another.

The keystone or summit of the said arch, the backward continuation of the fibromucous membrane of the hard palate to the velum, is moderately smooth, but dotted with puncta, the orifices of the very numerous palatine muciparous glands. The extension of this membrane becomes the duplicature of the uvula and posterior pillars of the fauces. The anterior palatine arch and faucial pillars are considerably in advance of the posterior, and equidistant between the uvula and proper root of the tongue.

The so-called anterior pillars of the fauces are moderately prominent bulgings, with a middle indentation running backwards to a recess lodging the tonsils.

Tonsils.—These amygdaloid bodies correspond very well in shape and size with what they have been likened to, almonds—their free edge and narrow end looking upwards and forwards. The resemblance to the fruit in question is further heightened by their surface being wrinkled and pitted, similar to the sculpturing of its outer husk or shell. There is a deep sulcus above, which runs round in front to the anterior lower third; the faucial membrane thus constitutes a semilunar fold. In the hollow between the tonsils and fold there is a trabecular arrangement of the membrane connecting them, forming a series of interstices or deep pits.

The velum pendulum palati, or soft palate, is a thick fold composed of mucous membrane, glandular and connective tissues, with an unusual quantity of strong fleshy muscular fibre. During the contracted state the thick, fleshy velum forms a complete partition between the pharyngeal cavity around the aperture of the glottis and the faucial one in front. The mucous membrane is studded laterally with muciparous apertures, which follow the attached base of the posterior pillars. The pendulous uvulæ are divided by a deep median incision. Each uvula is rounded, its free margin running outwards, backwards, and then downwards, as the posterior pillars of the fauces, to the front of the epiglottis; a fossa, however, exists between the two latter parts.

The parotid and submaxillary glands in their diminutive development offer resemblances to the Seal tribe generally. In this *Otary* the parotid obtains as a small flat subtriangular body situated below the tympanic region, sunk in a recess partially covered by the cranial end of the sternomastoid muscle. The submaxillary gland is rounder in form, but of nearly the same size as the parotid. It lies lower than the preceding, more behind the angle of the mandible, and upon the surface of the digastric muscle. Below the jaw and tongue, and in the concavity between the latter and inner normal surface, there is a long but irregular chain of flattened glandular substance, the sublingual gland. Through its substance the lengthened duct of the submaxillary passes; and both secretions find exit in the mouth, near the frænum linguæ.

d. *Muscles of the Tongue and Palate.*—Mylo-hyoid. Possessing strong coarse fascicular bundles of fibres, this broad and somewhat extensive sheet of muscle is attached to the ramal groove. The muscles of the opposite sides approach and freely inter-

mingle with each other in the middle line of the inframandibular region, rather forming a continuous whole and tolerably thick layer than thinning into a median longitudinal raphe. Anteriorly the fibres curve forwards; and centrally, about the middle, they have a transverse direction, while posteriorly they bend inwards and backwards. The latter are not inserted upon the basihyal of the os hyoides, but rather superficial to it, being fixed by strong tendinous fascia to the fibres of the sterno-hyoid, omo-hyoid, and hyoglossus muscles. Thus, as regards their action, the fibres of the mylo-hyoid are continuous with those derived from the sternum, and therefore must act inversely as a long lever, according as they act from the fixed point at either end. It follows also that they have an increased power of compressing the tongue and fauces during deglutition.

Together the genio-hyoidei form a thick tongue-shaped muscular mass arising anteriorly from the concavity of the mandibular symphysis, posteriorly spreading out and thinning as they are inserted in a continuous arched manner into the whole front of the basihyals and root of thyrohyals. Although divisible into two lateral equal-sized muscles, the fibres of the genio-hyoids are closely bound together, and, like the mylo-hyoidei, present scarcely any raphe. The fibres of each genio-hyoid at its insertion run outside into those of the middle constrictor of the pharynx, and likewise, with only a very indefinite fibrous division, join those of the sterno- and omo-hyoid. The genio-hyoids, from their great strength, must act very powerfully in drawing forwards the hyoidean apparatus, and also greatly assist the closure and grasping movement of the upper pharyngeal constrictor. Their outer insertions compress or bring together the thyrohyals. It may further be remarked that, when examined deeply, each genio-hyoid is seen to be composed of what might be considered two parts. The middle appears as a long strong muscle with straight fibres inserted into the basihyal and sterno-hyoid muscle. Outside this, behind and superficially, a thin layer diverges to be partially inserted into the root of the thyrohyal and to intermingle with the omo-hyoid and middle constrictor.

The massive genio-hyoglossi may be considered an azygos plane of muscular fibres originating at the symphyseal cleft, and, therefrom assuming a fan-shape, are directed upwards and forwards to the tip of the tongue. Medianly they become vertical, and posteriorly gain the horizontal line; inferiorly the horizontal fibres of the genio-hyoglossi are flattened or slightly scooped out to receive the thick genio-hyoid muscles.

The fibres of the anterior three fourths of each muscle do not ascend to the substance of the tongue. The remaining fibres are mainly inserted upon, and partly go to the inferior wall or basis of the pharynx. Those that go backwards are inserted into the upper surface of the basihyal and side of the ceratohyal.

Hyoglossus.—This muscle is large and tolerably thick, broad behind and narrow wedge-shaped in front, also convex below and concave or deeply scooped out above, so as to fit into the prominent ceratohyals. Its origin is from the ceratohyal, thyrohyal, and posterior root of the basihyal; its outer corner of origin from the thyrohyal is

furthest back and partly covered by the middle constrictor. As it reaches the root of the tongue and narrows, it likewise becomes vertically deeper and laterally compressed, and proceeds along the genio-hyoglossus to the tip of the tongue; previously to which the styloglossus ensheaths it.

Arising from the anterior and outer side of the stylohyal the thin layer of muscular fibres of the styloglossus passes forwards and downwards obliquely, and, wrapping round the anterior half of the thicker hyoglossus, goes on with it towards the tip of the tongue. The long flattened irregular-shaped sublingual gland lies on the surface of this muscle. Representatives of the levator palati and circumflex or extensor palati are present. These were not made out precisely before cutting away the tongue and pharynx. The remnants of both appeared large; the latter muscle must be rather strong, if the long deeply-grooved hamular process be indicative of a large tendon to it.

Azygos uvulæ.—This so-called pair of muscles are very long, narrow, but strong fleshy bands. They arise (close together) from the hinder edge and under surface of the palatine plates, and, proceeding backwards deeply within the tissues of the soft palate, diverge, one to each division of the uvula, being expanded inferiorly.

The palato-pharyngeus is a strong broad fleshy layer, with a postpalatine origin. The fibres as they go backwards diverge outwards and go round to the back of the pharynx, mingling partly with the superior constrictor, and partly covering the œsophageal membrane itself. A salpingo-pharyngeus was not differentiated, if it existed. The presence of a stylo-pharyngeus, however, was better attested, viz. a longish band starting anteriorly from the tympanohyal cartilaginous apex. Directed rearwards deeply between the superior and middle constrictors, and becoming broader, it is fastened to the nodular cartilage at the posterior end of the thyrohyal and to the anterior cornu of the thyroid cartilage. The fibres of the palato-glossus are intimately united with the neighbouring muscles. They pass inwards and downwards from the narial opening to the genio-hyoglossus.

2. *Deglutitive Apparatus.*

a. *Pharynx and fleshy appurtenances.*—The pharyngeal cavity comprehended behind the velum is capacious, but under the influence of powerful constrictors; at the same time it is so very distensible that, in the relaxed condition of the parts, many of the folds and rugæ are readily obliterated. Its whole interior mucous coat is remarkably glandular, and particularly so at the sides of the postnarial opening. A foreshortened view of the region under consideration is shown in Pl. LXXX. fig. 57; it may be described as follows:—The posterior pillar of the fauces projects on the side of the wall in front of the epiglottis; the lingual surface has numerous wrinkled folds, some of which may be considered to represent the frænula or glosso-epiglottidean ligaments of Man. From the surface of this part a number of long conical papillæ project; these are distributed rather widely apart. The epiglottis and superior aperture of the glottis

form the floor of the cavity (these have been described along with the organs of voice); but on either side of them are several longitudinal elastic folds of membrane (aryteno-epiglottidean folds) connecting the root of the epiglottis with the wavy plications of the œsophageal portion of the pharynx.

Inferior constrictor.—Under this head I shall describe what represents the above in human anatomy; but here it may conveniently be subdivided into two portions, although the fibres of these in the median line closely intermingle with one another. 1. The crico-pharyngeal portion springs as a narrow strong muscular band from the posterior hinder (inferior) angle of the cricoid cartilage, close to and somewhat overlapping the margin of the crico-thyroid muscle. Its fibres curve slightly forwards and round the œsophagus, mingling, as already hinted, with the second portion. 2. The thyro-pharyngeal portion is much the broader, and consequently stronger, of the two. Its origin is from the surface of the thyroid cartilage between its oblique line and upper posterior œsophageal border; whence the fibres are directed in an arched manner, meeting their fellows from the opposite side, and with scarcely any median fibrous raphe. The anterior median fibres curve in an angular manner forwards, considerably overlapping those of the middle constrictor.

Middle constrictor.—Like the last, this is an expanded, tolerably thick, fleshy layer, the fibres of which are coarse and present clefts such as might suggest separation of portions, as in the preceding; moreover its points of attachment are more numerous than in that muscle. Its most posterior origin is a superficial slip which overlaps the thyro-hyoid muscle. Fibres joining this slip come deeply from the thyro-hyoid ligament immediately adjoining the superior laryngeal nerve; this portion arches towards the middle line. The broader portion in advance of this arises from the thyrohyal nearly its whole length. This attachment has fibres in conjunction with the thyro-hyoid muscle which it overlaps; in the same way it overrides and commingles with the origin of the hyoglossus, and in turn itself is overlapped by the outwardly expanded posterior fibres of the genio-hyoid, which, indeed, intimately mix with it. On the right side a further narrow slip arose from the thyrohyal. From these several sources the fibres proceed round to meet their fellows of the opposite side. Posteriorly they are arched considerably, so that part of the muscle passes under the inferior constrictor, the hinder border being convex. About the middle they are nearly transverse, and in front present a concavity forwards, the centre being attached to the skull.

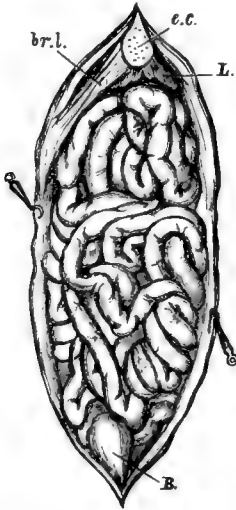
The superior constrictor underlies the fore part of the latter muscle, and is altogether very much weaker.

3. *Alimentary Canal.*

a. *Relative positions of the Abdominal Viscera.*—A longitudinal median incision having been made into the abdomen from the ensiform cartilage to the pubis, the contained viscera were found disposed in the undernoted condition. The Liver, which occupies

both the right and left hypochondriac regions, was not seen to descend or come posteriorly further than the ensiform cartilage. This viscus was equally divided into right and left moieties by the falciform ligament and the remains of the foetal vessels. The stomach was barely visible, being situated deeply in the left hypochondriac region, and almost entirely hidden by the liver. The great omentum, in the present instance perfectly devoid of fat, thin and quite transparent, did not, as is most commonly the case in Carnivora, cover the intestines, but was partially sunk among the folds of the gut. Nearly the whole visible contents of the abdomen seemed to be occupied by the small intestines; only a small portion of the rectum peered out behind them and towards the right iliac region. The empty and contracted urinary bladder extended forwards no great distance beyond the symphysis pubis. The cæcum, firmly attached to the mesentery, lay towards the right side of the spine and between the ensiform cartilage and pubes, being rather towards the former. From the cæcum the great intestine runs backwards to the iliac region, forms a loop and returns forwards again; then, with only a partial transverse fold, reaches the left of the spine, lying at this part behind the unusually loose kidney. Above the superior fundus of the bladder its rectal fold directs itself towards the median line, and passes into the pelvis, at first rather to the right side of the bladder.

Fig. 5.



Reduced sketch of the position of the abdominal viscera, as seen when opened.

e.c. Ensiform cartilage. *L.* Liver. *br.l.* The broad ligament. *B.* Urinary bladder.

[Compare with corresponding view in the Walrus, Trans. Zool. Soc. vol. vii. pl. 55. fig. 20.]

b. *The Œsophagus.*—Taking this wide tube as commencing at the lower border of the inferior constrictor muscle, it measures from this to the cardiac orifice of the stomach $22\frac{1}{2}$ inches in length. In the contracted condition its mucous membrane is tough and elastic, and thrown into very numerous interlacing and strongly ridged, pale-coloured, longitudinal plicæ. The submucous areolar tissue is plentiful, and the muscular coat very strong and thick.

The thick, well-developed muscular coat of the œsophagus of *Otaria* afforded me ample opportunity of testing whether its composition was similar or otherwise to what Dr. Rutherford¹ has described in the gullet of the Sheep, Ox, and Dog. According to him, layers of fibres cross obliquely like the letter X, but are not continuous spiral fibres from pharynx to stomach—rather decussating in evenly distributed bundles or loops, which form short parallelograms crossing three times. Thus, while strength and rapidity of transmission in either direction is gained, the tube retains a more or less uniform thickness of wall. I find, therefore, after tracing the fibres with great caution, in the hardened and distended gullet of this Seal, that they perfectly correspond with the structural conditions extant in the Ruminants and Carnivore examined by him. Indeed it becomes evident, on consideration, that the diverse direction and interdigitating of the fleshy fibres of the three massive constrictors of the pharynx are, with some modification, modelled after the same fashion. Those fibres at the opposite extremity of the tube, near the cardiac orifice, are thicker than at the middle of the gullet, and they pass on to the stomach, tending to form the so-called constrictor or oblique bands of the cardiac end of the stomach. The deep layer of fibres has the greater obliquity of the two.

Cuvier's² and Meckel's³ observations (unnoticed by Rutherford), though indefinite as regards the length and continuity of the spiral fibres, show at least there is a common type of structure prevalent among several orders of Mammalia, quite irrespective of ruminating-power.

c. The Stomach and Omenta.—The gastric viscus presents an enormous pear-shaped figure, with the neck or pyloric extremity bent sharply round. The œsophagus enters the stomach quite at the left and upper end; consequently the great *cul-de-sac*, or fundus, is short, but widely rounded. It follows also that the great curvature is long, and with a regular convex contour, whilst the lesser curvature is short and acutely angular. The small *cul-de-sac* of the right extremity, or antrum pylori, furthermore, is long, narrow, and directed forwards or upwards towards the diaphragm. The gastric and splenic vessels and nerves pass on to the surface of the stomach, about midway between the sharp angle of the lesser curvature and the cardiac orifice, and pursue their course on the anterior and posterior surfaces, as has been described under the vascular and nervous systems. They are large, and encompass the organ with a complete ramified network.

The size of the stomach of course varies according as it is distended or otherwise; the subjoined measurements therefore, it is to be noted, apply to the empty and flattened organ.

Extreme transverse diameter, median line drawn from the fundus
to the antrum pylori = 13½ inches.

¹ Linn. Soc. Journ. (Zool.) vol. iii. 1865, pp. 53–61, tab. 3.

² Leçons, 2nd ed. tome iv. p. 16.

³ Anat. Comp. vol. viii. p. 688.

| | |
|--|---------------|
| Depth or diameter between the highest point of the lesser curvature and lowest margin of the great curvature, in a line cutting the spleen | = 10½ inches. |
| Length or outer circumference, following the curve from the œsophageal to the pyloric orifice | = 31 „ |
| Length of the lesser curvature from the œsophagus to pylorus, following the inflexed margin of the viscus | = 11 „ |
| Depth of the narrowed part of the V-shaped angle of the lesser curvature | about 2 „ |

In the interior of the stomach the longitudinal folds of the œsophagus stop short, by a sphincter-like ring of mucous membrane sharply defining the cardiac orifice, which is wide and thick-walled. The mucous coat, throughout the entire cavity of the stomach, has a rough, marbled appearance, from the irregular crossing and inter-blending of slightly raised, narrow rugæ. There is a partial septum, formed by a large semilunar fold of membrane, which projects downwards in a line with the angular bend of the lesser curvature. Beyond this, towards the pylorus, the mucous plaits are more pronounced; and close to the pyloric orifice several longitudinal large folds exist; between these, reaching from one to the other, are fine, transverse, honeycomb or narrow elliptical depressions and sinuous plicæ. Although very indistinct, from the folds being low and flat, there is nevertheless a resemblance in the design of the mucous folds to what obtains in the first gastric cavity of the Cetacea, e. g. *Phocæna communis*. In the Lion (*Felis*) the lower part of the œsophagus has transverse circular folds, like valvulæ conniventes, whereas in *Otaria* they are longitudinal and thicker. The fundus is better marked (*i. e.* larger) than in *Otaria*, and the walls throughout much thicker. The orifices of the gastric glands in *Otaria* are distinctly seen as minute pinholes, distributed here and there at intervals on the membrane. The pyloric orifice, guarded by a circular fold or valve, is narrow, only admitting the finger, or less than half an inch in diameter.

The lesser omentum, while still comparatively thin, is rather thicker than the great omentum. It is attached to the lower or posterior surface of the left great venous reservoir, and to the right posterior edge of the left lobe of the liver. At this point it is also adherent to the right side of the left lateral ligament, passing on to the œsophageal end of the stomach. Having reached the upper curvature of the stomach, it stretches around and from it to the liver, there forming the dense layer of Glisson's capsule. The great omentum forms a large, but exceedingly delicate, web of membrane, traversed, as usual, by vessels derived from the right and left gastro-epiploic arteries &c. In the present instance there was not a trace of fat in the membrane when the abdomen was opened. It was observed not to cover the intestines and viscera, but to be inter-mixed among the folds of the gut. This possibly may have been an accidental circumstance.

d. *Intestines*.—The small intestines have a nearly uniform calibre throughout their entire course; the average diameter is three quarters of an inch. From the pyloric extremity of the stomach to the ileo-cæcal valve they have a length of 60 feet $2\frac{1}{2}$ inches.

Excepting the curve of the gut as it passes round the head of the pancreas, which may be arbitrarily termed the duodenum, there is no definite change in the character of the internal mucous membrane sufficient to limit the above as it passes on to the so-called jejunum. In like manner, excepting greater frequency of Peyer's patches, no line of demarcation exists between the jejunum and ileum. No valvulæ conniventes are present. The mucous lining of the whole of the small intestines ordinarily appears to the eye as smooth; but looked at more closely, and especially under water, the membrane is seen to be of a velvety or minutely villous character. The villi are arranged in transverse linear folds of a very delicate kind.

At the distance of 22 feet from the pyloric orifice the first Peyer's patch is found. It is 3 inches long and about 0·7 inch broad. Fourteen feet further on another patch of Peyer's glands is met with, which measures 7 inches in length, with a rather greater breadth than the first patch. The third agminated gland is 5 feet 10 inches apart from the second, and like it is broadish, but $5\frac{1}{2}$ inches long. A very considerable interspace then follows, apparently free from these glands. Eleven inches backwards from the ileo-cæcal valve there terminates an extraordinary long and continuous Peyer's gland. This enormous gland, or lengthened group of Peyer's vesicles, measures 4 feet 8 inches from the one extremity to the other. It varies in breadth from 0·5 to 0·8 inch, and in some places the vesicles or pits are more distinct than in others, but throughout its whole extent is well marked.

The caput cæcum coli is a simple, wide, cylindroid diverticulum, half an inch long.

The great intestine has few flexures; and its walls are remarkably free from sacculations. From the ileo-cæcal valve to the anus it measures $59\frac{1}{2}$ inches, including cæcum. The diameter of the greater part of its course is $1\frac{1}{4}$ inch, widening near the rectum to $1\frac{1}{2}$ inch. Mucous, muscular, and serous coats are each and all of considerable thickness. As may be inferred from the absence of sacculations, the longitudinal muscular fibres are not segregated in bands, but form a more or less uniformly distributed outer coat, thickest at the rectal portion, and terminating with the circular fibres in a large sphincter ani internus. The mucous folds are irregular slight elevations and shallow depressions, which only acquire a pronounced character at the lower part of the gut. The surface throughout has a minutely granulated appearance.

From what has been said it follows that the total length of the alimentary tract (that is, from the mouth to anus) is approximately equivalent to 69 feet: of this the œsophagus counts $22\frac{1}{2}$ inches, the stomach 21 inches, and the intestinal tube 65 feet 2 inches.

4. *Alimentary Glands &c.*

a. *Liver*.—As in the Earless Seals, the hepatic organ is divided in a remarkable manner—there being seven or eight very much separated lobes or lobules, and each of these is more or less subdivided into lobules and fissures of an extremely complicated kind. This furrowed and lobular character of the liver is in some respects identical with the condition obtained in the curious Rodent *Capromys fournieri*¹; only in the Sea-lion the superficial sculpturing and segregation into the smaller angular lobules does not proceed quite so far as in the animal compared. In the aberrant form of Lemuroid *Arctocebus calabarensis*² the main lobes of the liver are very much separated by deep incisions, but the surface of the organ is comparatively smooth.

In *Otaria* the root of the liver rests upon the enormously dilated abdominal venous sinuses, and, indeed, on the right side, partly surrounds that vascular reservoir.

What may be described as the first (I) lobule of the right hepatic lobe is, like the other main divisions, tongue-shaped, and only of moderate thickness. Along with the second lobule it is very much separated from the other right lobular divisions; indeed those two of themselves are quite free and placed widely apart. At its root the first lobule is adherent to the vena cava ascendens, and covers a portion of it deeply. In greatest length, upon its diaphragmatic surface, it measures 9 inches; and transversely its widest diameter is $3\frac{1}{2}$ inches. Superficially it possesses few furrows or marginal incisions, as compared with other of the hepatic segments. Those present are chiefly towards the left side, and have a trilobed character. The second, smaller lobule (II), $4\frac{1}{2}$ inches long, situated in front, springs from the root of the first. It is much the narrower of the two, and has an imperfect sagittate outline, the left barb of which is partially adherent, and crosses the base of the first lobule. Fig. 72 shows the second lobe displaced to the right of the first. The third lobule (III), much the largest division of the so-called right lobe, has a sinuous, faintly fissured margin, and comes into contact at the root behind and on the left with the fourth or quadrate lobule. It is thick, measures 10 inches in length, and averages 4 inches in breadth. Both surfaces are more or less irregularly furrowed, the gastric one furthermore having median, somewhat angular, lobulations. A thick broad ligament (*l*) passes from the left of these to the gall-bladder, which lies in the fissure betwixt the third and fourth lobules. The fourth division of the right lobe (IV), or lobus quadratus (*Q*), is differently shaped from the preceding, being composed of several pedunculate, unequally fissured parts, joined, however, at the roots and partially adherent and overlapped by the base of the third lobule behind the venous sinus. The suspensory ligament of the liver intervenes between the fourth and fifth lobules, though abdominally they are in contact. The neck of the gall-bladder is placed rather upon the left side of the third lobule; but its fundus passes obliquely to the dorsal surface of the quadrate lobule. Very large subdi-

¹ See Professor Owen's description of the anatomy of that animal, P. Z. S. 1832, p. 70.

² "On the Angwántibo," Professor Huxley, P. Z. S. 1864, p. 330, fig. 10, A, B.

visions of the portal vein run into the substance of both the third and fourth lobules; and these, along with the cystic ligament and a moderate amount of hepatic tissue, bridge together this otherwise separate or bifid cystic lobe. Its quadrate segment, our fourth lobule, is about 2 inches broad and 6 inches in extreme length.

The fifth lobule, counting from the right (v), or right moiety of the left lobe, is large, thick, and almost completely severed from its fellow moiety on the left. From its root to its narrowed free point is 11 inches long; and it varies from 3 to $3\frac{1}{2}$ inches in breadth. Marginally it is fissured, but not deeply, whilst its upper and lower surfaces are throughout very much grooved and ridged longitudinally. The furthest segment to the left, or sixth lobule (vi), is less tapering than the above, and rather smaller, namely 8 by $4\frac{1}{2}$ inches in diameter, though equally thick. Dorsally it is smoother than the fifth lobule, but ventrally is much sculptured like it; the left compartment of the venous sinus runs well into its substance.

At the root or middle of this much segmented liver, where the blood-vessels and hepatic ducts split into divisional branches, there are several leaf-like, almost separate, minor lobules. These, together, represent or are homologous with the Spigelian lobe (S), and, numerically considered, count as the seventh hepatic lobule (vii). From them there issues an hepatic duct (no. 4). They lie upon the venous reservoir, slightly to the right of its median constriction, merge into a flat hepatic piece still further on the right, and are themselves partially covered by the hepatic vessels, ducts, and Glisson's capsule. A flat, broad bridge of union (viii), connecting the otherwise separate first, second, third, and seventh lobules, runs outwards from the two latter towards the two former. It is tolerably smooth, and firmly adherent throughout to the vena cava. From its position, and being in some respects an appendage to the lobus Spigelius, as likewise its being situate between the here indefinite transverse fissure, cystic lobe, and divisions to the right of that, it appears to be homologous with the so-called lobus caudatus of Man (C).

Guided partly by the determination of both the above-mentioned anatomists on diverse Mammalian forms, and partly by a fresh consideration of the corresponding component parts in the human liver—the same organ in the Eared Seal, though greatly segmented, may be said to possess perfectly homologous constituents. That is to say, there is a right, a left, a quadrate, a Spigelian, and a caudate lobe,—each of the two former being cut into segments, the right lobe of human anatomy possessing what Owen has aptly termed a cystic lobe or division. Taking the broad ligament *suspensorium* hepatis as the line of demarcation, the four divisions to the right of it and above the enlarged venous sinus would together be equivalent to the right lobe of human anatomy. If, however, the parts be read contrariwise, what are here separate portions, have coalesced in those animals wherein the hepatic organ is simpler in conformation.

b. *Hepatic Ducts, Ligaments, and Gall-bladder.*—The very separate condition of the numerous lobes of the liver influences the distribution of the hepatic ducts. A branch

(No. 1) of considerable calibre, and 2·3 inches long, emerges from the innermost protuberant angle of the sixth lobe, and passes towards the right side, in what represents the transverse fissure of human anatomy. A very short, narrow branch (2), 0·3 inch in length comes from the diminutive and almost free lobule lying at the root of the cystic lobe, and joins the above-mentioned duct. These continue together about 0·2 inch, when a third duct pours its contents into the above conjoined one. This third branch (3) issues from the sinistral portion of the cystic lobe, is an inch long, and of equal diameter to that already spoken of as coming from the left lobe. A fourth adjunct carries the secreted bile from the irregularly shaped, nearly free lobule lying upon the immense vena cava. This branch (4) rolls round the hepatic artery, and crosses it from the left towards the right, terminating in the common tube formed by the three ducts already described, and about half an inch from them. At about the same distance further on a fifth branch (5), that sent off by the right moiety or lobule of the cleft cystic lobe, adds its contents to the united main trunk. This channel veers to the right and passes underneath the cystic duct, but without here joining it. 1·8 inch from where it received its last or fifth branch, it unites at a wide angle with a single capacious branch (6) coming from the right. This sixth division is the product of two branches—one, the wider, issuing from the right lobe, and the other the narrower, from the adjoining lobule. After the junction of the large trunk from the right side with that from the left, the single wide hepatic duct (*hd*), still keeping to the right of the cystic duct, runs parallel with it for half an inch, then joins to form the ductus communis choledochus (*dch*).

The gall-bladder is an elongated, slender-necked, pyriform sac. When distended it is 3·8 inches long and 1·8 inch in diameter at widest. It lies in the deep cleft or fissure separating the cystic lobe into a right and a left division. A ligament passing across the gall-bladder, about its middle, connects and binds it with the third and fourth hepatic lobules. The cystic duct itself is 3·2 inches long, and the ductus communis choledochus 2·3 inches. This last, the common bile-duct, externally appears to terminate in the intestine on its upper surface, about two and a half inches distant from the pyloric orifice. There, however, it only pierces the outer fibro-serous wall, but does not penetrate the mucous coat for two inches further on, where it opens in a semi-lunar slit-shaped manner. The reservoir, or expansion, is increased by an additional *cul-de-sac* extending backwards underneath the channel of ingress for almost half an inch.

The broad ligament, or suspensory peritoneal fold, as it proceeds from the diaphragm towards the liver, is attached to the immensely distended vena cava of the left side; it continues towards the incision dividing the third from the fourth lobe. The round ligament, as usual situated at the anterior margin of the broad ligament, enters what may represent the longitudinal fissure, namely that to the left of the cystic lobe, or cleft between the third and fourth lobes, where it joins the vena cava. In the present instance

this remnant of the fœtal circulation was obliterated close to the vein, at the point where a cross branch was sent to the third and another to the fourth lobe. The right lateral ligament is attached to a small portion of the upper surface of the right or first lobe, and near to its outer border. Posteriorly it joins the coronary ligament. The left lateral ligament, thicker than the right, comes from the diaphragm, close to the cardiac orifice of the stomach, and goes to the upper edge of the left lobe. The left end of the gastro-hepatic omentum joins at right angles on its right face, whence the left lateral ligament is continued onwards to the lower and inferior surface of the left capacious vena cava. The coronary ligament, traced from right to left, is attached to the posterior surface of the enlarged right vena cava, and passes along, between the vein and the diaphragm, to where the ascending vena cava penetrates the diaphragm. Opposite the right lobe of the liver it is joined at right angles with the right lateral ligament. Around and behind the right surface of the left venous reservoir the coronary ligament joins the left lateral ligament.

c. *Spleen, Mesenteric Glands, and Pancreas.*—The spleen is a flat, elongated, tongue-shaped organ, which lies behind and across the stomach, rather to the cardiac side of its middle. Its upper end has a rounded head and a beak-like process, which last is directed towards the left extremity of the stomach. The middle of the spleen is slightly the broadest part; the lower end is attenuated. The edges are smooth, and there are only two shallow emarginations—one below and to the right side, the other on the opposite border and about the middle. In the undistended state the spleen is fourteen inches long and varies from one to three inches broad. It is attached to the posterior wall of the stomach by a duplicature of the gastro-splenic omentum, which is from an inch and a half to two inches broad, and runs down for two thirds the length of the spleen in the central line. Within this omental fold some seven branches of the splenic artery and of the vein are conveyed to the gland in question; these divide into branches to the right and left sides as soon as they reach its surface, so that there is little or no hilus lienis. The internal structure of the spleen is of the usual trabecular character, and extraordinarily dilatable. Some enlarged lymphatic glands were observed on its attached or gastric side; but no accessory splenules existed, such as Owen¹ found in the Common Seal.

The mesenteric glands lie upon the anterior and the posterior surface of the main trunks of the superior mesenteric artery and vein. In all there are some six or seven of these glands; but they appear to form a continuous chain on either side of the vessels spoken of. In front they are above six inches long. The upper part, close to the root of the said vessels and below the duodenal flexure of the intestine, is an inch broad; but they lessen in size, and retain a nodulated character as they follow the course of the vessels downwards; and near the iliac flexure of the intestine the lowermost gland forms a sharp turn or bend upwards and backwards. Behind they possess

¹ P. Z. S. 1850, p. 152.

the same form, but without the lower curvature, which is replaced by a separate small kidney-shaped gland.

The surface of the mesenteric glands is traversed by innumerable parallel close-set white lines. These are chiefly lacteal vessels, but they also have nervous filaments intermingled. Some of these lacteals appear to cross the gland entirely and pass up towards the pancreas; but the greater number are derived from the mesenteric glands, and they follow the course of the arteries and veins.

Pancreas.—Whilst injecting the vessels of the abdomen with a composition chiefly of size and colouring-matter, it was observed that the pancreas became very much distended, but did not acquire the red tinge of the material employed. This was caused by an infiltration of the uncoloured fluid into the tissues of this organ, whereas the thicker colour was retained in the vessels. As a consequence the dimensions, relations, &c. of the gland were altered, so that no approximation to the truth can be offered.

VII. THE URINO-GENERATIVE SYSTEM.

1. *The Renal Viscera.*

a. *Suprarenal Capsules.*—These bodies have a position not uncommon among Carnivorous families—that is, in their non-adherence to the upper ends of the kidneys, but lying to their inner side and considerably apart from them. In the species of *Otaria* under consideration the suprarenal glands differ individually in shape and in their precise situation; but they agree in both being flattened, smooth-surfaced, and moderate-sized. The right suprarenal body is somewhat tongue-shaped, its right end, however, being expanded downwards so that the lower or posterior border is slightly concave. Its left end is continuous with and partly lies upon the very much dilated ascending vena cava. The left suprarenal gland is smaller-sized and trihedral in contour. Its inner border rests upon the left emulgent or renal vein, the narrower outer extremity pointing to the left kidney. From this latter it is distant $1\frac{1}{2}$ inch, being somewhat nearer to the abdominal aorta and ascending vena cava than to the kidney itself. When divided, the interior of each suprarenal capsule appears to consist of a uniform, soft, finely glandular substance of a pale yellowish hue. There is no central cavity, nor division into cortical and medullary parts, as is the case in Man and some Mammals.

b. *Kidneys.*—The most marked feature, as regards the position of these secreting glands in the Sea-lion, is their comparative looseness or partial freedom. Thus they are not firmly bound down by a closely adherent investment of fascia to the posterior wall of the iliac region, as occurs in many Mammals; but as in the Seals generally, and to some extent also in certain other families of the Carnivora, they are somewhat free or loosely pedunculate. Both kidneys are nearly uniform in size, 4.7 inches long and averaging 2.3 inches broad. Each is of an elongate, slightly

flattened, oval form, rather blunted, however, at the extremities; the hilus, as the kidney lies *in situ*, appears shallow, and has a somewhat forward or ventral direction. The two kidneys are situated almost on a level with each other, near the middle of the loins. The renal arteries, as has been mentioned, enter the hilus at right angles, while the emulgent veins of enormous calibre leave it more obliquely, and pass rather forwards; the ureters, most deeply situate, diverge at an opposite angle from the veins.

The capsular tunic is a strong, firm, fibrous membrane, pierced and ramified by numerous small vessels, chiefly arterial, but not possessing an external network of large veins as obtains in *Phoca vitulina* &c. Covered by its capsule, each kidney has a roughened aspect, indicating lobulation, but this by no means prominent. When the capsule is removed, the superficial renal lobulations become more manifest, the furrows and ridges, however, still being shallow and imperfectly defined.

As in feline animals generally, the external cortical substance of the kidney, when injected, presents a peculiar and rather beautiful arborescent vascular tracery. This dendritic appearance, shown in fig. 71, is due to the ramification of minute veins upon the surface of each renule; the arterial capillaries are not so distinct and not so numerous, but they nevertheless form an intervening complementary set of ramifications.

If a longitudinal section is made a little to one side of the median line, as fig. 70, Pl. LXXXI. illustrates, the kidney there is seen to be composed of between fifty and sixty lobules or renules of an irregular pentagonal and hexagonal figure, and varying in size from 0·2 to 0·5 or 0·6 of an inch. Each renule, though closely adherent to its neighbour, is clearly defined into its three renal constituents. In the middle and widest space are the fine and straight tubuli uriniferi, which radiate outwards; these are surrounded by a narrow arterial ring of short radiant vessels in which here and there puncta indicate the Malpighian corpuscles. Lastly, bounding the arterial ring circumferentially, is a rather broader venous band, which is common to the several adjoining lobules, and, as mentioned, has an arborescent cortical configuration. Each renule manifests its independent structure in the uriniferous tubules terminating in a papilla, projecting into a central cavity, which in the section in question is only displayed in some of the lobules. The cavities communicate with widish infundibular tubes, which convey the urine to the pelvis of the kidney, the latter being deeper on section than its outward appearance warrants. The renal artery, as it reaches the hilus, divides into several branches, which again subdivide into the lesser ramifications. The veins return the blood, in channels parallel with these, to the very wide emulgent vessel.

Previously to making the above-described section, I forced successfully into the kidney a fine injection of three different colours, viz. red into the artery, blue into the vein, and yellow into the ureter. By this method the structures were well differentiated. A whole kidney thus manipulated is now preserved in the Hunterian Collection; and a half of the other has been mounted by Mr. J. W. Clark, and is now deposited in the Zoological Museum of Cambridge.

c. *The Ureters and Bladder.*—As the former leave the kidneys they present a wide dilatation; but they narrow considerably at a short distance from their origin, and then, retaining the diameter of a goose-quill, enter the base of the urinary bladder a little way behind the neck, an inch apart from each other. Having penetrated the serous and muscular coats of the bladder, they continue within its walls for about three quarters of an inch, and, converging, open by narrow apertures, 0·2 inch separate, at the uvula vesicæ, immediately posterior to the prostatic portion of the urethra.

The urinary bladder is elongated and pyriform, the neck, however, being short. The serous, muscular, and mucous coats are of but moderate thickness. Of its ligaments I noted that the remains of urachus and hypogastric arteries obtain below the tip of the fundus. At the neck, just behind the prostate, a distinct strong median band of glistening tissue represents the anterior ligament. The lateral ligaments, broad and thin, reach from the neck to the fundus; and, furthermore, there is present an anterior vesical fascial layer.

2. *The Organs of Generation.*

a. *Urethra and Penis.*—The prostatic portion of the urethra is fully an inch long and narrow; the mucous membrane, thrown into narrow longitudinal folds, has the median inferior one most elevated. The caput gallinaginis or veru montanum is distinctly marked, though of small size, and is situated anterior to the middle of the prostate gland. On either side are slight depressions, the prostatic sinuses, in which minute puncta indicate the orifices of the said gland. The membranous portion of the urethra is slightly wider and more dilatable than the prostatic portion; but its mucous folds resemble the latter. Its length is fully two inches.

The penis, which is enclosed in a loose subcutaneous sheath, measures in the contracted condition about eight and a half inches from its symphysial root to the tip of the glans. It lies adherent along the median line of the abdomen, the external opening being eight inches distant from the anus. The suspensory ligaments are two short fibrotendinous cords attached to the pubic arch, and inserted on each side of the upper surface of the middle of the enlarged bulb. The strong crura, firmly fixed to both sides of the ischial arch, swell out as they go to form the deep enlarged bulb of the corpora cavernosa. The bulb, with its investing muscles, measures $1\frac{1}{4}$ inch in vertical depth, and rather over that in length. Beyond the bulb the conjoined corpora cavernosa, or body of the penis, is round, and about the thickness of one's little finger; this diameter is continued to the proximal end of the bone, a distance of between two and three inches. From this point the united cavernous body diminishes considerably, and is partially lost in the fibrovascular membrane investing the os penis.

There is no prominent corpus spongiosum, the urethral canal passing beneath the cavernous bodies, being embraced and almost hidden by them. It opens as the meatus urinarius at the front and lower end of the glans, immediately below the bone. The

preputial fold of skin continuous with the sheath is dark-coloured and much wrinkled, both circularly and longitudinally, the latter cuticular furrows being remarkably small. The prepuce is attached $1\frac{1}{2}$ inch behind the urethral orifice. The glans penis at its thinner hinder end has dark-coloured mucous membrane; but the bulbous terminal front is more florid. The truncate extremity of the glans is oval, the long diameter vertical, and the lower end the narrowest part. The somewhat prominent distal end of the bone is covered by a layer of mucous membrane, between which and the outer glans there is a shallow furrow.

The os penis, a strong bone, is altogether 4 inches long, but in the present example of *Otaria* angularly bent; suffice it to say that in other examples of the genus the os penis is more or less straight. The posterior extremity of the bone is thickest, the remainder forwards to the glans penis roundish, and about 0.2 inch in diameter. At the distal end it terminates abruptly in a vertically extended and laterally compressed truncation.

Strange to relate, the animal during life had the misfortune to sustain a fracture of the penis, though the exact nature of the injury was only revealed after death. Either just before or immediately after the *Otaria* came into the possession of the Society it was observed that the point of the penis protruded continuously through the membranous sheath which usually encloses it. With this constant supposed partial erection the glans and foreskin were inflamed and in a raw state. The tumidity &c. of the parts suggested the probability of phymosis; and it was proposed to alleviate the malady by topical treatment, or operation if need were. Neither, however, was very feasible; and as the swelling gradually subsided, no further active measures were taken. Time brought about a cessation of all bad symptoms; but the glans penis was never afterwards withdrawn within the sheath. At last it became leather-like and callous from the continual rubbings it was subjected to as the animal walked and scrambled about in its rough gravelly enclosure. On dissection of the body it was discovered that the os penis was broken exactly in its middle. The bones had firmly united in the form of an arch or obtuse angle; that portion of the external limb of the arch within the glans could necessarily never be withdrawn within the sheath. In the delineation of the organs of generation (Pl. LXXXII. fig. 73) this most remarkable piece of nature's surgery is shown, the asterisk pointing to the apex of the angle or seat of fracture. In the figure in question the relative positions of the bladder, urethra, and penis are, of course, altered from that which they had in the living animal; notwithstanding, the amount of bending in the bone is thoroughly appreciable.

b. *Muscles of the Genitals and Anus.*—The retractors of the penis are two long, narrow, riband-like muscles, which have origin among the fleshy fasciculi of the internal sphincter and levator ani muscles anterior to the rectum. The retractors pursue a parallel course along and under the surface of the penis, and are inserted into the tissues connected with the prepuce.

The membranous portion of the urethra has a thin layer of transversely striped mus-

cular fibres covering the whole length of its exterior. This is the true compressor urethræ; and, as far as my dissection enables me to judge, the muscular sheet in question comprehends what, in human anatomy, have been respectively termed the *circular fibres* of Santorini, or *stratum internum circulare* of J. Müller, the *constrictor urethræ*, and the *levator prostatae*. The compressor urethræ, then, in *Otaria jubata* embraces the membranous portion of the urethra in such a way that it appears to surround the parts spirally. The fibres posteriorly are partially continuous with those of what has been named by some anatomists the "*sphincter vesicæ*." They are very sparse over the prostate, however, and, on reaching the membranous portion of the urethra, apparently divide into two thick symmetrical halves, which have a direction downwards and forwards towards the anus and pubes. These fleshy moieties may be taken as the equivalent of Guthrie's muscle in the human being, which would seem to be but the continuation forwards of the outer oblique fibres of the bladder, Pettigrew's figure-of-8 loops. In front and below, a laterally compressed band of fibres goes towards, and joins, through the rectovesical fascia, the levator ani muscle. This portion seems to represent the "*levator prostatae*" of Santorini, Albinus, and Soemmering, and to be the fibres known as Wilson's muscle. Some few fibres, again, extend upwards to the symphysis pubis; these are analogous to the constrictor urethræ of some human anatomists, and may be what has been described as the ascending portion and origin of Wilson's muscle.

The bulbo-cavernosus muscle is made up of strong fibres, which curve round the bulb as in other Carnivora &c. The erectors of the penis have origin from the ischial tuberosities; and each, as a thick carneous mass curvilinear in figure, is inserted into the side and postero-inferior surface of the enlarged crus penis.

The sphincter ani internus is strong and broad. It powerfully constricts the lower part of the rectum and anus for an inch or more. The circular fibres join those of the transversus perinæi, levator ani, and retractores penis. There is also an external sphincter of the anus, which is of considerable size.

Reference and figures of the unusually large and peculiarly inserted levator ani and transversus perinæi muscles are given in Part II.; so that nothing further need be said of them in this place.

c. ♂ *Genital Glands, Scrotum, &c.*—Prostate gland.—Surrounding the urethra for an inch in antero-posterior extent, and of a cylindroid or spindle-shape, is the very moderately raised glandular body of the prostate. Its structure is compact and finely textural, merging almost indefinitely in the fibres of the sphincter vesicæ behind, and equally continuous with the urethral walls in front. The efferent canal and ejaculatory ducts appear to open at the minute orifice of the sinus pocularis an inch in advance of the apertures of the ureters.

There are no vesiculæ seminales; and bodies representing Cowper's glands are absent, or so small as to escape observation.

Testes and surrounding parts.—Enveloped in a strong, but loose, tunica vaginalis, the

testicles occupy the very remarkable ischio-rectal fossæ, and thus, as respects position, differ widely from those of the Earless Seals, whose testes lie in the pubic region, or the groin outside the abdomen. There is, moreover, in this Eared Seal (*Otaria jubata*), as has been mentioned and figured along with the cutaneous parts, an external scrotum; but it is not usually prominent; nor does it generally hang downwards, as in other mammals. Indeed the superficial scrotal tissues are chiefly distinguished from the neighbouring skin by the wrinkling and folds rather than by the dependent nature of the sac.

On slight pressure being applied above this somewhat rudimentary scrotum, the testicles come down or emerge from the ischio-rectal cavity in which ordinarily they are lodged, and, as they pass into the scrotal sac, dilate it considerably. They do not, however, show a tendency to remain down, but are easily replaced or returned to the ischio-rectal hollow already alluded to.

This ischio-rectal fossa, wherein each testicle ordinarily lies, is a narrow elongated cavity, between two and three inches deep, the opening of which is to the outer side of the very limited perinæum. On removal of the integument and a further dissection being made (such as is exhibited in fig. 33, pl. lxxiii., of former memoir), the boundaries and general relations of this cavity are unfolded. These are as follows:—Anteriorly or superficially is a somewhat semilunar-shaped fold of strong fibrous tissue, or proper perineal fascia, which is partly continuous with the dartos or scrotal muscular fibres and those of the transversus perinæi. Externally, above and in connexion with this perineal fascia is the oblique sweeping arch or fleshy plane of the gracilis muscle; beneath or deeply, the great broad semimembranosus; posteriorly and also deeply, or at the bottom of the fossa, the semitendinosus and partly glands and vessels; inwardly or in the median line, the transversus perinæi, root of the penis, circular fibres of sphincter ani, and the rectum itself.

The testis itself and investing vaginal tunic is, moreover, supported by fibres which run towards the perinæum; and other still more delicate fibres proceed outwards and pass on to the superficies of the muscles of the lower tibial region. Some of the transverse layer of fleshy fibres representing transversus perinæi, along with fibrous tissue and fat, constitute a partial protection or anterior wall to this most unusual testicular chamber.

The body of the testicle, including the epididymis, is smooth-surfaced, and of an oval or almond shape, 1·8 inch long and 0·9 inch broad. A strong duplicature of the tunica vaginalis firmly binds down the testicle to the bottom of the pouch; the reflection of this, the tunica albuginea, is of considerable thickness. On a vertical median section of the testis being made, the tunica albuginea is seen to dip between the lobes of the glandular substance. At its back part, where covered by the globus major, it is almost a line in depth; and, in the uninjected condition, at this part it possesses a punctate or trabecular arrangement from the intermingled vascular network, the *rete* or

tunica vasculosa. The glandular lobes of the tubuli seminiferi are small and very numerous, the corpus Highmorianum being centrally well pronounced. The epididymis is nearly of uniform breadth, the globus major having no very marked obtuse head. Structurally to the eye it has a glandular-looking aspect, with irregular transverse, white, glistening septa.

DESCRIPTION OF THE PLATES.

PLATE LXXV.

- Fig. 1. Upper view of the skull of the Society's male specimen of *Otaria jubata*.
 Fig. 2. Basis of the same skull, viewed from below.
 Fig. 3. Front and foreshortened aspect of same, with mandible.
 Fig. 4. Occipital view of the skull, minus the inferior maxilla. Objects here given all about $\frac{2}{3}$ nat. size, and from photographs.

PLATE LXXVI.

- Fig. 5. Profile view of the same male Otary's cranium, with mandible.
 Fig. 6. Portion of its inferior basis cranii, slightly tilted inwards to show certain relations of alisphenoid canal &c.
 Fig. 7. Upper view of the inferior maxillæ.
 Fig. 8. The angle and articular condyle of the left mandible, seen from below.
 Fig. 9. The internal basis of the same skull, opened by a horizontal section made from the squamo-frontal process to the upper ends of the occipital condyles, and vertically cut by an incision 0.3 inch behind the former point.
 Fig. 10. The interior surface of the removed calvarium. Figures each reduced, about two thirds natural size.

In this and the preceding Plate the same lettering is used throughout.

Bones.

| | |
|---------------------------------------|----------------------------|
| <i>Pmx.</i> Premaxilla. | <i>So.</i> Supraoccipital. |
| <i>Mx.</i> Superior maxilla. | <i>Eo.</i> Exoccipital. |
| <i>Na.</i> Nasal. | <i>Bo.</i> Basioccipital. |
| <i>Fr, Fr*.</i> Pre- and postfrontal. | <i>Bs.</i> Basisphenoid. |
| <i>Pa.</i> Parietal. | <i>Ps.</i> Presphenoid. |
| <i>Sq.</i> Squamosal. | <i>As.</i> Alisphenoid. |
| <i>Ju.</i> Jugal or malar. | <i>Ty.</i> Tympanic. |
| <i>Pl.</i> Palatine. | <i>Ma.</i> Mastoid. |
| <i>Pt.</i> Pterygoid. | <i>Mn.</i> Mandible. |
| <i>Vo.</i> Vomer. | |

Processes.

| | |
|-----------------------------------|--------------------------------|
| <i>ao.</i> Antorbital. | <i>cd.</i> Mandibular condyle. |
| <i>po.</i> Postorbital. | <i>co.</i> Coronoid. |
| <i>pf.</i> Postfrontal. | <i>a.</i> Angle of mandible. |
| <i>c.</i> Condyle. | <i>t.</i> Tentorium. |
| <i>pmd.</i> Paramastoid. | <i>gl.</i> Glenoideum. |
| <i>h.</i> Hamular (of pterygoid). | <i>eth.</i> Ethmoidal spine. |

Foramina.

| | |
|---|----------------------------------|
| <i>ap.</i> Anterior palatine. | <i>vc.</i> Vidian canal. |
| <i>io.</i> Infraorbital. | <i>pe.</i> Posterior ethmoidal. |
| <i>als.</i> Alisphenoid. | 2. Optic. |
| <i>ov.</i> Ovale. | <i>la.</i> Lacerum anterior. |
| <i>ca, ca*.</i> Carotid (canal). | <i>lm.</i> Lacerum medius. |
| <i>jug.</i> Jugular. | <i>sp.</i> Spinosum. |
| <i>mae.</i> Meatus auditorius externus. | <i>af.</i> Aquæductus Fallopii. |
| <i>mai.</i> Meatus auditorius internus. | <i>av.</i> Aquæductus vestibuli. |
| <i>sm.</i> Stylo-mastoid. | <i>lg.</i> Longitudinal (sinus). |
| <i>aur.</i> Auricular. | <i>mg.</i> Meningeal groove. |
| <i>ac.</i> Anterior condyloid. | <i>me.</i> Mental. |
| <i>ex.</i> Exoccipital. | <i>i.</i> Incisive. |
| <i>fm.</i> Foramen magnum. | <i>id.</i> Inferior dental. |
| <i>v.</i> Vascular (bony channels). | |

Teeth.

| | |
|---|---|
| <i>I, \bar{I}.</i> Incisors. | <i>PM, \overline{PM}.</i> Premolars. |
| <i>C, \bar{C}.</i> Canines. | <i>M, \bar{M}.</i> Molars. |

The upper dotted line in fig. 5 denotes where calvarium was sawn through. Compare figs. 9 and 10.

PLATE LXXVII.

Fig. 11. Skeleton of the Zoological Society's male Sea-lion, sketched in the natural attitude of walking, and with dorsum of the sacro-pelvic region slightly turned towards the observer.

Series of skulls of *Otaria jubata*, illustrating progressive growth, reduced to scale one fourth their natural magnitudes:—

Fig. 12. Profile of skull, No. 3971 c, College-of-Surgeons Museum. It is one of two young Seals' crania presented by Captain B. J. Sullivan, R.N., in 1844, and described by him in a letter as "about a fortnight old."

Fig. 13. Upper view of the same specimen.

Fig. 14. Side view of skull, No. 3971 B, College-of-Surgeons Museum, said by donor, Captain Sullivan, to be that of a "yearling."

Fig. 15. Same skull as seen from above.

Fig. 16. Profile of a female skull, No. 3968, Osteol. Cat. Roy. Coll. Surg. Presented by Admiral Beaufort, C.B., F.R.S.

Fig. 17. Upper view of ditto, exhibiting roughening or commencement of occipito-parietal crests.

Fig. 18. Side view of skull of the mounted skeleton, No. 3971 A, Roy. Coll. of Surg. Collection. This with the above crania, figs. 12-14, are each from the Falkland Islands. Attested by Captain Sullivan of H.M. ship 'Philomel,' and referred to in a letter, 21st May 1844, as male of the Hair Seal, Sea-lion, not full grown. *Vide* interleaved Catalogue and Minutes of Museum Committee, 30th August, 1844.

Fig. 19. Upper surface of skull, figured 18: B marks a bullet lodged between the frontal and root of nasal bones.

Fig. 20. Skull of a large and old *Otaria jubata*, from Dungeness Point, S.E. Patagonia, 12th January, 1867. Presented to the Hunterian Museum by the Admiralty, 1868, and in the College Catalogue numbered 3971 E.

Fig. 21. The same skull, minus the mandible, in bird's-eye view, or from above.

The letters *, *a*, *b*, *c*, in figs. 21, 20, 19, & 18, respectively indicate extraneous processes and crest, developed and most marked as age advances.

Fig. 22. A longitudinal mesial section of an aged skull in the College-of-Surgeons Museum (No. 3971, Cat.), to show the interior brain-cavity, ethmoidal bones, &c.: *c*, great occipital crest; *tent*, bony tentorium, separating cerebral and cerebellar areas; *ex*, exoccipital foramen; *pn*, posterior nares. *Fr*, frontal, *Eth*, ethmoid, and *Tb*, turbinal bones.

Fig. 23. Under view of pelvis, last two lumbar, and the sacro-caudal vertebræ of the Zoological Society's male Otary. The parts are united by ligament and the intervertebral cartilages: about $\frac{2}{3}$ nat. size. *L*, lumbar transverse processes; *c*, intervertebral cartilage; *I*, ilium; *S*, sacrum; *P*, pubis.

The separate drawings between figs. 24 and 37 are two views of each of the bones composing the left carpus and tarsus of the male central skeleton, fig. 11.

Fig. 24. Conjoined scapho-lunar bone, as seen from above (*A*) and below (*B*): *d*, upper or dorsal surface; *r*, radial articular face; *tz*, anterior facet, which articulates with the trapezium and trapezoides; *p*, lower or palmar surface; *m*, facet for os magnum; *uc*, unciform facet.

Fig. 25. Cuneiform, (*A*) its postero-outward and (*B*) antero-inner faces: *ag*, upper hinder, and *ag**, lower front angle of the bone; *ul*, ulnar fossa; *m^s*, facet for fifth metacarpal; *r*, radial facet; *uc*, unciform facet; *d*, narrow upper or dorsal surface.

- Fig. 26. Pisiform bone, (*A*) upper and (*B*) lower surface: *o*, outer extremity; *ul*, ulnar and cuneiform facet.
- Fig. 27. Trapezium, (*A*) upper and (*B*) lower and inner face: *s*, scapho-lunar border; *o*, outer border; *m*¹, first metacarpal facet; *td*, trapezoidal facet; *m*², second metacarpal facet; *p*, palmar surface.
- Fig. 28. Trapezoides: (*A*) inner and anterior faces, (*B*) outer and lower faces. *tp*, facet for trapezium; *m*², second metacarpal facet; *d*, upper or dorsal surface; *p*, palmar surface; *s*, scapho-lunar facet.
- Fig. 29. Os magnum, (*A*) inner and (*B*) outer surface: *d*, dorsal, and *p*, palmar apices; *m*³ and *m*⁴, facets for third and fourth metacarpals; *s*, scapho-lunar ridges; *cb*, cuboidal facet; *td*, trapezoidal facet.
- Fig. 30. Unciform, (*A*) postlateral inner and (*B*) postlateral outer surfaces: *s*, scaphoid facet; *mg*, face partially articulating with os magnum; *m*⁴ fourth metacarpal facet; *c*, cuneiform facet; *m*⁵, fifth metacarpal facet; *d*, dorsal, and *p*, palmar surface.
- Fig. 31. Astragalus, (*A*) upper and (*B*) lower surfaces: *t*, tibial, and *f*, fibular articular faces; *n*, navicular facet; *c*¹, *c*², the two calcaneal facets.
- Fig. 32. Os calcis, (*A*) superior and (*B*) inferior surfaces: *, epiphysis adherent to the posterior extremity of the tuberosity; *a*¹, *a*², the two astragaloid facets; *cb*, cuboidal articular surface.
- Fig. 33. The cuboid: (*A*) upper, outer, and partly anterior and posterior faces; (*B*) inner and inferior faces. *c*, calcaneal end; *m*^{4,5}, distal extremity for fourth and fifth metatarsals; *d*, dorsum; *g*, peroneal groove; *n*, naviculare, and *ec*, ecto-cuneiform facets.
- Fig. 34. Naviculare, (*B*) posterior and (*A*) anterior faces: *d*, dorsum; *a*, astragaloid fossa; *i*, internal angle; *ec*, *mc*, *en*, ecto-, meso-, and entocuneiform facets.
- Fig. 35. Entocuneiform, dorsal (*A*) and plantar (*B*) superficies: *n* and *mc*, facets for naviculare and mesocuneiform; *m*¹ and *m*², articular faces of first and second metatarsals; *d*, dorsum; *g*, groove for peroneus longus.
- Fig. 36. Mesocuneiform, (*A*) internal and (*B*) external faces: *d*, dorsal, and *p*, plantar border; *m*², second metatarsal articular surface; *ec* and *en*, ecto- and entocuneiform facets.
- Fig. 37. Ectocuneiform, (*A*) exterior and (*B*) interior faces: *d* and *p*, dorsal and plantar borders; *m*^{3,4}, articular border for third and fourth metatarsals; *cb*, cuboid facet; *n*, hind border or naviculare facet; *en*, part entocuneiform facet.

PLATE LXXVIII.

- Fig. 38. Upper surface of the brain of the male *Otaria jubata*, about nat. size.
- Fig. 39. Base of the same, with cerebral nerves.
- Fig. 40. Right lateral superficial view of the brain, also nat. size.

Fig. 41. Reduced sketch of a posterior segment of the inner face of the right cerebrum, designed to show the hippocampal sulci.

Fig. 42. An outline representing the same Sea-lion's brain, as seen in front or fore-shortened. Taken from a cast of the interior cavity of the skull, with the dura mater in place.

Fig. 43. Posterior or occipital view of same. Both very much reduced.
The same lettering corresponds in all the figures of this Plate.

Cerebral Lobes.

| | | |
|---------------------|--|----------------------|
| <i>F.</i> Frontal. | \| | <i>T.</i> Temporal. |
| <i>P.</i> Parietal. | \| | <i>O.</i> Occipital. |

Convolution.

| | | |
|---|--|---|
| <i>IO.</i> Internal orbital. | \| | <i>PT.</i> Posttemporal. |
| <i>MO.</i> Mid orbital. | \| | <i>Oc.</i> Occipital (inferior). |
| <i>EO.</i> External orbital. | \| | <i>Lob¹.</i> Lobule of anteroparietal. |
| <i>IF.</i> Inferofrontal. | \| | <i>Lob².</i> Lobule of postparietal. |
| <i>MF.</i> Mid frontal. | \| | <i>Lob³.</i> Lobule of supramarginal. |
| <i>SF.</i> Superofrontal. | \| | <i>Lob⁴.</i> Lobule of angular. |
| <i>Cr.</i> Crucial. | \| | <i>Lob⁵.</i> Lobule of posttemporal. |
| <i>AP.</i> Anteroparietal (=premier pli ascendant). | \| | <i>Lob⁶.</i> Lobule of internal occipital. |
| <i>PP.</i> Posteroparietal (=second pli ascendant). | \| | * Fold connecting internal occipital with quadrilateral lobule. |
| <i>SM.</i> Supramarginal. | \| | <i>Ma.</i> Great marginal. |
| <i>Ang.</i> Angular. | \| | <i>Ca.</i> Callosal. |
| <i>AT.</i> Anterotemporal (=inframarginal). | \| | <i>Cl.</i> Callosal lobule. |
| <i>M.T.</i> Mid temporal. | \| | <i>Ql.</i> Quadrilateral. |
|  | \| | <i>U.</i> Uncinate. |

Fissures and Sulci.

| | | |
|---|--|---|
| <i>io.</i> Intorbital. | \| | <i>mt.</i> Mid temporal. |
| <i>mo.</i> Mid orbital. | \| | <i>ot.</i> Occipito-temporal (=posttemporal). |
| <i>eo.</i> Extorbital. | \| | <i>ep.</i> External perpendicular (faint line pointing to front one). |
| <i>cs.</i> Crucial. | \| | <i>ip.</i> Internal perpendicular. |
| <i>ap.</i> Anteroparietal. | \| | <i>cm.</i> Calloso-marginal. |
| <i>ro.</i> Rolando. | \| | <i>co.</i> Colateral. |
| <i>ipa.</i> Intraparietal. | \| | <i>calc.</i> Calcarine. |
| <i>sy¹.</i> Sylvian (antero-vertical). | \| | <i>dent.</i> Dentate. |
| <i>sy².</i> Sylvian (postoblique). | \| |  |
| <i>at.</i> Anterior temporal (=parallel). | \| |  |

Parts Base and Internal Face.

| | | |
|-----------------------------|--|---|
| <i>al.</i> Corpus albicans. | \| | <i>py.</i> Anterior pyramid of medulla oblongata. |
| <i>pv.</i> Pons Varolii. | | <i>f.</i> Fornix. |
| <i>cc.</i> Corpus callosum. | | |

Nerves.

| | | |
|---------------------------|--|--|
| 1. Olfactory. | \| | 6. Abducentes. |
| 1*. Olfactory bulb. | | 7. Facial and auditory. |
| 2. Optic (at commissure). | | 8. Glossopharyngeal and pneumogastric. |
| 3. Motores oculorum. | | 8*. Spinal accessory. |
| 4. Pathetici. | | 9. Hypoglossal. |
| 5. Trifacial. | | <i>ce.</i> Cervical (anterior). |

Cerebellum.

| | | |
|----------------------------------|--|------------------------------------|
| <i>h</i> Hollow. | \| | <i>p.</i> Posterior lobe. |
| <i>fl.</i> Flocculus. | | <i>sv.</i> Sup. vermiform process. |
| <i>to.</i> Tonsil (or amygdala). | | <i>ls.</i> Lobus superioris. |
| <i>a.</i> Anterior lobe. | | <i>li.</i> Lobus inferioris. |
| <i>m.</i> Middle lobe. | | |

PLATE LXXIX.

Fig. 44. Inner surface of the right half of the same Otary's brain, of natural dimensions: *Ma*, great marginal convolution; *cm*, calloso-marginal sulcus; *Ca*, callosal gyrus; *Cl*, its callosal lobule; *Ql*, quadrilateral lobule; *Io*, internal occipital lobule, more fully shown in fig. 41, and marked *Lob*^s; *, a ridge therefrom partly connecting it with the quadrilateral lobule; *ip*, internal perpendicular fissure; *ocp*, occipital sulcus (see fig. 41); *cc*, corpus callosum; *sp*, splenium; *g*, genu; *f*, fornix; *V*^s, fifth ventricle; *th*, thalamus opticus; *pi*, pineal gland; *c*⁴, corpora quadrigemina; *V*³, fourth ventricle; *acm*, anterior commissure; *av*, arbor vitæ; *al*, corpus albicans; 1, olfactory bulb; 2 and 3, second and third nerves; *pv*, pons Varolii; *ap*, anterior pyramid of medulla oblongata.

Fig. 45. Horizontal section of the left cerebral moiety, exposing the cavity of the lateral ventricle &c.: *ac*, anterior cornu; *cs*, corpus striatum; *cf*, corpus fimbriatum, overlying choroid plexus; *th*, thalamus opticus; *pc*, posterior cornu, the dotted line in front, indicating the middle or descending cornu; *sy*, Sylvian fissure; 1*, olfactory bulb.

Fig. 46. Somewhat enlarged outline of the under surface of the left temporal lobe and neighbouring parts. The middle or descending cornu is opened into, and the

hippocampus major shown. *sy*, Sylvian fissure; *mc*, middle cornu; *hm*, hippocampus major; 2, 3, 4, portions of roots of corresponding nerves.

Fig. 47. Dissections displaying the heart, the great vessels, their divisions, and portions of the lungs.

1, 2, 3, 4, roots of different lobuli of right lung; *tr*, trachea at its bifurcation; a portion of the pulmonary substance is removed to show the bronchial divisions and vessels at lung's root; *ao*, dilated arch of the aorta; *ao**, descending aorta, of diminished calibre; *Pa*, pulmonary artery; *da*, ductus arteriosus; *i*, innominata; *r.s*, *l.s*, right and left subclavians; *r.c*, *l.c*, right and left common carotids; *r.s*, *l.s*, right and left subclavian arteries; *v*, vertebral; *im*, internal mammary; *vc*, vena cava descendens.

Fig. 48. Reduced sketch, exhibiting the semidivided upper or anterior surfaces of the great hepatic venous sinuses, and their relations to the diaphragm, liver, and stomach, as seen on removal of the parts *en masse*.

*Vs*¹, right moiety, and *Vs*², left moiety of the hepatic venous sinus or dilated vena cava ascendens; *D*, diaphragm; *br*, its broad ligament; *r.l*, round ligament; *la*, right lateral ligament; *St*, stomach, hidden in great part by the liver; *G.b*, gall-bladder.

Fig. 49. Vertical antero-posterior section of the contents of the right orbit, made slightly to one side of the median line: *l*, lens; *V*, vitreous chamber; *A*, anterior or aqueous chamber; *c*, conjunctiva; *co*, cornea; *sc*, sclerotic at its thickened hinder part; *ch*, choroid; *r*, retina; *cp*, ciliary processes; *i*, iris; *P*, canal of Petit; *S*, venous sinus or canal of Schlem; *n*, opening of nasal duct; *gl*, gland; *t*, tarsal cartilage; *o*, optic nerve; *a*, artery; *Rs*, *Ri*, superior and inferior rectus; *cho*, choanoid muscle.

Fig. 50. Inner view of the anterior segment of the eyeball, cut crossways. The lettering applies as in the preceding: *sp*, sphincter iridis.

Fig. 51. The vitreous humour with adherent crystalline lens and zonula of Zinn. Seen in front, and about nat. size. The dark pigmental radial processes (*p*) of the ciliary zone are unusually long and prominent.

PLATE LXXX.

Fig. 52. Tongue and fauces of the Sea-lion shown as an anatomical preparation, looking into the throat, but in a three-quarters view.

v, velum palati; *a*, anterior pillars of the fauces; *p*, posterior pillars; *t*, right tonsil; *e*, right postlingual eminence, or postfaucial tract; *g*, mesial groove or cleft.

Fig. 53. Under surface of the tongue, larynx, and portion of the trachea. The superficial layer of muscles &c. are retained on the left side, and a deeper dissection of the several structures brought out on the right.

M.h. Mylo-hyoid.

O.h. Omo-hyoid.

S.h. Sterno-hyoid.

S.th. Sterno-thyroid.

C.th. Crico-thyroid.

Th.h. Thyro-hyoid.

G.h. Genio-hyoid.

S.g. Stylo-glossus.

s.l. Superior laryngeal nerve and artery.

l. Lingual artery and hypoglossal nerve.

g. Gustatory nerve.

T.gl., thyroid gland; *Sgl.*, sublingual gland and duct.

- Fig. 54. Side view, deep dissection, of the same regions as in fig. 53, but enlarged. The lettering agrees, but there is in addition:—*Ghg*, genio-hyoglossus; *Thy*, thyroideus; *Ic*, inferior constrictor; *Mc*, middle constrictor; *Sph*, stylo-pharyngeus; *Hg*, hyoglossus; *oe*, œsophagus; *v*, jugular vein; *ca*, common carotid artery, dividing anteriorly into internal and external carotids, with subsidiary branches; *pn*, pneumogastric nerve, superior laryngeal, pharyngeal, and lingual derivatives springing and being distributed anteriorly.
- Fig. 55. Upper view of the pharyngeal constrictors and the adjoining parts: *il*, inferior laryngeal nerve; *Sc*, superior constrictor, in part; *Azu*, azygos uvulæ uncovered on one side; *Pp*, palato-pharyngeus; arrow leads into pharynx. Other letters apply as in preceding (fig. 54) and succeeding (fig. 56), in which latter portions of muscles have been removed.
- Fig. 56. A deeply dissected side view of the same region as in fig. 55. *He*, hyo-epiglottic.
- Fig. 57. Epiglottis and laryngeal fissure, with part of the pharyngeal membrane of the left side, reflected outwards. Seen from above, and somewhat less than natural dimensions: *Ep*, epiglottis; *sp*, fatty prominences, or Santorinian projections; *ae*, aryteno-epiglottic folds; *p*, papillæ of the postfaucial floor; *a*, arytenoid prominences; *ph*, pharyngeal cavity.
- Fig. 58. Reduced diagrams illustrating the outline of the superior aperture of the larynx in three different states of tension: 1, its natural condition; 2, slightly open, or during inhalation (?); 3, fully distended. The black ground marks the longitudinal chink, the light the divaricating loops.
- Fig. 59. The interior left half of the larynx as displayed by a mesial longitudinal section through the entire organ, but retaining the epiglottis intact: *ep*, epiglottis; *sp*, fatty projections above the cartilage of Santorini; *T*, *T**, sections of the thyroid cartilage, the smaller portion being the narrow bridge anteriorly connecting the thyroid alæ; *C*, cricoid, in front and behind; *tr*, trachea; *s*, orifice of laryngeal sac.
- Fig. 60. The deep lateral thyro-arytenoid muscles &c. The dotted outline signifies the boundary of the right thyroid ala, which has been removed. *L.c.a.*, lateral crico-arytenoid; *P.c.a.*, posterior crico-arytenoid; *Ar*, arytenoideus; *Th.a¹*, thyro-arytenoideus, its first or lower portion; *Th.a²*, second or upper portion of the thyro-arytenoideus; *s*, laryngeal sac or pouch; *ep*, epiglottis.

- Fig. 61. Hinder view of the larynx and its arytenoideus muscles; the dotted outlines indicating the absent left thyroid cartilaginous moiety. *Ar*, arytenoideus; *P.c.a*, posterior crico-arytenoid.
- Fig. 62. Ventral surfaces, hyoid bones, thyroid and cricoid cartilages, and on opposite half the deep muscles connected therewith. *H*¹ and *Hg*², separate insertions of hyoglossus; *Mc*, fibres of middle constrictor; *Thy*, thyroideus; *Cth*, cricothyroideus.
- Fig. 63. Larynx and hyoidean arch, in profile. *T*, thyroid cartilage; *C*, cricoid; *tr*, trachea; *c.t.l*, crico-thyroid ligament; *l*, lateral thyro-hyoid ligament; *sh*, stylohyal, and *tyh*, tympanohyal, its cartilaginous articulating tip; *eh*, epihyal; *cth*, ceratohyal; *bh*, basihyal; *th*, thyrohyal.
- Fig. 64. View from behind of the hyoidean arch and larynx. *A*, arytenoid cartilage; *S*, cartilage of Santorini; *n*, nodule in thyro-hyoid membrane. Other lettering corresponds with the parts in fig. 63.

PLATE LXXXI.

- Fig. 65. Reduced view of the distended stomach, seen from behind, with the spleen, vessels, and nerves *in situ*:
æ, œsophagus, cardiac end; *py*, pyloric end of stomach; *d*, duodenum; *sp*, spleen; *h.a*, hepatic artery cut short; *s.a*, splenic artery; *v.b*, trunk of one of the vasa brevia; *c.a*, cardiac artery; *g.es*, gastric epiploica sinistra as it proceeds to inosculate with the dextral branch. The veins not lettered follow alongside the arteries; *n*, gastric nerve other branches are seen distributed upon the surface of the stomach.
- Fig. 66. A few inches of the Jejunum, with the mesentery attached, and showing the intestinal subdivision and distribution of the superior mesenteric vessels: *a*, artery; *v*, vein.
- Fig. 67. Portions of the ileum and colon, with cæcum coli and ramifications of the ileo-cæcal artery and vein: *cæ*, cæcum; *a*, artery; *v*, vein. The arrows indicate the passage from small to great gut.
- Fig. 68. Small piece of intestine (14 feet from pylorus), cut open to display part of broad elongated Peyer's patch. *Pgl*. Peyer's gland, about nat. size.
- Fig. 69. A portion of the rectum, exhibiting its mucous membrane, of nat. dimen.
- Fig. 70. A longitudinal section of the right kidney, sliced through a little to one side of its middle. Of nat. size. The arteries, veins, and urinary tubes have each different-coloured injection thrown into them. *r.a*, renal artery; *rv*, renal vein; *u*, ureter; * veno-arterial inoscultations.
- Fig. 71. Segment of the cortical surface of the same kidney, showing the arborescent nature of its superficial vascularity. The darker stellate lines indicate chiefly the veins. The undulate marginal periphery exhibits but slight lobulation.

PLATE LXXXII.

- Fig. 72. Under surface of the liver, its vessels, and a small piece of the gut. Reduced. *R*, right and *L*, left hepatic moieties. I, II, III, IV, V, VI, VII, VIII, lobes or segments of the liver as described in the text. *C*, caudate, *Q*, quadrate, and *Sp*, Spigelian lobuli; *l*, cystic ligament; *cl*, coronary ligament; *Gb*, gall-bladder; *cd*, cystic duct; *hd*, hepatic duct; 1, 2, 3, 4, 5, 6, branches of same, distributed to the several lobules (see text); *h.a*, hepatic artery; *p.v*, portal vein; *Vc*, vena cava; *VS*¹, *VS*², venous sinuses, right and left, the latter only partially visible; *dch*, ductus communis chole-
dochus, an arrow showing its tunnel within wall of duodenum (*duo*) to its orifice at *o*.
- Fig. 73. Urino-generative parts, displayed as a preparation. *B*, bladder; *uh*, remnant of the urachus; *u*, ureter; *la*, lateral ligament; *a.l*, portion of the anterior ligament of the bladder; *v.d*, the termination of the vasa deferentia; *P*, prostate; *c.u*, compressor urethræ; *I.c*, ischio-cavernosus, its bony insertion cut through; *B.c*, bulbo-cavernosus; *R.p*, retractores penis; *sph*, sphincter ani; *R*, portion of rectum; *c*, left crus; *s.l*, suspensory ligament; *a.v*, dorsal artery and vein of the penis; *c.s*, dark line representing the corpus spongiosum; *os*, os penis, posteriorly defined by a dotted line; *, the bent part where fractured; *f*, frænum; *g*, glans.
- Fig. 74. Point of the penis. Front view, about nat. size. *os**, truncate termination of os penis; *g*, glans; *m.u*, meatus urinarius.
- Fig. 75. Neck of bladder, prostatic and membranous portions of urethra, opened from above. *B*, bladder; *u*, orifices of ureters; *e.d*, ejaculatory duct; *P*, prostate in section; *c.c*, corpus cavernosum.
- Fig. 76. Testicle in section and its sac. *t.v*, tunica vaginalis; *g.m*, globus major; *r.v*, rete vasculosum.

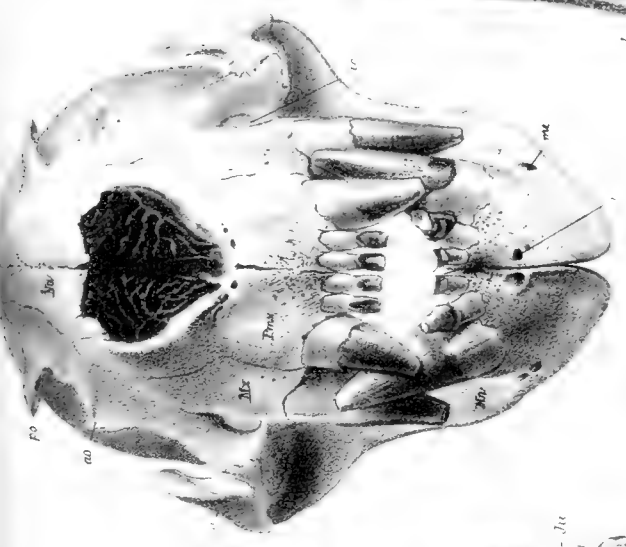
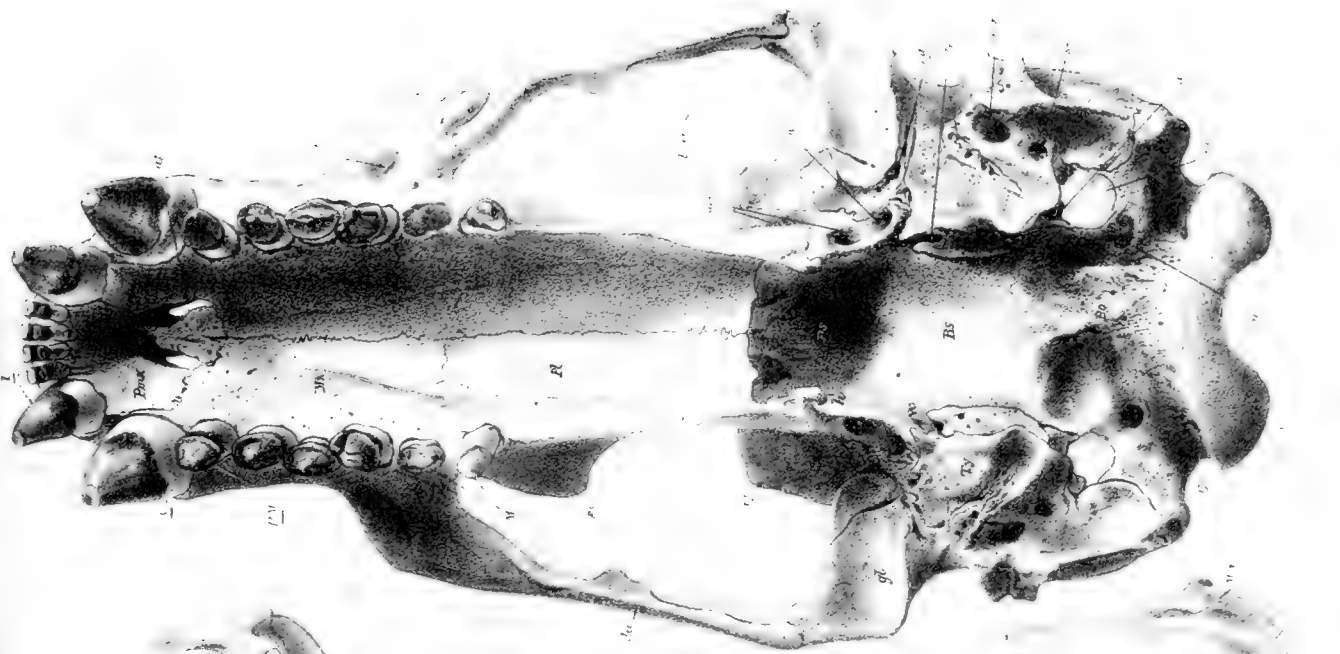


Fig 3

Fig 1









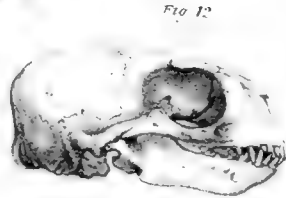
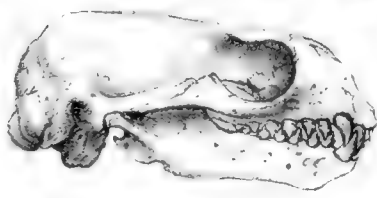
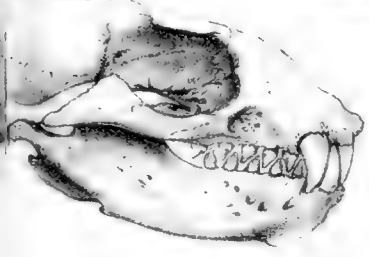
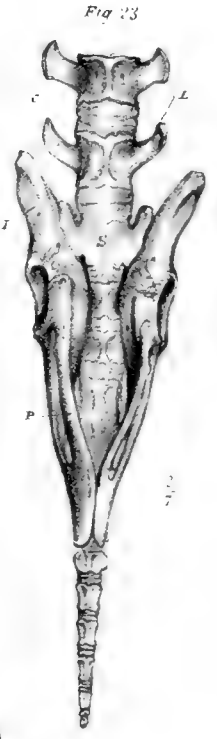
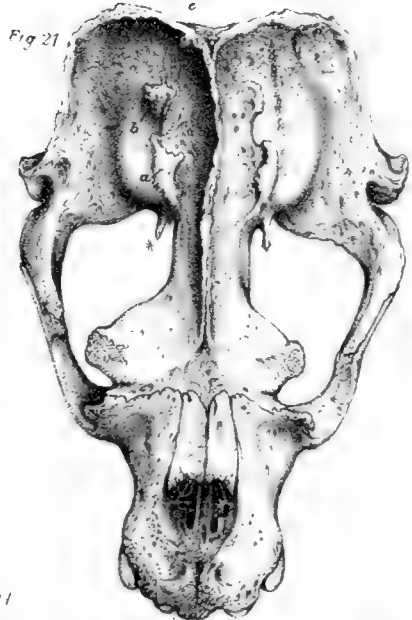
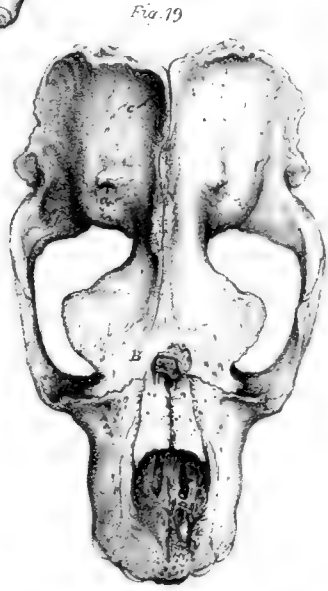
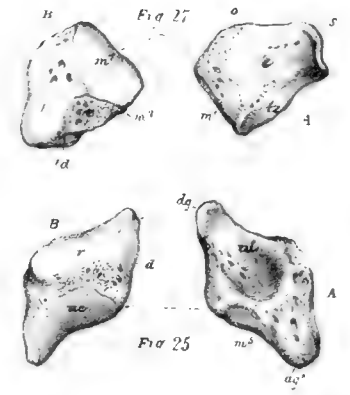
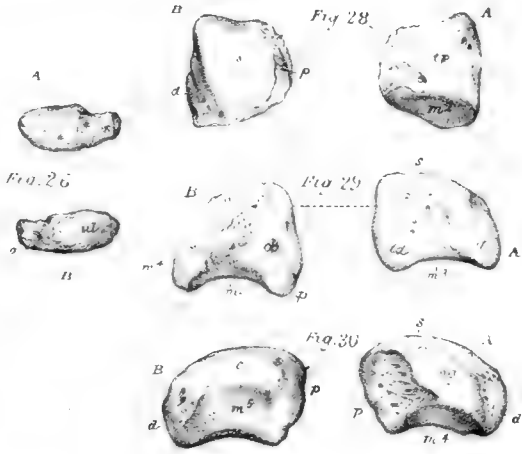
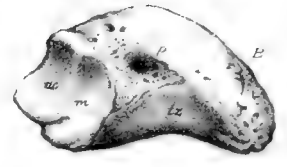
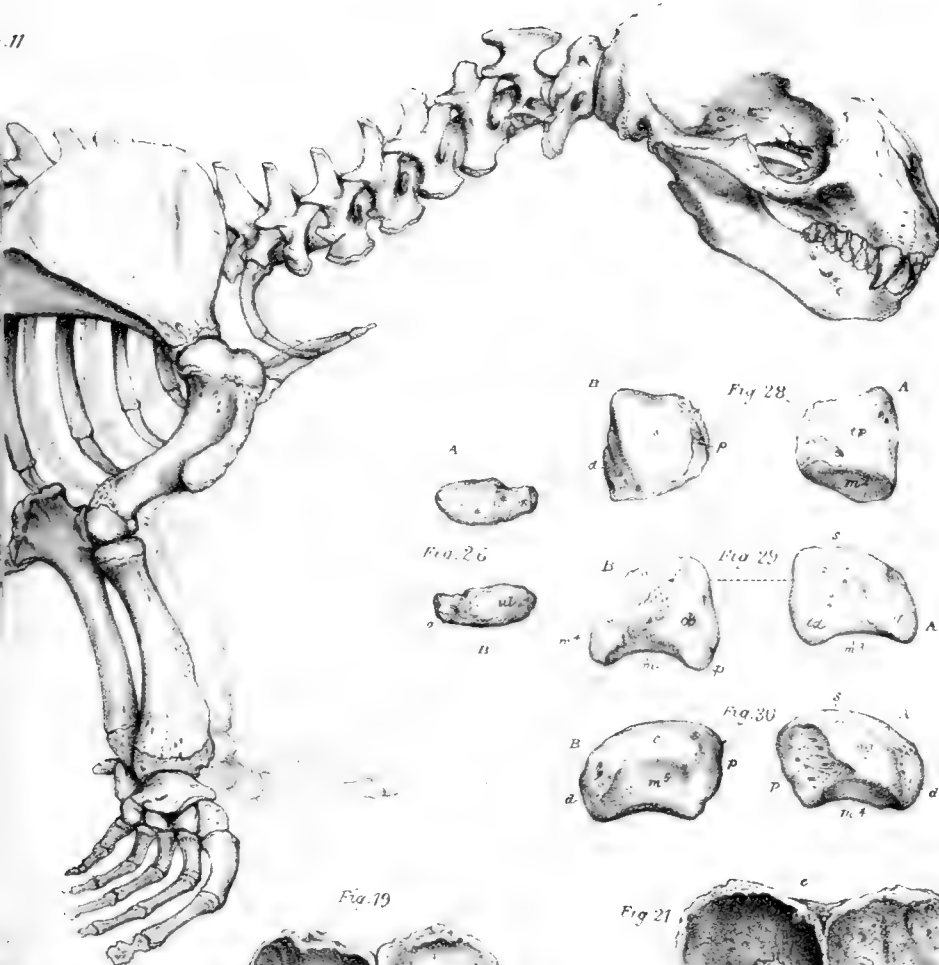




Fig. 39

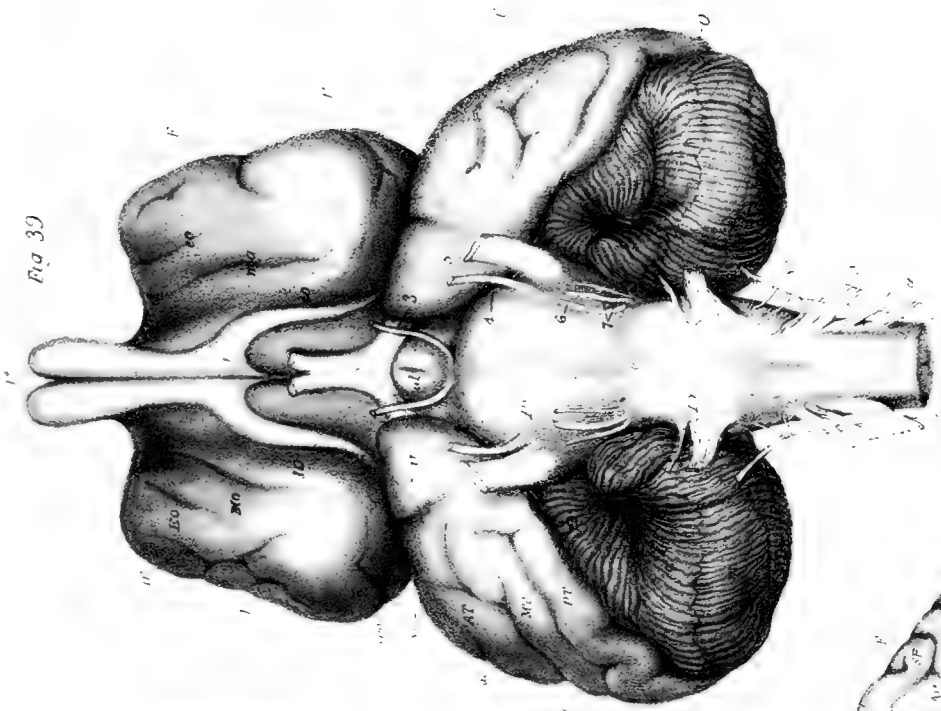


Fig. 40



Fig. 41

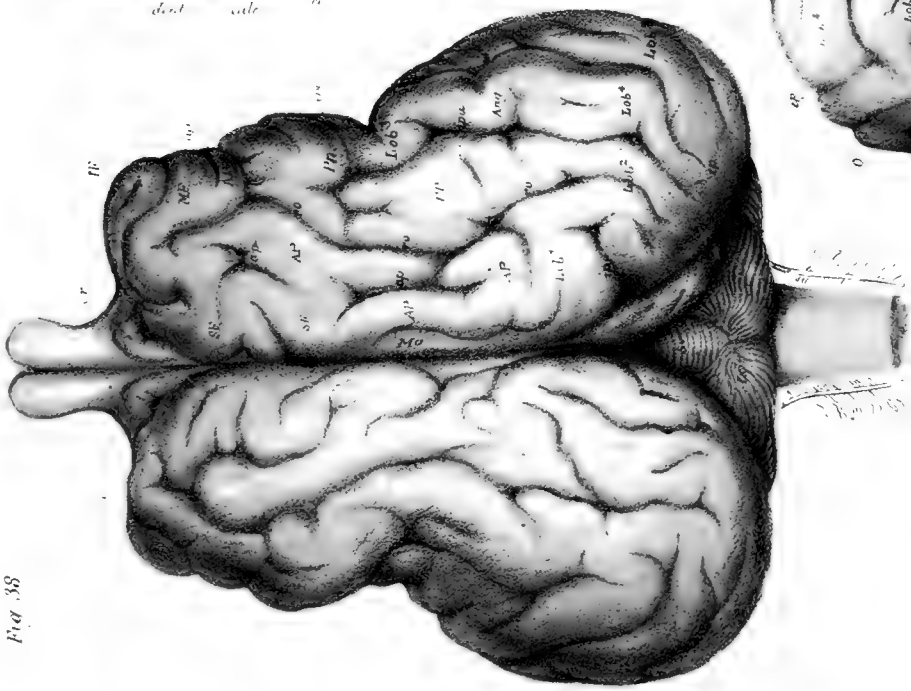
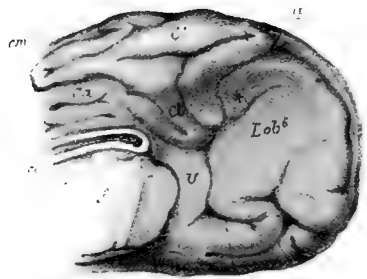


Fig. 38

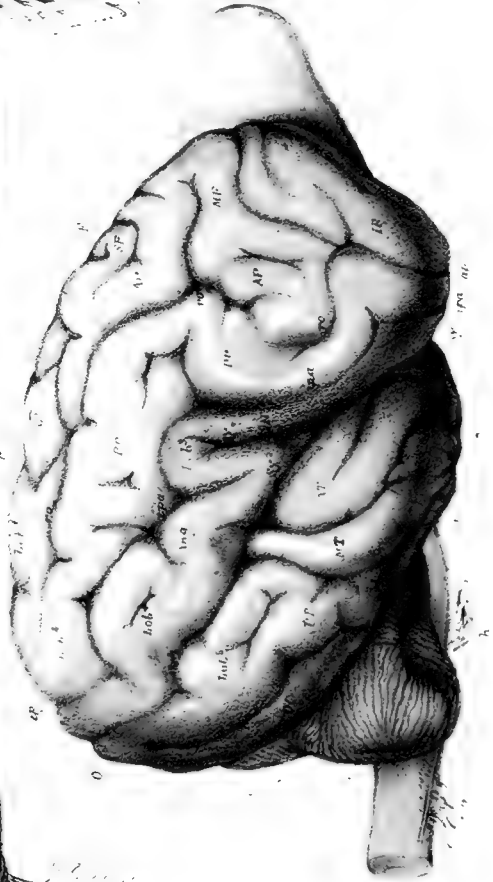


Fig. 42





Fig 48



Fig 50

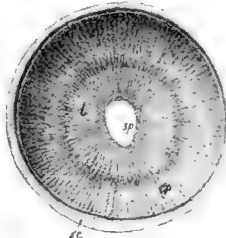


Fig 49

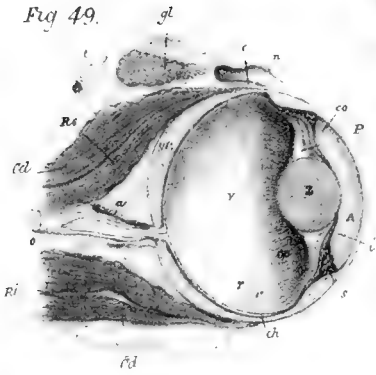


Fig 51

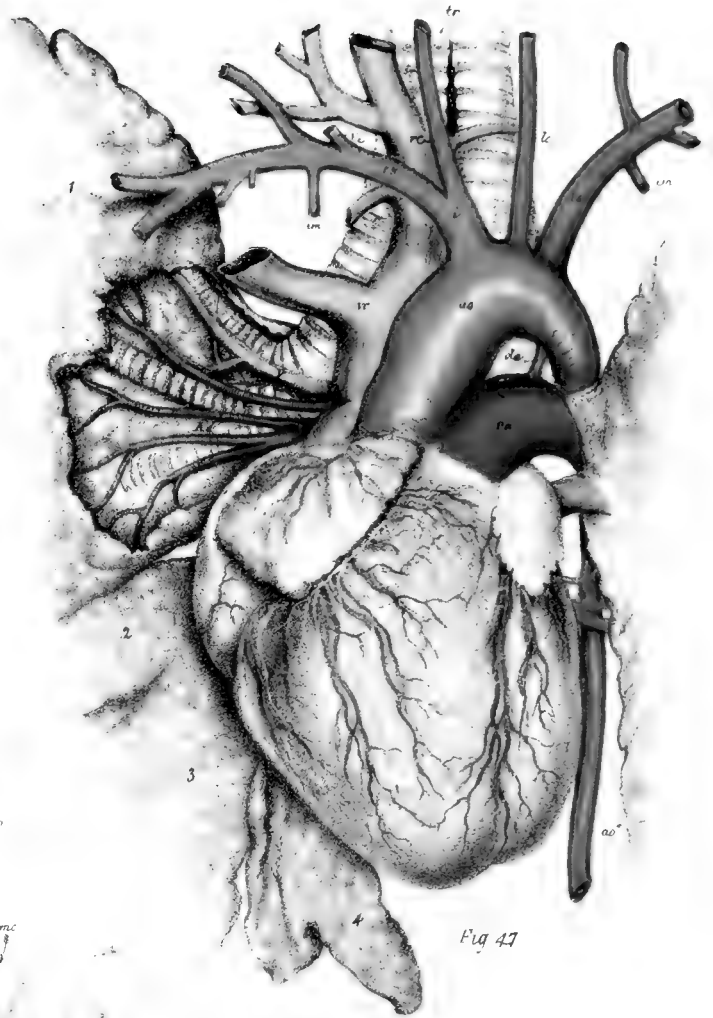
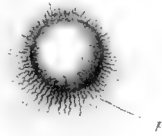


Fig 47

Fig. 45

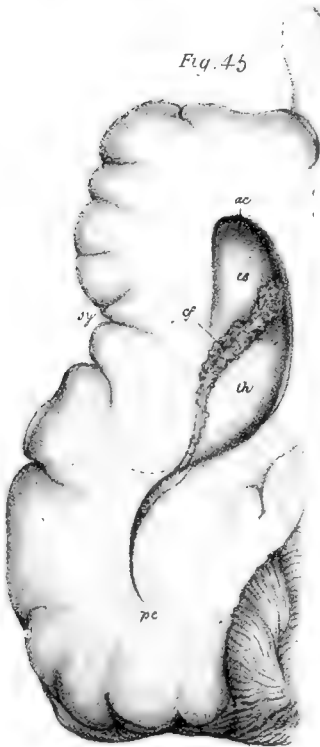


Fig 46

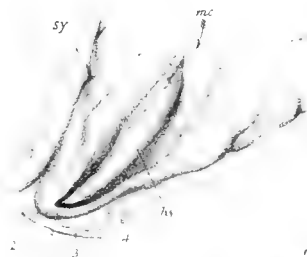
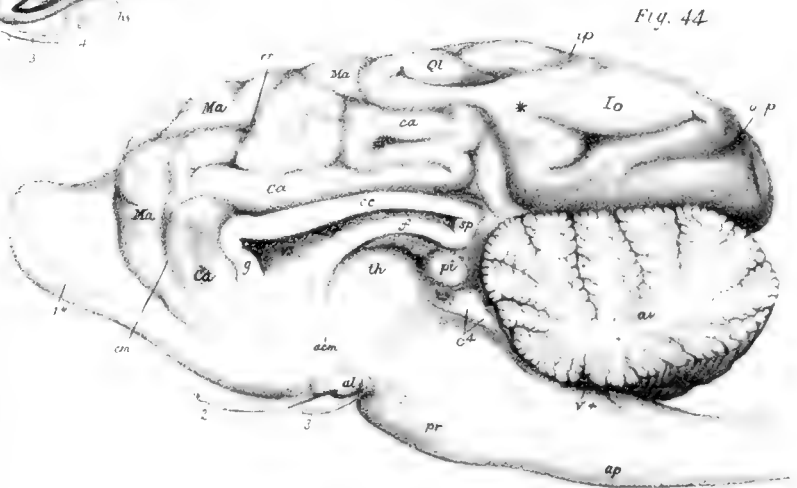


Fig. 44



C. Berjeau lith.

Berjeaux & Murie del

SENSORY AND VASCULAR ORGANS.
OTARIA JUBATA

M&N Hankart imp



Fig 55

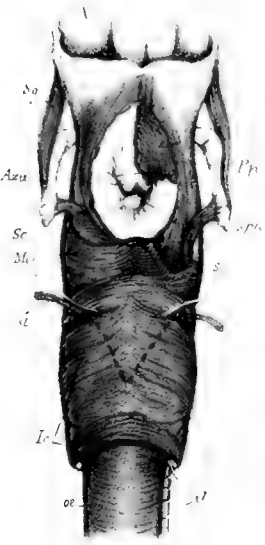


Fig 59

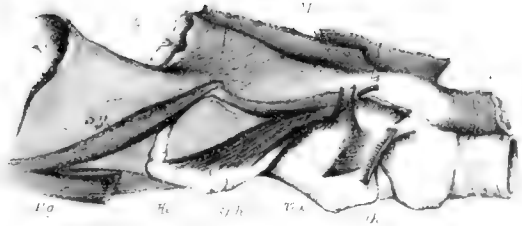


Fig 61



Fig 62

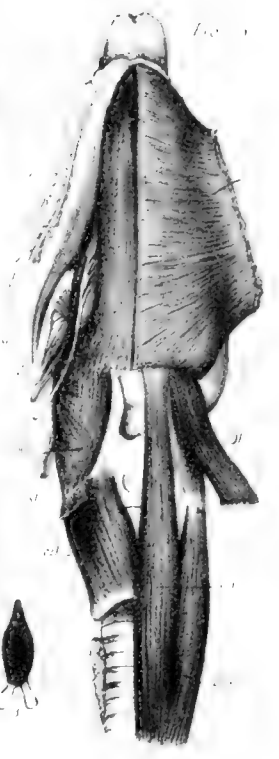


Fig 62



Fig 63

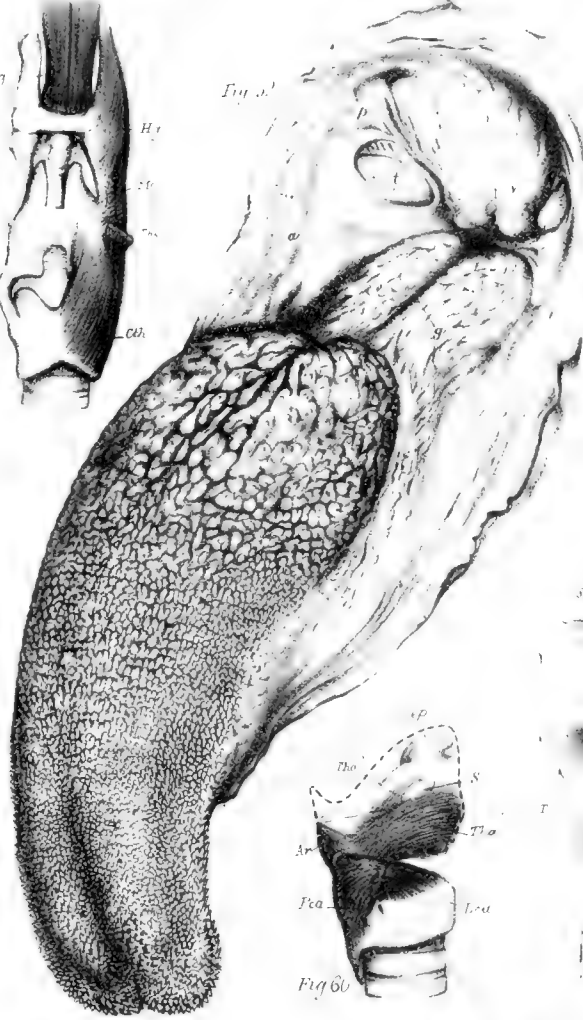


Fig 63

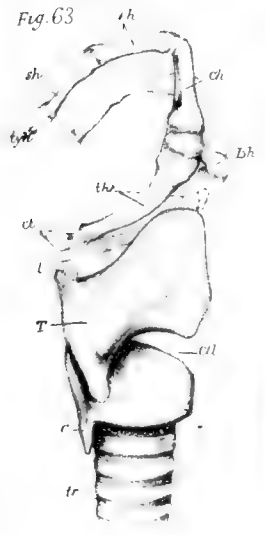


Fig 65



Fig 61

Fig 60

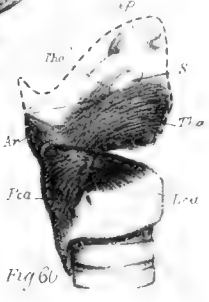


Fig 69

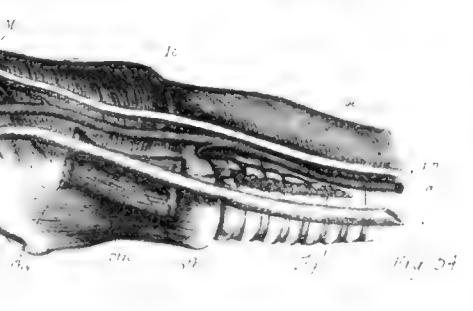


Fig 57



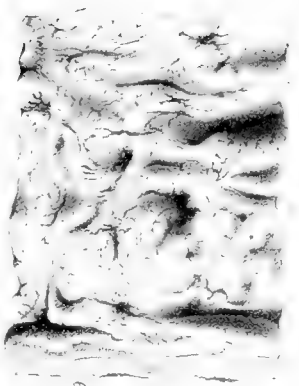


Fig. 69

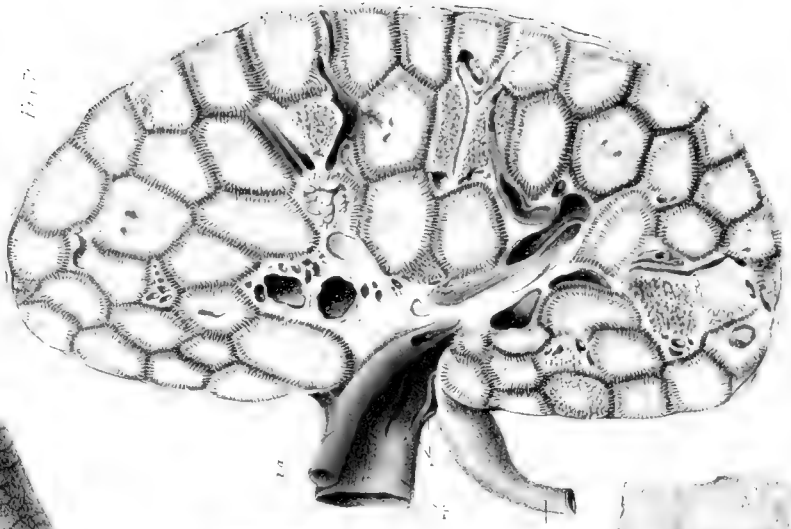


Fig. 70

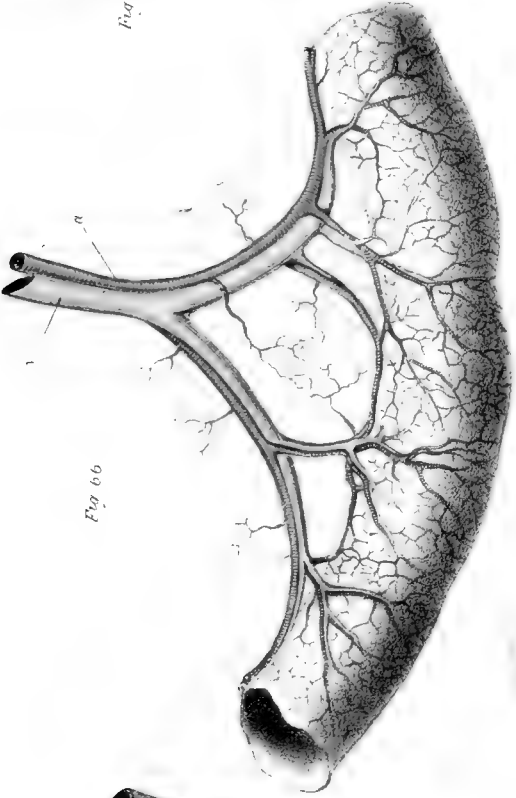


Fig. 66

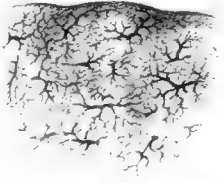


Fig. 71



Fig. 68

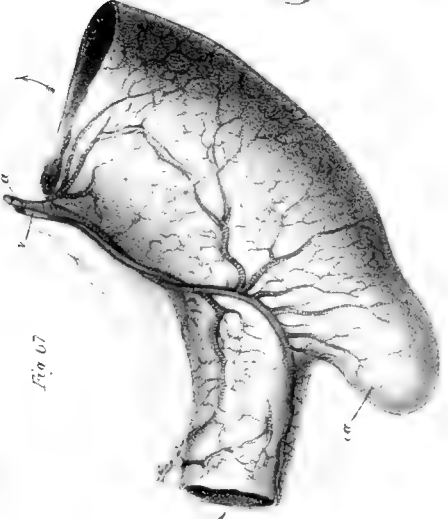


Fig. 67

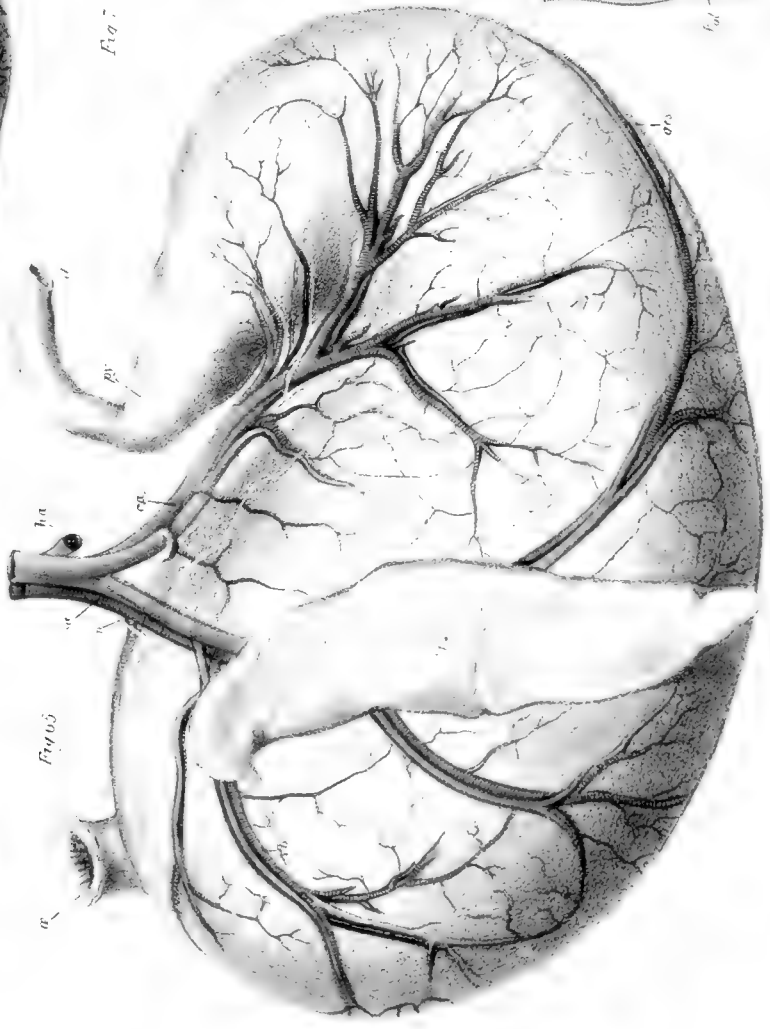


Fig. 65



Fig 74

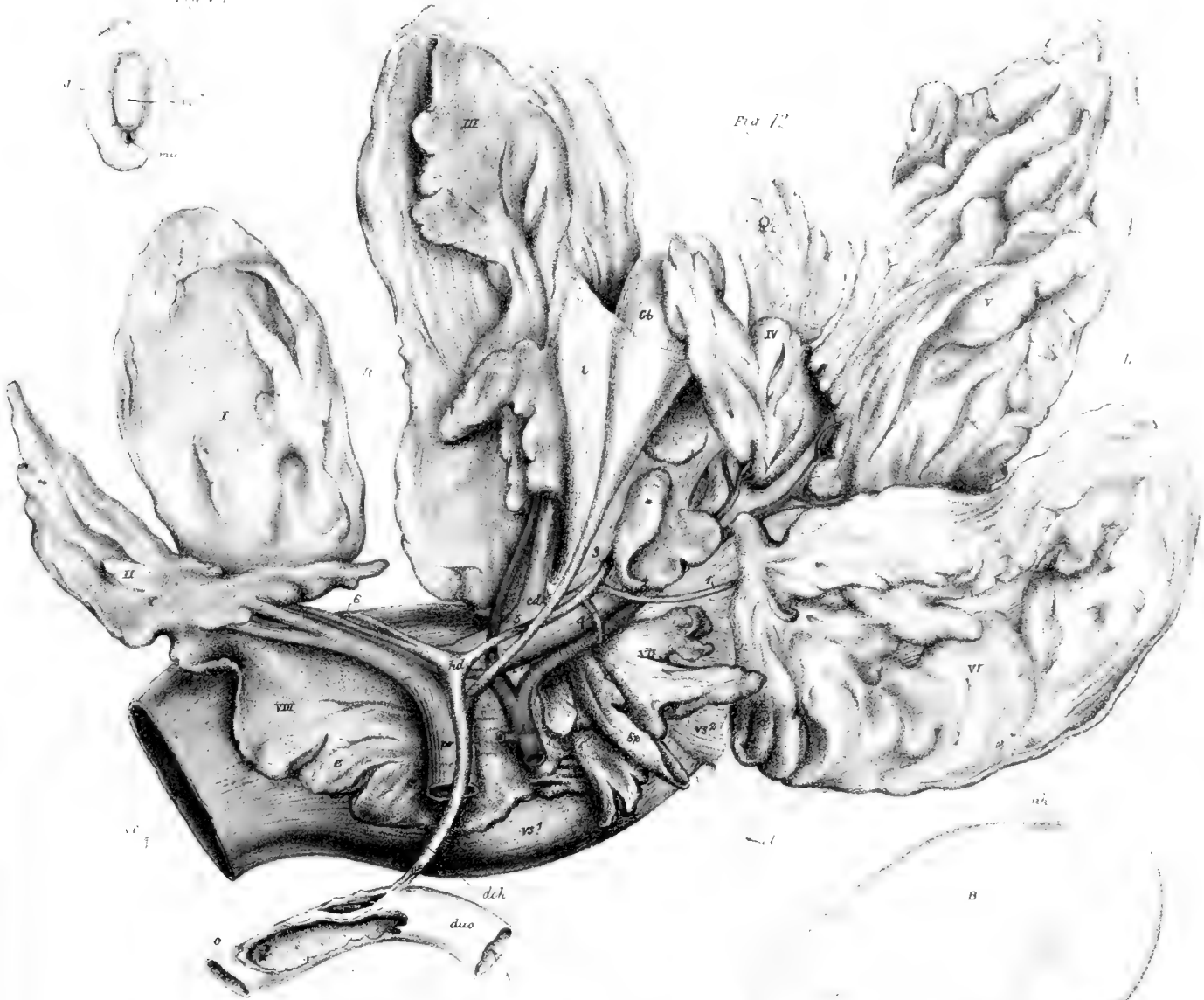


Fig 75

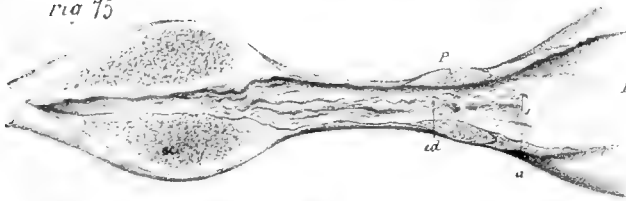


Fig 73

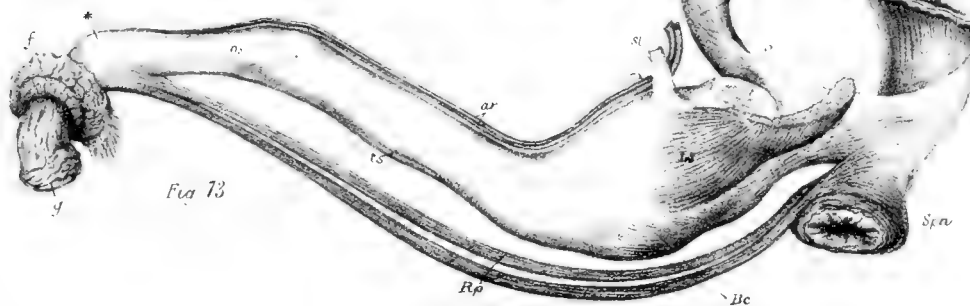
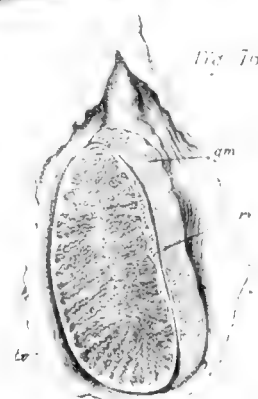


Fig 70





LIST OF THE PAPERS CONTAINED IN VOL. VIII.

| | Page | | Page |
|--|------|--|------|
| ALLMAN, Professor G. J., F.R.S. | | Researches upon the Anatomy of the Pinnipedia. Part III. Descriptive Anatomy of the Sea-lion (<i>Otaria jubata</i>) | 501 |
| Report on the Hydroids collected during the Expeditions of H.M.S. 'Porcupine' | 469 | OWEN, Professor, C.B., F.R.S., F.L.S., F.Z.S., &c. | |
| ANDERSON, Professor JOHN, M.D., C.M.Z.S. | | On Dinornis (Part XVII.): containing a Description of the Sternum and Pelvis, with an attempted Restoration, of <i>Aptornis defossor</i> , Ow. | 119 |
| On the Osteology and Dentition of <i>Hylomys</i> | 453 | On Dinornis (Part XVIII.): containing a Description of the Pelvis and Bones of the Leg of <i>Dinornis gravis</i> | 361 |
| DUNCAN, Professor P. MARTIN, M.B. (Lond.), F.R.S., F.G.S. | | On Dinornis (Part XIX.): containing a Description of a Femur indicative of a new Genus of large Wingless Bird (<i>Dromornis australis</i> , Owen) from a post-tertiary deposit in Queensland, Australia | 381 |
| A Description of the Madreporaria dredged up during the Expeditions of H.M.S. 'Porcupine' in 1869 and 1870 | 303 | On the Osteology of the Marsupialia (Part III.). Modifications of the Skeleton in the Species of <i>Phascalomys</i> | 345 |
| FLOWER, WILLIAM HENRY, F.R.S., V.P.Z.S., Hunterian Professor of Comparative Anatomy, and Conservator of the Museum of the Royal College of Surgeons. | | On the Osteology of the Marsupialia (Part IV.). Bones of the Trunk and Limbs, <i>Phascalomys</i> | 483 |
| On Risso's Dolphin (<i>Grampus griseus</i> , Cuv.) | 1 | WALDEN, ARTHUR VISCOUNT, F.R.S., P.Z.S. &c. | |
| On the Recent Ziphioid Whales, with a Description of the Skeleton of <i>Berardius arnouzi</i> | 203 | A List of the Birds known to inhabit the Island of Celebes | 23 |
| MIVART, St. GEORGE, F.R.S., F.L.S., F.Z.S. | | Appendix to a List of Birds known to inhabit the Island of Celebes | 109 |
| On the Axial Skeleton of the Ostrich (<i>Struthio camelus</i>) | 385 | | |
| MURIE, JAMES, M.D., F.L.S., F.G.S., &c. | | | |
| On the Form and Structure of the Manatee (<i>Manatus americanus</i>) | 127 | | |
| On the Organization of the Caaing Whale (<i>Globiocephalus melas</i>) | 235 | | |

INDEX OF SPECIES, ETC., IN VOL. VIII.

- Accipiter cruentus*, 34.
 — *hyogaster*, 34.
 — *rufitorques*, 34.
Acridotheres cinereus, 77, 108.
 — *fuscus*, 77.
 — *javanicus*, 77.
Acrocephalus arundinaceus, 64.
 — *brunnescens*, 64.
 — *magnirostris*, 64.
 — *orientalis*, 64.
Actitis glareola, 96.
 — *hypoleucos*, 96.
Ægialites curonicus, 89, 90.
 — *hiaticula*, 89, 90.
 — *dubius*, 89.
 — *minutus*, 89, 90.
 — *peronii*, 90, 108.
Æthopyga flavostriata, 71.
Aglaophenia dromaius, 471, 475, 476, 480.
 — *elongata*, 471, 476, 481.
 — *myriophyllum*, 471.
 — *tubulifera*, 476.
Alcedo asiatica, 45.
 — *collaris*, 44.
 — *diops*, 44.
 — *meninting*, 45.
 — *minor moluccensis*, 45.
 — *moluccensis*, 45.
 Allman, G. J. Report on the Hydroids collected during the Expeditions of H.M.S. 'Porcupine,' 469.
Amphihelia atlantica, 307, 324, 326.
 — *miocœnica*, 307, 323, 324.
 — *oculata*, 305, 307, 322, 324, 325, 326, 337, 338, 339, 340, 342.
 — *ornata*, 307, 324, 326.
 — *ramea*, 305, 307, 324, 326, 337, 338, 339, 340, 342, 343.
Amphihelia sculpta, 307, 323.
 — *venusta*, 323.
Anas gracilis, 102.
 — *querquedula*, 102.
 Anderson, John. On the osteology and dentition of *Hylomys*, 453.
Antennularia antennina, 471.
Anthreptes malaccensis, 70.
Anthus arboreus, 117.
Aodon, 209.
Apiaster philippensis major, 42.
Aporosa, 306, 309-332.
Apteryx australis, 363.
Aptornis defossor. On *Dinornis* (Part XVII.): containing a description of the sternum and pelvis, with an attempted restoration of, by Prof. Owen, 119.
 — —, comparison of the sternum and femur of, with *Tribonyx ventralis*, *Ocydromus australis*, *Notornis*, *Aptornis otidiformis*, &c., 119-122.
 — —, comparison of sternum of, with *Cnemidornis*, 122.
 — —, ilium of, 124.
 — —, pelvis of, 122, 125.
 — —, sternum of, 119, 120.
 — —, vertebræ of, 122-124.
 — *otidiformis*, 119-124.
Aquila audax, 380.
Arachnechthra flavigastra, 71.
 — *frenata*, 71.
Arachnothera longirostra, 70.
Arctocebus calabarensis, 563.
Ardea alba, 99.
 — *caledonica*, 100.
 — *fusca*, 98.
 — *gardeni*, 100.
 — *garzetta*, 99.

- Ardea goliath*, 98.
 — *insignis*, 98.
 — *lepida*, 99.
 — *leucocephala*, 101.
 — *maculata*, 100.
 — *melanophis*, 99.
 — *melanoptera*, 99.
 — *melanotis*, 99.
 — *modesta*, 99.
 — *nebulosa*, 99.
 — *nigripes*, 99.
 — *prasinosecles*, 98.
 — *rectirostris*, 98.
 — *sumatrana*, 98.
 — *typhon*, 98.
Ardeola grayi, 98.
 — *leucoptera*, 98, 99.
 — *malaccensis*, 98, 99.
 — *speciosa*, 98.
Ardeomega nobilis, 98.
Ardetta cinnamomea, 99.
 — *sinensis*, 99.
Artamides bicolor, 70.
Artamus leucogaster, 67.
 — *leucopygialis*, 67.
 — *leucorhynchus*, 67, 68.
 — *melaleucus*, 67.
 — *mentalis*, 67.
 — *monachus*, 67, 107, 113.
 — *papuensis*, 67.
Astræidæ, 307, 327–332.
Astur barbatus, 37.
Athene borneensis, 40, 41.
 — *florensis*, 41.
 — *japonica*, 41.
 — *malaccensis*, 41.
 — *ochracea*, 38.
 — *punctulata*, 38.
 Avifauna, list of species to be added to the Celebean,
 114.
Balæna mysticetus, 265, 268.
Balænoptera carolinæ, 236.
 — *musculus*, 236, 266, 263, 276, 286, 298,
 299.
 — *rostrata*, 235–237, 248, 263–265, 273–
 276.
 — *sibbaldii*, 236, 237, 239, 271.
Balanophyllia britannica, 334.
Balanophyllia cellulosa, 308, 333, 337, 339, 344.
 — *gaditana*, 308, 333, 337, 339.
 — *jeffreysia*, 334.
 — *socialis*, 308, 333, 337, 338, 342.
Basileornis celebensis, 77.
 — *corythæic*, 77.
Bathycyathus atlanticus, 306, 318, 337, 339, 343.
 — *chilensis*, 318.
 — *sowerbyi*, 318.
Baza magnirostris, 36.
 — *reinwardtii*, 36.
Berardius arnouvi. On the recent Ziphioid Whales,
 with a description of the skeleton of, by W. H.
 Flower, 203.
 — —. Preliminary notice of a Ziphioid
 Whale, probably *Berardius arnouvi*, stranded
 on the 16th of December, 1868, on the sea-
 beach, near New Brighton, Canterbury, New
 Zealand, by Julius Haast, 214.
 — —, antero-posterior length of the bodies of
 the thoracic, lumbar, and caudal vertebræ of,
 228.
 — —, caudal vertebræ of, 228.
 — —, cervical vertebræ of, 224; dimensions of,
 226.
 — —, description of the skeleton of, 217–
 233.
 — —, dimensions of, 212.
 — —, dimensions of the bones of the right
 pectoral limb of, 231.
 — —, history of, 212.
 — —, hyoid bones of, 223.
 — —, lumbar vertebræ of, 227.
 — —, pectoral limb of, 230.
 — —, pelvic bones of, 232.
 — —, ribs of, 229.
 — —, skull of, 217–223; dimensions of, 221.
 — —, sternum of, 229.
 — —, teeth of, 222.
 — —, thoracic vertebræ of, 226.
 — —, vertebral column of, 223.
 — *hectori*, 211.
 Birds, table of Indian genera of, found in Celebes, 24.
 —, table showing the Australian genera of, found
 in Celebes, 25.
 —, table showing the genera of, represented in
 Celebes which likewise occur both within and
 beyond the limits of the Indian region, 25.

- Birds, table showing the genera of, found in Celebes which are also common to the Indian and Australian regions, 25.
- , table showing the principal Austro-Malayan or Papuan genera of, which do not occur in Celebes, 29.
- , table showing the principal Indian genera of, which are wanting in Celebes, 27.
- Brachyurus celebensis*, 62.
- *forsteni*, 62.
- Broderipus celebensis*, 112.
- *coronatus*, 60, 112.
- *frontalis*, 61.
- Buceros cassidix*, 47.
- *corrugatus*, 51.
- *exaratus*, 47, 107.
- *sulcatus*, 51.
- Budytes viridis*, 65.
- Buphus bacchus*, 98.
- Butalis hypogrammica*, 66.
- Buteo pygmaeus*, 37.
- *pyrrhogenys*, 37.
- Butorides chloriceps*, 101.
- *javanica*, 100.
- Caaing Whale (*Globocephalus melas*), on the Organization of the, by J. Murie, 235.
- — (see *Globocephalus melas*).
- Cacatua æquatorialis*, 30, 31.
- *sulphurea*, 30, 31.
- Caccabis rufa*, 101.
- Cacomantis assimilis*, 54.
- *borneensis*, 54.
- *bronzinus*, 54.
- *castaneiventris*, 54.
- *dumetorum*, 54.
- *fasciolatus*, 55.
- *flabelliformis*, 54.
- *infaustus*, 54.
- *infuscatus*, 55.
- *insperatus*, 54.
- *lanceolatus*, 53-55.
- *merulinus*, 54, 55.
- *pallidus*, 54.
- *passerinus*, 54, 55.
- *pravatus*, 55.
- *pyrogaster*, 54.
- *rufovittatus*, 55.
- *sepulchralis*, 54, 116.
- Cacomantis simus*, 54, 55.
- *sonnerati*, 55.
- *tenuirostris*, 54.
- *threnodes*, 54.
- *tymbonomus*, 54.
- Callialcyon rufa*, 44.
- Calenas nicobarica*, 86.
- Calornis affinis*, 79.
- *amboinensis*, 80, 81.
- *aromatica*, 82.
- *cantaroides*, 80, 81.
- *chalybea*, 79, 81.
- *crassirostris*, 80, 81.
- *curvirostra*, 82.
- *gularis*, 80.
- *kittlitzii*, 80.
- *metallica*, 79-81, 107.
- *mysolensis*, 80.
- *neglecta*, 79, 80, 81, 113.
- *nitida*, 80.
- *obscura*, 79, 80.
- *psittacea*, 82.
- *purpurascens*, 80, 81.
- *virescens*, 80.
- *viridescens*, 80.
- Calycella fastigiata*, 471.
- Campephaga nigra*, 69.
- Caprimulgus affinis*, 114.
- *arundinaceus*, 115.
- *birotatus*, 115.
- *europæus*, 114.
- *macrourus*, 115.
- *monticolor*, 115.
- Cupromys fourrieri*, 563.
- Carpophaga luctuosa*, 84.
- *paulina*, 83.
- Caryophyllia abyssorum*, 306, 310, 311, 315, 337, 339, 340.
- *africana*, 313.
- *arcuata*, 306, 310, 313, 317, 337, 339, 342.
- *berteriana*, 314, 317.
- *borealis*, 305, 306, 309, 312, 338, 340, 343.
- *calveri*, 306, 310, 311, 312, 316, 337, 339.
- *clavus*, 305, 306, 310, 311, 337, 338, 339, 340, 343, 344.
- *corniformis*, 317.
- *cyathus*, 306, 310, 313, 337.

- Caryophyllia cylindracea*, 306, 310, 311, 314, 315, 337, 339, 340.
 — *elongata*, 306, 311, 340, 344.
 — *epithecata*, 306, 312, 344.
 — *exserta*, 306, 312, 343.
 — *formosa*, 317.
 — *inskipi*, 306, 310, 311, 316, 337, 339.
 — *ornata*, 314.
 — *pourtalesi*, 306, 310, 311, 317, 337, 339, 341.
 — *sequenzæ*, 306, 310, 314, 337, 338, 342.
 — *smithii*, 305, 306, 309, 312, 340, 344.
 — *vermiformis*, 306, 310, 311, 316, 337, 339, 341.
Casuaris bennettii, 124.
Ceblepyris fimbriatus, 69.
 — *lugubris*, 69.
 Celebes. A list of birds known to inhabit the Island of, by Arthur, Viscount Walden, 23.
 —. An appendix to a list of birds known to inhabit the Island of, by Arthur, Viscount Walden, 109.
Centrococyx affinis, 56–60, 112.
 — *bengalensis*, 59, 60.
 — *dimidiatus*, 59.
 — *javanensis*, 58, 60.
 — *medius*, 58, 60.
 — *moluccensis*, 59, 60.
 — *rectunguis*, 60.
 — *viridis*, 58.
Centropus affinis, 60.
 — *ateralbus*, 56.
 — *bengalensis*, 57.
 — *bicolor*, 55.
 — *borneensis*, 57.
 — *bubutus*, 57.
 — *chlororhynchus*, 57.
 — *dimidiatus*, 57.
 — *eurycercus*, 57.
 — *javanensis*, 57, 112.
 — *lepidus*, 57, 58, 60.
 — *lignator*, 57, 59.
 — *medius*, 56, 57.
 — *melanopus*, 56.
 — *molkenboeri*, 58.
 — *moluccensis*, 57.
 — *nigrifrons*, 56.
 — *phasianus*, 57.
 — *philippensis*, 58.
 — *pumilus*, 58, 60.
Centropus pygmaeus, 59.
 — *rectunguis*, 56, 57.
 — *rufinus*, 59.
 — *rufipennis*, 56, 57.
 — *viridis*, 57, 59.
Ceratocyathus armatus, 306, 310, 314.
Ceycopsis fallax, 45, 112.
Chatura celebensis, 46.
 — *gigantea*, 46.
Chalcophaps hombroni, 86.
 — *indica*, 86, 114.
 — *stephani*, 85, 86, 114.
Chalcosteitha porphyrolæma, 71.
Charadrius alexandrinus, 89.
 — *curonicus*, 89.
 — *fulvus*, 88.
 — *giganteus*, 91.
 — *intermedius*, 89.
 — *magnirostris*, 91.
 — *minor*, 89.
 — *minutus*, 89.
 — *philippinus*, 89.
 — *pusillus*, 89.
Charitornis albertinæ, 76, 77.
Circus approximans, 38.
 — *assimilis*, 37, 38, 380.
 — *gouldi*, 38.
 — *jardinii*, 37, 38.
 — *macropterus*, 38.
Cisticola cursitans, 64, 65.
 — *grayi*, 117.
 — *lineocapilla*, 65.
 — *schænicola*, 64.
Cittura cyanotis, 44.
 — *sanghirensis*, 44.
Cladocarpus formosus, 471, 478, 481.
Climacteris leucophæa, 106.
Collocalia concolor, 46.
 — *esculenta*, 46.
 — *fuciphaga*, 46.
 — *hypoleuca*, 46.
Columba ænea, 83.
 — *diademata*, 83.
 — *hypogastra*, 83.
 — *monacha*, 83.
 — *viridis*, 81.
Coracias papuensis, 43.
 — *temminckii*, 43.

- Corvus advena*, 74, 75.
 — *balicassius*, 70.
 — *caledonicus*, 74, 75.
 — *corone*, 74.
 — *dauricus*, 75.
 — *enca*, 74, 113.
 — *validus*, 74, 113.
 — (*Physocorax*) *moneduloides*, 74.
Corydalla gustavi, 117.
Corydonia maculatus, 59.
 — *pyrrhopterus*, 58.
Cranorrhinus cassidix, 47–49.
Criniger aureus, 109.
Cuculus canoroides, 116.
 — *canorus*, 115, 116.
 — *flavus*, 54.
 — *himalayanus*, 116.
 — *micropterus*, 116.
 — *præsagus*, 51.
 — *pyrrhocephalus*, 52.
 — *saturatus*, 116.
 — *sumatranus*, 53.
 — *tolu*, 58.
Cuncuma leucogaster, 35.
Cuspidella grandis, 471.
Cyathaxonidæ, 308, 335.
Cyornis banyumas, 117.
 — *rufigula*, 66, 107.
Dacelo cyanocephalus, 43.
 — *monachus*, 43.
Dasyurus macrurus, 496.
Delphinorhynchus, 209.
 — *micropterus*, 210.
Delphinus acutus, 20.
 — *aries*, 16.
 — *bidentatus*, 209.
 — *butskode*, 209.
 — *densirostris*, 209.
 — *edentatus*, 209.
 — *epiodon*, 209.
 — *globiceps*, 20.
 — *grælandicus*, 209.
 — *griseus*, 17–19.
 — *heavisidii*, 20.
 — *melas*, 235.
 — *micropterus*, 209, 210.
 — *nesarnak*, 237.
 — *obscurus*, 20.
Delphinus phocæna, 264, 268.
 — *risso*, 16.
 — *sowerbensis*, 209.
 — *sowerbyi*, 210.
 — *tursio*, 266, 287.
 — (*Heterodon*) *sowerbensis*, 210.
 — (*Phocæna*) *rissoanus*, 16, 18, 19.
Demiegretta asha, 100.
 — *sacra*, 100.
Dendrocygna gouldi, 103.
 — *guttata*, 102.
 — *guttulata*, 102.
 — *vagans*, 102.
Dendrophyllia cornigera, 308, 334, 337, 339.
Dermophyllum costatum, 307, 321, 322.
 — *crista-galli*, 305, 307, 321, 337, 339, 340, 341.
 — *cumingi*, 307, 321.
 — *dianthus*, 321.
 — *stokesi*, 322.
Dicæum celebicum, 72.
 — *leclancherii*, 72.
Dicrurus atroceruleus, 106.
 — *bimaënsis*, 106.
 — *leucops*, 70.
 — *pectoralis*, 70.
Didelphys ursina, 345.
Dinornis (Part XVII.). Containing a description of the sternum and pelvis, with an attempted restoration of *Aptornis defossor*, Ow., by Prof. Owen, 119.
 — (Part XVIII.). Containing a description of the pelvis and bones of the leg of *Dinornis gravis*, by Prof. Owen, 361.
 — (Part XIX.). Containing a description of a femur indicative of a new genus of large wingless bird (*Dromornis australis*, Owen), from a post-tertiary deposit in Queensland, Australia, by Prof. Owen, 381.
 — *altus*, 375.
 — *casuarinus*, 362, 366, 368, 369, 375, 376.
 — —, dimensions of the femur, tibia, and metatarsus of, 371.
 — *crassus*, 362–365, 373, 375–377.
 — —, dimensions of the femur, tibia, and metatarsus of, 371, 373.
 — *curtus*, 375.
 — —, dimensions of the femur, tibia, and metatarsus of, 371.
 — *didiformis*, 369, 372, 375.

- Dinornis didiformis*, dimensions of the femur, tibia, and metatarsus of, 371, 372.
 — *dromioides*, 372, 375.
 — —, dimensions of the femur, tibia, and metatarsus of, 371.
 — *elephantopus*, 365, 375–377.
 — —, dimensions of the femur, tibia, and metatarsus of, 371, 373.
 — *geranoides*, 372, 375, 377.
 — —, dimensions of the femur, tibia, and metatarsus of, 371.
 — *giganteus*, 361, 366, 368, 369, 375, 376.
 — —, dimensions of the femur, tibia, and metatarsus of, 371, 374.
 — *gracilis*, 375.
 — —, dimensions of the femur, tibia, and metatarsus of, 371, 372.
 — *gravis*. On *Dinornis* (Part XVIII.), containing a description of the pelvis and bones of the leg of, by Prof. Owen, 361.
 — —, dimensions of the femur, tibia, and metatarsus of, 371, 372.
 — —, femur of, 366, 379.
 — —, metatarsus of, 362, 378.
 — —, pelvis of, 369; dimensions of, 370.
 — —, tibia of, 364, 378.
 — *ingens*, 361, 375, 376.
 — —, dimensions of the femur, tibia, and metatarsus of, 371, 374.
 — *maximus*, 366, 375.
 — —, dimensions of the femur, tibia, and metatarsus of, 371, 375.
 — *rhœdes*, 375–377.
 — —, dimensions of the femur, tibia, and metatarsus of, 371.
 — *robustus*, 365, 375–377.
 — —, dimensions of the femur, tibia, and metatarsus of, 371, 375.
 — *struthioides*, 361, 373, 375.
 — —, dimensions of the femur, tibia, and metatarsus of, 371, 374.
 —, table of admeasurements of the bones of the leg of the known species of, 371.
Diodon, 209.
Diphasia coronifera, 471, 474, 480.
 — *pinaster*, 470, 471.
Diplodon, 209.
 — *europæus*, 211.
Diplodon gervaisii, 211.
Diplohelia dodderleiniana, 307, 324, 327.
 — *meneghiniana*, 307, 324, 327.
 — *profunda*, 307, 324, 326.
 — *sismondiana*, 327.
Diplopteron insigne, 471, 479–481.
Dolichodon, 209.
 Dolphin, Risso's (see *Grampus griseus*).
Dromaius ater, 382.
 — *novæ-hollandiæ*, 366.
Dromornis australis. On *Dinornis* (Part XIX.): containing a description of a femur indicative of a new genus of large wingless bird, from a post-tertiary deposit in Queensland, Australia, by Prof. Owen, 381.
 — —, femur of, compared with *Dinornis elephantopus*, 382–384.
 — —, measurement of femur of, 382.
Drymophila alecto, 107.
 Duncan, P. Martin. A description of the Madrepোরaria dredged up during the expeditions of H.M.S. 'Porcupine' in 1869 and 1870, 303.
Dysporus sula, 106.
Electus mülleri, 31.
Etoliosoma melanolema, 69.
 — *morio*, 69.
Elanus hypoleucos, 30, 36.
 — *intermedius*, 36.
 Emu, the, 382.
Enodes erythrophrys, 78.
Eos cochinchinensis, 107.
Ephialtes leucospila, 39, 40.
 — *magicus*, 39, 40.
 — *menadensis*, 30, 40.
Epiodon australe, 235.
 — *australis*, 208.
 — *desmarestii*, 207.
Erythra phœnicura, 94.
Erythropitta celebensis, 62.
Erythrospiza iogastra, 34.
 — *trinotata*, 33.
Esacus magnirostris, 91.
 — *recurvirostris*, 91.
Eudendrium ramosum, 470, 471.
Eudromia vercdus, 88.
Eudynamis melanorhyncha, 53, 112.
Eulabes javanus, 81.
Eurystomus orientalis, 43.

- Eurystomus pacificus*, 43.
Excofactoria chinensis, 87.
 ——— *minima*, 87.
Falcinellus igneus, 101.
 ——— *peregrinus*, 101.
Falco aldrovandi, 33.
 ——— *columbarius*, 33.
 ——— *cuculoides*, 34.
 ——— *indicus*, 37.
 ——— *javanicus*, 37.
 ——— *poliogenys*, 37.
 ——— *rupicolus*, 33.
Filellum serpens, 470.
Flabellum distinctum, 307, 322, 337, 339, 340.
 ——— *extensum*, 307, 322.
 ——— *laciniatum*, 307, 322, 337, 338.
 Flower, W. H. On the recent Ziphioid Whales, with a description of the skeleton of *Berardius arnoui*, 203.
 ———. On Risso's Dolphin, *Grampus griseus* (Cuv.), 1.
Fungia symmetrica, 308, 334, 337, 339, 344.
Fungiidae, 308, 334.
Gallinago megala, 98.
Gallinula ardosiacea, 94.
 ——— *chloropus*, 94.
 ——— *frontata*, 93.
 ——— *haematopus*, 93.
 ——— *orientalis*, 94.
 ——— *tenebrosa*, 93.
Gallus bankiva, 86.
 ——— *ferrugineus*, 87.
Gastornis parisiensis, 366.
Gazzola caledonica, 75.
 ——— *typica*, 74, 75.
Geocichla erythronota, 61, 107, 113.
 ——— *interpres*, 61.
Geopelia striata, 86.
Glareola grallaria, 117.
Globiocephalus affinis, 290.
 ——— *chinensis*, 235, 291.
 ———, comparative table of diagnostic characters of, compared with *Grampus*, 20, 21.
 ——— *edwardsii*, 290.
 ——— *grayi*, 291.
 ——— *indicus*, 291.
 ——— *macrorhynchus*, 291.
 ——— *melas*, 20, 235.
 ——— ———, alimentary canal of, 256-260.
Globiocephalus melas, auditory appendages of, 249-251.
 ——— ———, cavity of the mouth, dental armature, and pharynx of, 252-256.
 ——— ———, external characters of, 238-242.
 ——— ———, eye and its surroundings of, 242.
 ——— ———, fleshy motor agents of body and limbs of, 272-284.
 ——— ———, general observations and history of, 235-237.
 ——— ———, genitalia of, 284.
 ——— ———, glands accessory to alimentation of, 260-262.
 ——— ———, heart of, 266.
 ——— ———, hyoidean and laryngeal structures of, 262-365.
 ——— ———, measurement of the tail of, 241.
 ——— ———, measurements of, 240.
 ——— ———, muscles acting chiefly on the pectoral limb of, 272-276.
 ——— ———, muscles acting on the sterno-costal framework of, 281, 282.
 ——— ———, muscles acting on the trunk and tail of, 276-281.
 ——— ———, muscles connected with neck and head of, 282-284.
 ——— ———, nasal passages of, 242-248.
 ——— ———, nervous centre of, 272.
 ——— ———, on the organization of, 235.
 ——— ———, organs subservient to deglutition and digestion of, 252-262.
 ——— ———, parts related to the senses of, 242-252.
 ——— ———, pelvic bones, ligament, and muscles of, 286-290.
 ——— ———, respiration and machinery involved, 262-266.
 ——— ———, reflections, zoological and physiological, on, 290-293.
 ——— ———, sanguiferous distribution of, 266-272.
 ——— ———, skin, and subcutaneous coverings of, 248, 249.
 ——— ———, tongue of, 251.
 ——— ———, tracheo-pulmonary parts of, 265.
 ——— ———, urino-generative organs and pelvic-appendage homologues of, 284-290.
 ——— ———, vascular channels and reservoirs of, 268-271.

- Globiocephalus propinquus*, 291.
 — *sieboldii*, 291.
 — *svineval*, 235, 239, 264, 282, 290.
Grammaria abietina, 470.
Grampus cuvieri, 15.
 — *griseus*, Risso's Dolphin, by W. H. Flower, 1.
 — —, 235.
 — — and *G. rissoanus*, identity of, 18.
 — —, anterior surface and side view of cervical vertebrae of, 5.
 — —, bones of the pectoral limb of, 10.
 — —, earliest account of, 15.
 — —, carpal bones of, 10.
 — —, carpal bones and the phalanges of the young of, 14.
 — —, chevron bones of, 7.
 — —, coloration of, 3.
 — —, coloration of the young of, 12.
 — —, dimensions of vertebrae of, 5.
 — —, dimensions of the young of, 12.
 — —, fins of the young compared with those of the adult, 12.
 — —, general form of, 2.
 — —, general form of skull of, 8.
 — —, general form of the young of, 12.
 — —, humerus of, 10.
 — —, pelvic bones of, 8.
 — —, periotic and tympanic bones of, 9.
 — —, principal dimensions of, 1.
 — —, principal dimensions of the bones of the pectoral limb of, 11.
 — —, principal dimensions of the skull of, 10.
 — —, scapulae of, 10.
 — —, skeleton of, 4.
 — —, skeleton of young of, 13, 14.
 — —, sternal ribs of, 8.
 — —, sternum of, 8.
 — —, systematic position of, 20.
 — —, teeth of young of, 13.
 — —, vertebrae of, 4.
 — —, vertebrae of young of, 14.
 — —, vertebral ribs of, 7.
 — *richardsonii*, 15, 18.
 — *rissoanus*, 6, 8, 10, 11, 15, 236, 247, 266, 274.
 — —, identity with *G. griseus*, 18.
Graucalus atriceps, 65.
 — *leucopygius*, 68.
 — *personatus*, 68.
Graucalus temminckii, 68, 113, 118.
 Grey-headed Gallinule, 92.
 Grind Whale, 237.
Guynia annulata, 308, 335, 337, 340, 343.
 Haast, Julius. Preliminary notice of a Ziphioid Whale, probably *Berardius arnuxii*, stranded on the 16th of December, 1868, on the Sea-beach, near New Brighton, Canterbury, New Zealand, 214.
Halcyon chloris, 44.
 — *coromanda*, 44.
 — *diops*, 106.
 — *funebis*, 106.
Haliastur leucosternus, 35.
Halicornaria ramulifera, 471, 477, 481.
Haplophyllia paradoxa, 335.
Hemichelidon griseosticta, 66.
Hemicyathus crassicostratus, 336.
Hemiphaga forsteni, 84.
Herodias alba, 99.
 — *egretta*, 99.
 — *garzetta*, 99.
 — *nigripes*, 99.
Heterodon densirostris, 209.
 — *sowerbensis*, 209.
Hierococcyx crassirostris, 116, 118.
Himantopus intermedius, 91.
 — *leucocephalus*, 91.
Hirundinapus giganteus, 46.
Hirundo brevirostris, 46.
 — *esculenta*, 46.
 — *francica*, 46.
 — *gutturalis*, 65.
 — *javanica*, 66.
 — *panayana*, 65.
 — *rustica*, 65.
 — *unicolor*, 46.
 — *vanicorensis*, 46.
Hydralector gallinaceus, 92.
Hydrallmania falcata, 469, 470.
Hydrochelidon delalandii, 103.
 — *fluvialis*, 103.
 — *leucopareia*, 103.
 — *nigra*, 103.
Hydroida. Report on the, collected during the Expeditions of H.M.S. 'Porcupine,' by G. J. Allman, 469.
Hylomys. On the osteology and dentition of, by John Anderson, 453.

- Hylomys peguensis*, anapophyses of, 462.
 — — —, carpus of, 465.
 — — —, chevron bones of, 463.
 — — —, clavicle of, 464.
 — — —, colouring of, 455.
 — — —, ears of, 454.
 — — —, eye of, 454.
 — — —, femur of, 465.
 — — —, general form of, 454, 455.
 — — —, hypapophyses of, 463.
 — — —, hyperapophyses of, 462.
 — — —, humerus of, 465.
 — — —, innominate bone of, 465.
 — — —, limbs of, 454, 455.
 — — —, measurements of, 455.
 — — —, measurements of the skull of, 461, 462.
 — — —, metapophysial processes of, 462.
 — — —, præsternum and mesosternum of, 464.
 — — —, radius and ulna of, 465.
 — — —, scapula of, 463, 464.
 — — —, skeleton of, 462–467; measurements of, 466.
 — — —, skull of, 455–462.
 — — —, snout of, 454.
 — — —, spinous processes of, 462.
 — — —, tail of, 455.
 — — —, teeth of, 459.
 — — —, tibia and fibula of, 465.
 — — —, transverse processes of, 462.
 — *suillus*, 453.
Hyloterpe sulfuriventra, 117.
Hyperoodon gervaisii, 206, 207.
 — *rostratus*, 203, 209, 234.
 — *semijunctus*, 206.
Hypotaenidia celebensis, 95.
 — *philippensis*, 95.
 — *striata*, 95.
Hypothymis manadensis, 66.
 — *puella*, 66, 107.
Hypotriorchis severus, 33.
Ibis falcinellus, 101.
Inocotis papillosa, 101.
Iotreron melanocephala, 30, 83.
 Javan Hawk, 37.
Kogia, 223.
Lafoea dumosa, 470, 471.
 — *fruticosa*, 470, 472.
 — *halecioides*, 471, 472, 477, 480.
Lafoëidæ, 472.
Lagenorhynchus albifrons, 273.
 — *albirostris*, 236, 247, 250, 275, 280, 281, 296, 300.
Lalage aurea, 70, 107.
 — *dominica*, 69.
 — *leucopygialis*, 69, 108.
 — *melanoleuca*, 69.
Lamprotornis cantor, 79.
 — *columbianus*, 80.
 — *metallica*, 80.
 — *minor*, 80, 81.
 — *obscura*, 80.
 — *pyrrhopogon*, 78.
Lamprotreron formosa, 82.
Lanius dominicanus, 67.
 — *dubius*, 81.
 — *leucogaster*, 67.
 — *leucorhynchus*, 67.
 — *manillensis*, 67.
 — *pacificus*, 80.
 — *silens*, 69.
Lasiorhinus m'coyi, 345.
Leptopteryx leucorhynchus, 67.
Leucotreron gularis, 83.
Lamnaëtus lanceolatus, 34, 110, 111.
Limosa uropygialis, 97.
Lobipes hyperboreus, 97.
Lophohelia affinis, 308, 331.
 — *anthophyllites*, 307, 331.
 — *defrancei*, 308, 331.
 — *gracilis*, 305, 308, 332, 339, 341.
 — *latistella*, 332.
 — *prolifera*, 305, 307, 328, 331, 332, 337–342.
 — *stoppaniana*, 308, 331.
 — *striata*, 332.
 — *subcostata*, 307, 331.
Lophospiza griseiceps, 33.
Lophotes reinwardtii, 36.
Loriculus amabilis, 26.
 — *exilis*, 32.
 — *flosculus*, 27.
 — *pusillus*, 27.
 — *quadricolor*, 109.
 — *sclateri*, 32.
 — *stigmatus*, 26, 32.
Lyncornis cerviniceps, 112.
 — *macropterus*, 47, 112.
 — *macrotis*, 112.
 — *temmincki*, 112.

- Macropteryx klecho*, 45.
 — *leucophaea*, 46.
 — *wallacii*, 45.
Macropus rufus, 483.
Macropygia albicapilla, 85.
 — *leptogrammica*, 85, 107.
 — *macassariensis*, 85.
Madrepora oculata, 323.
 — *ramea*, 324.
Madreporaria. A description of the, dredged up during the Expeditions of H.M.S. 'Porcupine' in 1869 and 1870, by P. Martin Duncan, 303.
 —, classification of the species of, 306, 308.
 —, distribution of the species, in the recent and past faunas, of, 337.
 —, tables of the localities, &c. of, 338.
Madreporidæ, 308, 333.
 Manatee (*Manatus americanus*), on the form and structure of, by J. Murie, 127.
Manatus americanus, additional note on, 191-193.
 — —, admeasurements of, 128-130.
 — —, air-passages of, 178, 179.
 — —, alimentary canal of, 169.
 — —, blood-vessels and lymphatic glands of, 175-178.
 — —, cranium and dentition of, 140-143.
 — —, digestive tract of, 164-175.
 — —, exterior aspects and dimensions of, 127-131.
 — —, fatty envelope of, 134, 135.
 — —, general contour of, 127, 128.
 — —, glands concerned in digestion of, 172-175.
 — —, hair and bristles of, 133, 134.
 — —, heart of, 175.
 — —, hyoid and the surrounding pharyngo-glossal fleshy parts of, 179, 180.
 — —, integument, its appendages and subjacent textures, of, 131-135.
 — —, interior of the mouth, and tongue of, 164-169.
 — —, limbs, pelvis, and ligaments of, 139, 140.
 — —, muscles of the accessory skeleton of, 156-163.
 — —, muscles of the axial skeleton of, 143-156.
Manatus americanus, muscles connecting the spinal column of: dorsal aspect, 143-145; ventral aspect, 145-148.
 — —, muscles of the costal arches of: thoracic, 151-153; abdominal, 153-156.
 — —, muscles of the dermis of, 163, 164.
 — —, muscles of the hip-girdle of: pelvic and generative, 161-163.
 — —, muscles of the pectoral limb of: dorsal, 158, 159; ventral of, 159-161.
 — —, muscles of the shoulder-girdle of, 156-158.
 — —, muscles of the skull or cephalic segment of: facial or supracranial, 148-151.
 — —, muscular system of, 143-164.
 — —, nervous system of, 180-186.
 — —, nose and nasal passages of, 186, 187.
 — —, ocular and auditory apparatus of, 187, 188.
 — —, organs of circulation of, 175-178.
 — —, parts related to generation (in the female and male) of, 188, 189.
 — —, rank and relations of, 189-191.
 — —, sensory organs of, 186-188.
 — —, skeleton and its ligamentous connexions of, 135-143.
 — —, skin of, 131-133.
 — —, spinal axis of, 135-138.
 — —, spinal ligaments of, 138, 139.
 — —, vocal and respiratory apparatus of, 178-180.
Mareca gibberifrons, 102.
 — *punctata*, 102.
Marsupialia, on the osteology of the (Part III.). Modification of the skeleton in the species of *Phascolomys*, by Prof. Owen, 345.
 —, on the osteology of the (Part IV.). Bones of the trunk and limbs of *Phascolomys*; by Prof. Owen, 483.
Megacephalon maleo, 87, 88.
 — *rubripes*, 87, 88.
 — *rufipes*, 87.
Megapodius gilberti, 87.
 — *rubripes*, 87.
Melanopelargus episcopus, 101.
Melanopitta forsteni, 62.
Melias diardi, 53.
Melittophagus minutus, 111.

- Meropogon bullockoides*, 111.
 — *forsteni*, 42, 111, 112.
Merops daudini, 42.
 — *ornatus*, 42.
 — *philippinus*, 42, 112.
 — *viridis*, 42.
Merula solitaria philippensis, 63.
Mesodiodon, 209.
 — *densirostris*, 211.
 — *seychellensis*, 211.
Mesoplodon, 208-212.
 — *densirostris*, 224.
 — *sowerbyensis*, 210.¹
 — *sowerbyi*, 223, 224, 229, 231.
Micropteron bidens, 210.
Micropterus, 209.
Milvus affinis, 36.
 Mivart, St. George. On the axial skeleton of the
 Ostrich (*Struthio camelus*), 385.
Monachalcyon monachus, 43.
 — *princeps*, 43.
Monodon monoceros, 278.
Monticola solitaria, 63.
Motacilla flavescens, 65.
Mulleripicus fulvus, 41.
 — *pulverulentus*, 41.
Munia brunneiceps, 73, 108.
 — *molucca*, 73.
 — *nisoria*, 73.
 — *pallida*, 107.
 — *punctularia*, 73.
 — *rubro-nigra*, 73, 74.
 Murie, J. On the form and structure of the Manatee
 (*Manatus americanus*), 127.
 —. On the organization of the Caaing Whale,
 Globiocephalus melas, 235.
 —. Researches upon the anatomy of the Pinnipedia.
 Part III. Descriptive anatomy of the
 Sea-Lion (*Otaria jubata*), 501.
Muscicapa cantatrix, 117.
 — *panayensis*, 79.
 — *rufigastra*, 117.
Myiagra azurea, 66.
 — *rubeculoides*, 66.
Myialestes cinereocapilla, 66.
 — *helianthea*, 66, 107.
Myristicivora bicolor, 84.
 — *luctuosa*, 84.
Myristicivora spilorrhœa, 84.
Myzomela chloroptera, 117.
Nectarinia aspasia, 71.
Nectarophila grayi, 71.
Neopus malayensis, 34.
Neoziphius, 209.
Ninox affinis, 41.
 — *japonicus*, 40.
 — *madagascariensis*, 41.
 — *nipalensis*, 40.
 — *philippensis*, 38, 41.
Nisus cruentus, 34.
 — *trinotatus*, 33.
 — *virgatus rhodogaster*, 33.
Noctua hirsuta japonica, 40.
 — *philippensis*, 38.
Nodus, 209.
Notornis mantelli, 120.
 —, length of femur and sternum of, 119.
Numenius minor, 96.
 — *minutus*, 96.
 — *phœopus*, 96.
 — *uropygialis*, 96.
 — *viridis*, 101.
Nycticorax caledonicus, 100, 114.
 — *griseus*, 100.
 — *manilensis*, 100.
Octopus, 214.
Oculinidæ, 308, 332.
Ocydromus australis, 120, 124-126.
 — —, length of sternum and femur of,
 119.
Edicnemus grillarius, 91.
 — *magnirostris*, 91.
Onychoprion anæsthetus, 104.
 — *melanauchen*, 104.
Orca gladiator, 20, 237.
Oriolus galbula, 60, 112.
 — *hippocrepis*, 60.
 — *horsfieldii*, 60.
 — *indicus*, 60.
 — *kundoo*, 113.
 — *sinensis*, 78.
Ortygometra cinerea, 94.
 — *quadristrigata*, 94.
Osmotreron bicincta, 114.
 — *griseicauda*, 82.
 — *vernans*, 81, 113.

- Ostrich (*Struthio camelus*), on the axial skeleton of,
by St. George Mivart, 385.
—, the (see *Struthio camelus*).
- Otaria jubata*, descriptive anatomy of, by J. Murie, 501.
— — —, alimentary canal of, 558.
— — —, alimentary glands &c. of, 563-567.
— — —, aorta of, 536.
— — —, arterial distribution of, 536-545.
— — —, arteries of the base of the brain of, 539.
— — —, arteries of the head and neck of, 536.
— — —, arteries of the pectoral limb of, 540.
— — —, arteries of the pelvic limb of, 544.
— — —, bones of the extremities of, 513-517.
— — —, brain of, 519-530; outward aspects and dimensions of, 519-521; cerebrum, 520; the cerebral lobes, 521; clefts and sulci of cerebrum, outer face, 522; convolutions of the outer face, 524; sulci and gyri of the inner face, 525; folds and furrows, left half of the cerebrum, 526; interior structures, 527; basal parts of cerebellum, 528; weight, 529.
— — —, carpus, metacarpus, and phalanges of, 514.
— — —, cartilages of the larynx of, 547.
— — —, cavities of larynx and trachea of, 551.
— — —, components of hyoid and larynx of, 546.
— — —, cranio-facial nerves of, 530.
— — —, deglutitive apparatus of, 557.
— — —, digestive system of, 553-567.
— — —, dura and pia mater of, 518.
— — —, faucial folds, tonsils, and oral glands of, 554.
— — —, femur and patella of, 516.
— — —, genital glands, scrotum, &c. of, 571.
— — —, glands in proximity to air-passages of, 552.
— — —, hepatic ducts, ligaments, and gall-bladder of, 564.
— — —, hind foot of, 516.
— — —, humerus of, 513.
— — —, hyolaryngeal and pulmonary systems of, 546-553.
— — —, intestines of, 562.
— — —, kidneys of, 567.
— — —, laryngeal membranes and ligaments of, 548.
— — —, lingual organs superficially considered of, 553.
— — —, liver of, 563.
- Otaria jubata*, lungs of, 552.
— — —, muscles of the genitals and anus of, 570.
— — —, muscles of the os hyoides and larynx of, 549.
— — —, muscles of the tongue and palate of, 555.
— — —, nerves of, 530-533.
— — —, nerves in fore limb of, 531.
— — —, nerves of the main branches of head and limbs of, 530.
— — —, nerves of loins and hind limb of, 532.
— — —, nervous system of, 517-534.
— — —, œsophagus of, 559.
— — —, organs of generation of, 569-573.
— — —, organs of vision of, 534; eyeball, 534; orbital muscles, 535.
— — —, parts and organs within the mouth of, 553-557.
— — —, pectoral limb of, 513-515.
— — —, pharynx and fleshy appurtenances of, 557.
— — —, pelvic limb of, 515-517.
— — —, pelvis of, 515.
— — —, relative positions of the abdominal viscera of, 558.
— — —, remarks on the extraction of the brain and membranes of, 517.
— — —, renal viscera of, 567.
— — —, ribs of, 510-513.
— — —, scapula of, 513.
— — —, sensory apparatus of, 534.
— — —, skeleton and cranial changes of, 501-517.
— — —, skull of, general aspects, 501; cranial bones, 502; the mandible, 503; foramina of lower base, 504; interior, 505; sexual differences, 506; progressive cranial changes, 507.
— — —, spinal column and thorax of, 509-513.
— — —, spleen, mesenteric glands, and pancreas of, 566.
— — —, sternum of, 512.
— — —, stomach and omenta of, 560.
— — —, teeth and palate of, 553.
— — —, tibia and fibula of, 516.
— — —, ulna and radius of, 514.
— — —, ureters and bladder of, 569.
— — —, urethra and penis of, 569.
— — —, urino-generative system of, 567-573.
— — —, venous blood-channels, 545.
— — —, vertebræ of, 509.
— — —, visceral arteries of, 542.

- Otaria jubata*, vocal passages, respiratory organs, and glands of, 551-553.
- Otus magicus*, 39.
- Owen, Professor. On *Dinornis* (Part XVII.): containing a description of the sternum and pelvis, with an attempted restoration, of *Aptornis defossor*, Ow., 119.
- On *Dinornis* (Part XVIII.): containing a description of the pelvis and bones of the leg of *Dinornis gravis*, 361.
- On *Dinornis* (Part XIX.): containing a description of a femur indicative of a new genus of large wingless bird (*Dromornis australis*, Owen) from a post-tertiary deposit in Queensland, Australia, 381.
- On the osteology of the *Marsupialia* (Part III.). Modification of the skeleton in the species of *Phascolomys*, 345.
- On the osteology of the *Marsupialia* (Part IV.). Bones of the trunk and limbs, *Phascolomys*, 483.
- Padda oryzivora*, 72.
- Palapteryx ingens*, 373, 374, 376, 377.
- Paracajathus agassizi*, 306, 319, 357, 339, 342.
- *confertus*, 320.
- *crassus*, 319.
- *striatus*, 306, 319, 337, 340, 342.
- Parra cristata*, 92, 93.
- *gallinacea*, 93.
- *indica*, 93.
- Pastor ruficollis*, 78.
- *senex*, 78.
- Pelargopsis melanorhyncha*, 45.
- Pelecanopus cristatus*, 105.
- *medius*, 104.
- Perforata*, 306, 333-335.
- Pernis celebensis*, 111.
- *crassirostris*, 36.
- *cristata*, 36.
- *ptilorhyncha*, 36, 111.
- Petaurus (Acrobates) pygmaeus*, 358.
- Petrorhynchus capensis*, 208.
- *mediterraneus*, 207, 209.
- Phalacrocorax melanoleucus*, 106.
- Phalangista gliriformis*, 358.
- Phalaropus australis*, 97.
- Phascolomys*. On the osteology of the *Marsupialia* (Part III.). Modifications of the skeleton in the species of, by Professor Owen, 345.
- Phascolomys*. On the Osteology of the *Marsupialia* (Part IV.). Bones of the trunk and limbs of, by Professor Owen, 483.
- , atlas of, 483, 484.
- , bones of the fore limbs of, 487.
- , bones of the hind limbs of, 494-497.
- , cranial characters of, 345-353.
- , dental characters of, 355-358.
- , femur of, 494.
- , fibula of, 494.
- , humerus of, 488.
- , ilium of, 486.
- , ilium and pubis of, 493.
- , mandibular characters of, 353-355.
- , neck of, 485.
- , pubis of, 493.
- , radius and ulna of, 490.
- , ribs of, 484, 485.
- , sacrum of, 486.
- , scapula of, 487.
- , tail of, 487.
- , tibia of, 494.
- , vertebrae of, 485-487.
- , vertebral column of, 483-487.
- *angasii*, 345.
- *lasiorhinus*, 345.
- *latifrons*, 345-360, 483-491, 494-500.
- *niger*, 345.
- *platyrhinus*, 345-360, 483-491, 494-500.
- *setosus*, 345.
- *vombatus*, 345-360, 483, 485-487.
- Philemon collaris*, 106.
- *inornatus*, 106.
- *moluccensis*, 106.
- Phlogoenas cruenta*, 29.
- *luzonica*, 29.
- *tristigmata*, 85.
- Phoca vitulina*, 522, 568.
- Phocæna communis*, 241, 255, 274, 278, 280, 561.
- *globiceps*, 235.
- *griseus*, 15.
- *risonnus*, 17.
- Phœnicophaës œneicaudus*, 52.
- *calorhynchus*, 52, 53.
- *curvirostris*, 52, 53.
- *erythrognathus*, 52, 53.
- *pyrrhocephalus*, 52, 53.
- Phyllodes laciniatum*, 322.

- Physalus antiquorum*, 266, 286, 298, 299.
Physeter, 208, 219, 220, 223.
 — *bidens*, 210.
 — *macrocephalus*, 272.
Pica albicollis, 75.
Picus fulvigaster, 41.
 — *horsfieldii*, 41.
 — *javensis*, 41.
 — *leucogaster*, 41.
 — *sanguineus*, 42.
 Piked Whale, 255.
 Pilot Whale (see *Globocephalus melas*).
Pinnipedia, anatomy of, Part III. Descriptive anatomy of the Sea-lion (*Otaria jubata*), by J. Murie, 501.
Pipastes batchianensis, 117.
Pitta melanocephala, 62.
 — *mülleri*, 62.
Plectolophus buffoni, 30.
Pliobothrus symmetricus, 336, 338, 344.
Plotus melanogaster, 106.
 — *novæ-hollandiæ*, 106.
Plumularia catharina, 479.
 — *penanula*, 477.
 — *pluma*, 476.
 — *setacea*, 476.
Plumulariæ, 475–480.
Podiceps gularis, 105.
 — *minor*, 105.
Polioætus humilis, 35.
Poliornis indicus, 37.
 — *liventer*, 37.
Polophilus lathamii, 59.
Polyphasia merulina, 54.
Pontoporia blainwillii, 235.
Porphyrio cinereus, 94, 95.
 — *indicus*, 92.
 — *neglectus*, 92.
 — *pulverulentus*, 92.
 — *samoënsis*, 92.
 — *smaragdinus*, 92.
Pratincola atrata, 63.
 — *caprata*, 63.
Prioniturus flavicans, 32.
 — *platurus*, 32.
 — *wallacei*, 32.
Prionochilus aureolimbatus, 72.
Psittacus cyanicollis, 107.
Psittacus setarius, 32.
 — *sumatranus*, 31.
Ptilinopus flavicollis, 107.
 — *hyogaster*, 107.
 — *melanocephalus*, 83.
 — *xanthogaster*, 107.
Pyrrhocentor celebensis, 55, 56.
 — *unirufus*, 55, 56.
Querquedula ciria, 102.
 — *humeralis*, 102.
Rallina isabellina, 96.
 — *minakasa*, 95.
 — *rosenbergii*, 96.
Rallus aquaticus, 124.
 — *gularis*, 95.
 — *lewinii*, 95.
 — *pectoralis*, 95.
 — *quadririgatus*, 95.
 — *superciliaris*, 94.
 — *torquatus*, 95.
Reinwardtæna reinwardti, 85, 107.
Rhinocærus sumatranus, 247.
Rhizotrochus affinis, 307, 323, 337, 339, 343.
 Risso's Dolphin, *Grampus griseus* (Cuv.), by W. H. Flower, 1.
 — — (see *Grampus griseus*).
Rugosa, 306, 335.
Sabinotrochus apertus, 306, 320, 339, 337, 341.
Saiga tartarica, 246.
Sauropatis chloris, 44.
 — *forsteni*, 44.
 — *sancta*, 44.
Scissirostrum dubium, 81.
 — *pagei*, 81.
Scops madagascariensis, 40.
 — *mantis*, 106.
 — *rutilus*, 40.
Scythrops novæ-hollandiæ, 51.
 Sea-Lion (*Otaria jubata*), descriptive anatomy of the, by J. Murie, 501.
 —, the (see *Otaria jubata*).
Sertularella gayi, 469–471, 474, 480.
 — *polyzonias*, 469–471, 474.
 — *robusta*, 471.
Sertularia abietina, 470.
Sertulariæ, 474.
Solenosmia variabilis, 307, 321, 328, 337, 339, 341, 342.

- Sphenotrochus intermedius*, 305, 306, 320, 337, 341.
 — *milletanus*, 320.
 — *milletianus*, 305.
Spilornis rufipectus, 35.
Spizaetus cirratus, 34.
 — *cirratus*, 35.
 — *crisatellus*, 35.
Sterna affinis, 104.
 — *bengalensis*, 104.
 — *bergii*, 105.
 — *delamotta*, 103.
 — *grisea*, 103.
 — *hybrida*, 103.
 — *panaya*, 104.
 — *panayensis*, 104.
 — *pelecanoides*, 105.
 — *ressa*, 105.
 — *similis*, 103.
 — *sumatrana*, 104.
 — *velox*, 105.
Sternula minuta, 118.
Streptilas interpres, 91.
Streptocitta albicollis, 75.
 — *caledonica*, 75-77.
 — *torquata*, 76, 77.
Strix hirsuta, 40.
 — *rosenbergi*, 41.
 — *scutulata*, 41.
Struthio camelus. On the axial skeleton of the Ostrich, by St. George Mivart, 385.
 — —, atlas of, 387-390.
 — —, axis of, 390-394.
 — —, catapophyses of, 451.
 — —, caudal vertebræ of, 387, 428-430.
 — —, centra of, 448.
 — —, cervical vertebræ of, 385, 387.
 — —, cervico-dorsal vertebræ of, 385, 386, 407-413.
 — —, coccygeal vertebræ of, 386.
 — —, diapophyses of, 450.
 — —, dorsal vertebræ of, 385, 386, 413-419.
 — —, dorso-lumbar vertebræ of, 385.
 — —, dorsal aspect of lumbar and sacral vertebræ of an immature specimen of, 425.
 — —, hypapophyses of, 451.
 — —, hyperapophyses of, 450.
 — —, ilium of, 436.
Struthio camelus, ischium of, 437.
 — —, lateral aspect of lumbar and sacral vertebræ of an immature specimen of, 422.
 — —, lateral aspect of the vertebræ from the fortieth to the forty-sixth inclusive, in an immature condition of, 427.
 — —, lumbar sacro-caudal vertebræ of, 420.
 — —, lumbar vertebræ of, 387, 421-424.
 — —, metapophyses of, 450.
 — —, neural laminæ of, 449.
 — —, neural spines of, 449.
 — —, parapophyses of, 451.
 — —, paraxial parts of, 450, 451.
 — —, pelvis of, 431-438.
 — —, pelvis of, dorsal aspect, 434.
 — —, pelvis of, lateral aspect, 433.
 — —, pelvis of, lateral aspect of acetabular region of an immature, 437.
 — —, pelvis of, preaxial aspect, 431.
 — —, pelvis of, ventral aspect, 435.
 — —, pleurapophyses of, 451.
 — —, postzygapophyses of, 450.
 — —, presacral part of axial skeleton of, 386.
 — —, presacral vertebræ of, 387-407.
 — —, prezygapophyses of, 449.
 — —, pubis of, 437.
 — —, ribs of, 438-447.
 — —, sacral vertebræ of, 387, 424-426.
 — —, sacro-caudal vertebræ of, 387, 426, 427.
 — —, ventral aspect of lumbar and sacral vertebræ of an immature specimen of, 423.
 — —, vertebræ of, 385-431.
 — —, vertebral parts and processes of, 448-450.
Sturnia albofrontata, 78.
 — *pyrrhogenys*, 78.
Sturnus dauricus, 78.
Stylaster gemmascens, 308, 332, 337, 338, 344.
Sula fiber, 106
Sylvia cysticola, 64.
Tachyspiza soloënsis, 34, 110.
Tantalus castaneus, 101.
 — *falcinellus*, 101.
Tanygnathus albirostris, 31.
 — *mülleri*, 31.
Tanysiptera riedelii, 45, 112.
 Tapir, 246, 247.
Temenuchus dominicanus, 78.

1933-5
1/2 ET

