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 foreshortened[1]. 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 figure[2], copied by Frederick Cuvier[3], to J. A. Albers's fœtus[4], and to that of Alexander von Humboldt[5]. Dr. Hermann Stannius[6] 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. Vrolik[7] 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 phototography 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 rounded[1], 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. inches.	Male. 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 $4\frac{1}{2}$ 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. inches.	Male. 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 minutiæ. 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 ○ to ◯, 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 inch[1].

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 proc ss

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 Ligamentous 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's[1] 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 Krauss[2], in their special monographs on the American species, largely treat of the skeleton; whilst the names of Schlegel[3], Owen[4], Gervais[5] and Serres, Kaup[6], Brandt[7], Gray[8], Nordmann[9], Huxley[10], 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. Jarhb. 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 Sirenologicæ," 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, Leuckart[1], and Robert[2] have enunciated that there are seven cervical elements; whilst Daubenton, the brothers Cuvier, Meckel[3], Schlegel, Stannius, A. Wagner[4], 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 communication[1], 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 incremement, 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 shown[1]; 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 Manatee[1]; 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's[2] superb delineations serve well my purpose for the latter; Stannius's, Carte and Macalister's[3], 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 Stannius[1] partly treats along with the semispinales in the Porpoise; but in the Pilot Whale, Macalister[2] 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 Elephant[3] 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 M^2, N, and N^1.

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 us[1], 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 underside 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 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 Vrolik[1] 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 symphysial 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 Cuvier[1]) panniculus; but there is besides a broad and fleshy combined elevator and depressor of the inferior lip[2].

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 *Globiocephalus*, 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 Elephant[1], 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 ×-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 layers[2]; 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 Stannius[3] in *Phocœna*, with some additional fibres which he terms *malaris externus*; but in the Pike Whale[4] 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*.

[2] Recueil, pl. 276, *j*, *j*[1].

[3] *L. c.* pp. 4 & 5.

[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 n 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.

Rapp[1] 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 Stannius[2], who names both a scalenus anticus and posticus to the first and second ribs. This agrees with what Macalister[3] and I have found in the Pilot Whale; but Carte[4] 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 Elephant[5]—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[b].

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.mg*, 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 Elephant[1] is very massive, and extends backwards to the tenth or eleventh rib. Meckel[2] says it is very small in Cetaceans, only fixed to at most four ribs; but my own researches agree rather with Carte and Macalister[3] and partly with Stannius[4], 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 Daubenton[1] 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 postpelvic 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. Rapp[1] 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 Vrolik[1] 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 ($P.c^1$) 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 dorsalwise 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*.

$2\frac{1}{2}$ inches broad and $1\frac{1}{2}$ inch thick at this point); thence it passes forwards and outwards ($P.c^2$) 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 ($P.c^3$), 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 infraspinatus. 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 manducatory 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 symphysial 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 bestrewed 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 Huxley[1], Messrs. Quoy and Gaimard[2] 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 symphysial 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 symphysial 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. Petersburgh, to correct the otherwise accurate Steller upon an important point, viz. the structure of the palatal and mandibular laminæ. 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 pad[1].

We learn, moreover, from the extensive researches of MM. Eschricht and Reinhardt[2], that in the fœtal 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 fœtus 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 arches[3]) 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 symphysial 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 *Ovis* 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 Owen[2]. 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 secerning 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 lessser 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 intestiniform, 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. Perkins[1] in his examination of Wyman's[2] *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 sidewards, 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 laminæ, 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 trifid 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 Stannius[1], 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 vasia brevia, and the hæmorrhoidal arterioles have inosculations 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 converge 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 thyroidal 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 indisputably 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 quadrangular, 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 semicircle, 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 Flower[2], 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 halfway 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 says[1], "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.

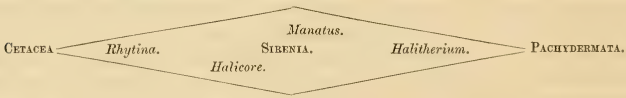
The position of the generative outlet is mentioned in the paragraph of measurements. Excepting in proximity to the anus, there is really very little difference between the sexes. An elevated labial rim surrounds the vulva, diminishing behind as it passes into a linear perineal raphe. A few shallow sulci 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 tincæ 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 Agassiz[1] 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. Gray[1] ranges the others under the family Manatidæ. Professor Kaup's[2] 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, *viâ* 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.

Sp.d. Spinalis dorsi + Levator caudæ internus, *Lci.*
L.d. Longissimus dorsi + Levator caudæ externus, *Lce.*
Sp. Splenius; *Co.* Complexus.
Tz. Trapezius; *Rh.* Rhomboideus.
S.l, *S.l**. Sacro-lumbalis.
Ei. External intercostals.
E.o. External oblique.
L.cd. Lumbo-caudalis.
Sc. Sacro-coccygeus.
P.c[1]., *P.c*[2]., *P.c*[3]., *P.c*[*]. Different portions of the panniculus carnosus muscle; including the platysma myoides, or transverse nuchal portion of the panniculus.
La.d. Latissimus dorsi.
f. Dorsal layer of fat.

Muscles of the Head.

Te. Temporalis; *ac.* Auditory canal.
O.p. Orbicularis palpebarum.
L.l.s.a.n. Levator labii superioris alæquæ nasi.
L.s.p. Levator labii superioris proprius.
D.l.i, *D.l.i**. Depressor labii inferioris.
D.a.o. Depressor anguli oris.
Pc[2]. Mandibular portions of panniculus.

Muscles of the Pectoral Limb.

I.sp. Infraspinatus.
D. Deltoid.
T[1], *T*[2]. Triceps (first and second portions).
T.ma. Teres major.
B.a. Brachialis anticus.
E.md. Extensor minimi digiti.
Pl &c. Palmaris longus &c.
Sl.&E.c.r.l. Supinator longus and extensor carpi radialis longior.
E.c.d. Extensor communis digitorum.
E.c.u. Extensor carpi ulnaris.
E.p.i.p. Extensor primi internodii pollicis.

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.

R.ab. Rectus abdominis.
E.o. External oblique.
I.o. Internal oblique.
Tra. Transversalis.
Is.c. Ischio-coccygeus.
Ifc. Infracoccygeus.
P.ma, *Pma**. Pectoralis major.
P.mi. Pectoralis minor.
C.h. Cephalo-humeral.
St.m. Sterno-mastoid.
S.hy. Sterno-hyoid and Sterno-thyroid.
T.hy. Thyro-hyoid.
S. Subscapularis.
Di. Digastric.
Ma. Masseter.
L.l.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.

Te. Temporalis.
Di. Digastric, seen in part.
*Ma*¹, *Ma*². Masseter, two layers.
L.l.s.a.n. The levator labii superioris alæque nasi cut short and reflected.
L.s.p. Levator labii superioris proprius.
C.n. Compressor nasi &c.
O.o. Orbicularis oris.
Bu. Buccinator.
D.a.o. Depressor anguli oris.
D.l.i. Depressor labii inferioris.
*Pc*¹, *Pc*², *Pc*³. Cheek and lip insertions of panniculus.

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*ˢ, superficial interossei; 1 to 5, the digits.

Fig. 15. A similar view, but with the superficial muscular expanse (*I*ˢ) hooked forwards, exposing deep interossei: *Id*, deep interosseous series.

Fig. 16. Profile fœtal skull of Manatee in the Amsterdam Museum. Nat. size. *Fr*, frontal; *Mx*, 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; *fm*, 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 symphysial pad; *T*, tongue; *id*, inferior dental foramen; *œ*, œsophagus; *tr*, trachea; *Cs*, constrictor superior; *Cm*, constrictor medius; *S.ph*, 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 semispiral appendicular cavity; *gl*, cardiac gland; *sp*, spleen; *Cœ*, 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.

œ, 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 basicephalic chamber.

R.a.ma. Rectus capitis anticus major.
R.a.mi. Rectus capitis anticus minor.
Lc^1, Lc^2, Lc^3. Longus colli, its three parts.
Rl. Rectus lateralis.
Sca. Scalenus.
S.mg. Insertion of serratus magnus into atlas.
Ch. Cephalo-humeral.
St.m. Tendinous insertion, sterno-mastoid.
S.h. Stylo-hyoid cartilage, cut cranial origin.

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 trifid 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; r^1, first rib; *st*, sternum reflected; c^3, the three sternal cartilages; *P*, pericardium opened; *œ*, 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*, splenium; *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*, uncinate; *Ma*, marginal; *C*, callosal.

Cerebellum:—*av*, arbor vitæ; *sv*, superior vermiform process or middle lobe; *fl*, 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 diaphgram; *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; *œ*, 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^{l}, levator caudal tendons, and t^{d}, 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 tincæ; *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.

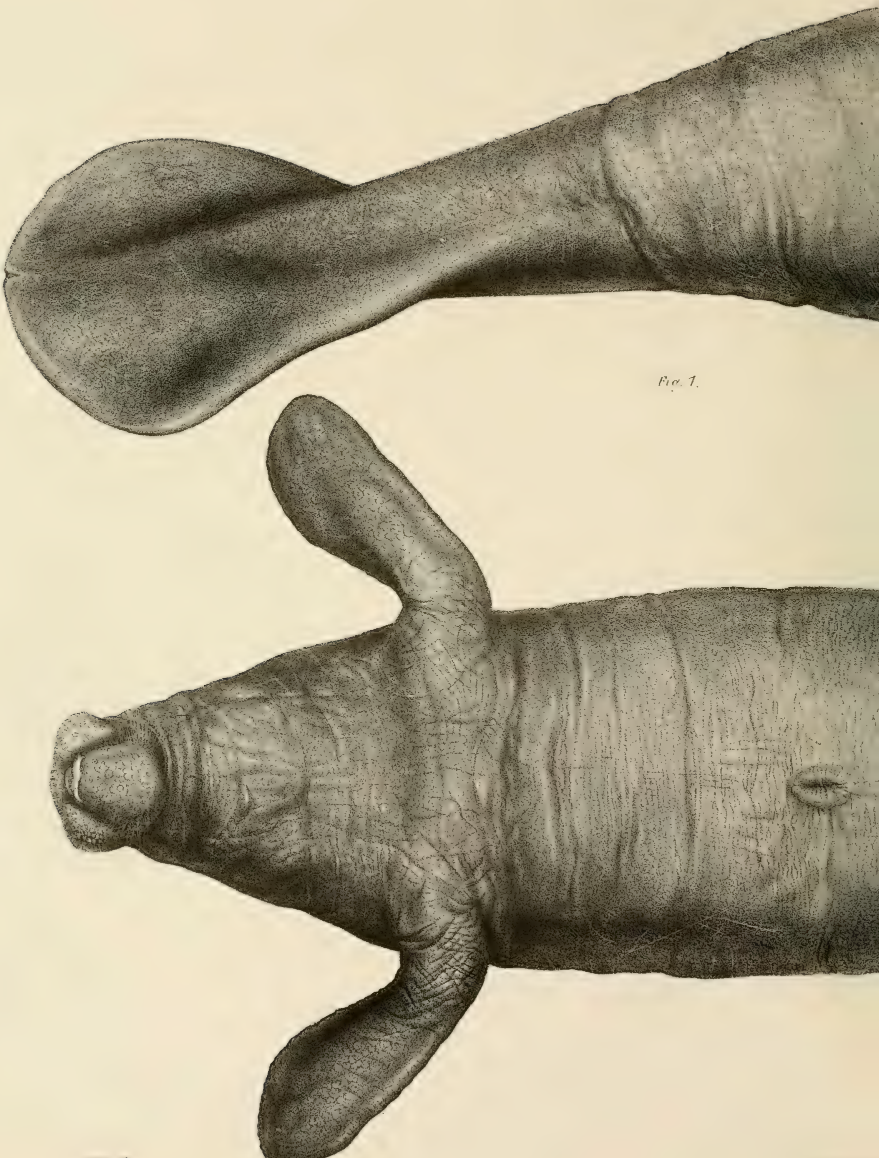
Fig. 48. A reduced sketch of the vulva, the skin and superficial tissues having been removed: *cl*, clitoris; *mu & v*, vulva and meatus urinarius; *Spv*, sphincter vaginæ.

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 vaginæ; *L.a*, levator ani; *Tp*, transversus perinæi; *E.c*, erector clitoridis.



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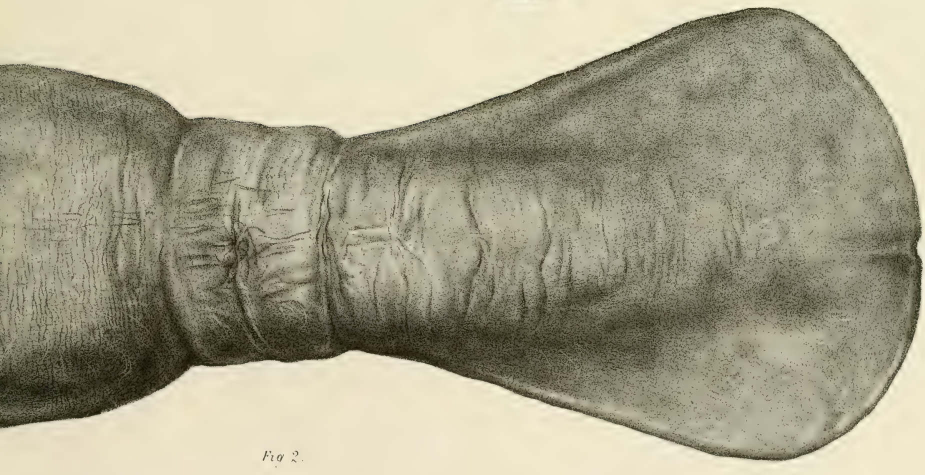

Fig 2.

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Fig. 1.

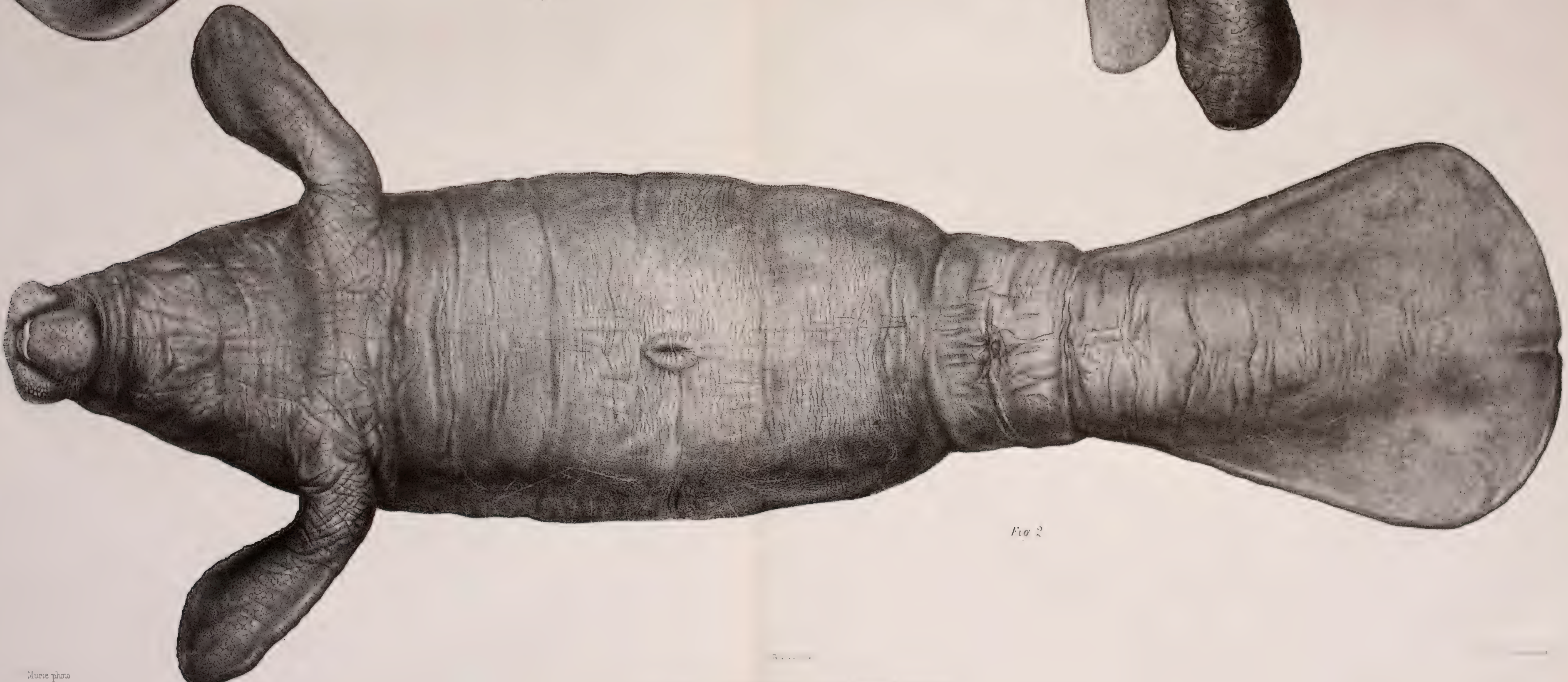

Fig. 2

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Fig 3

Fig 4

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Fig. 5

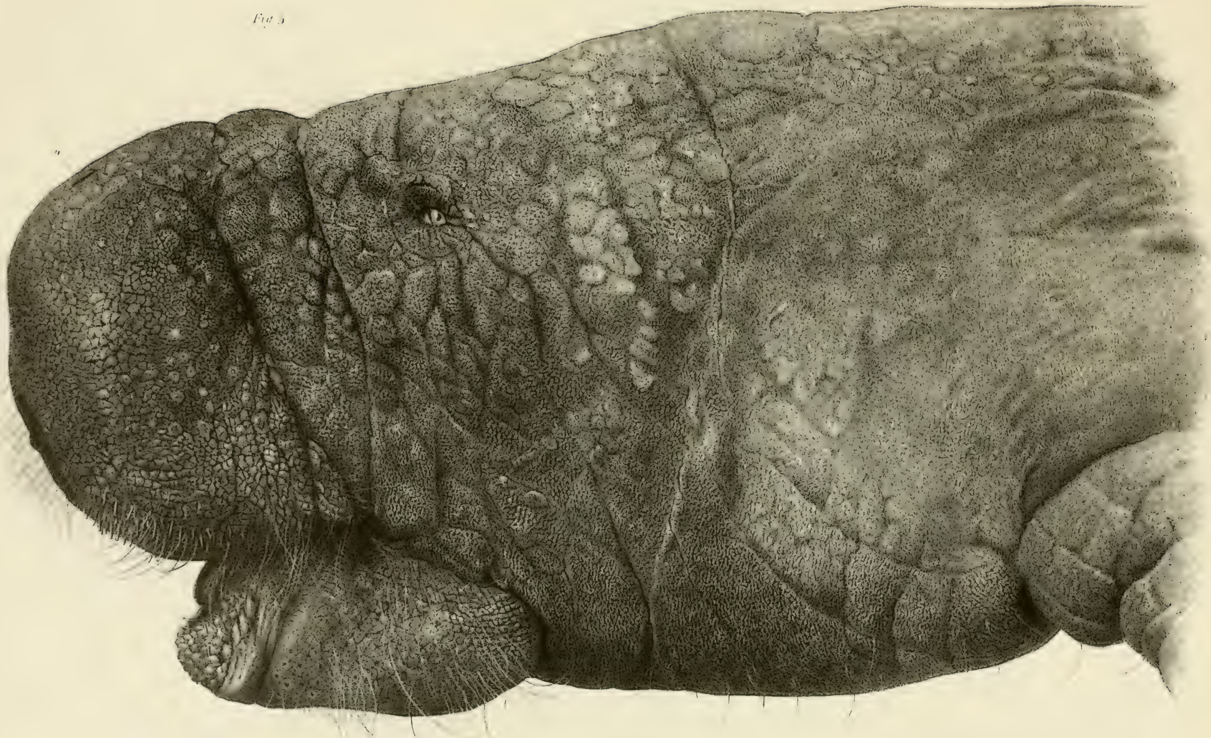
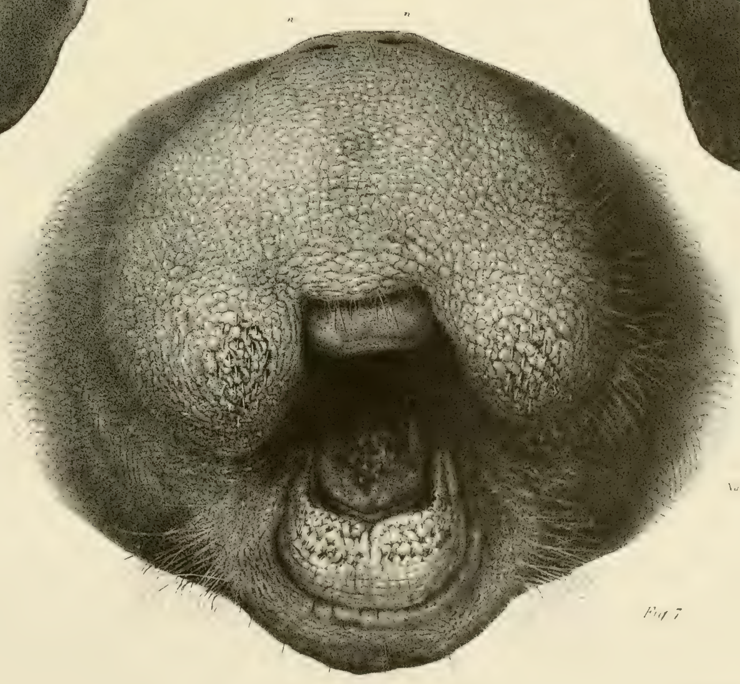


Fig 6



Nat Size

Fig 7

J Murie photo J Smit lith

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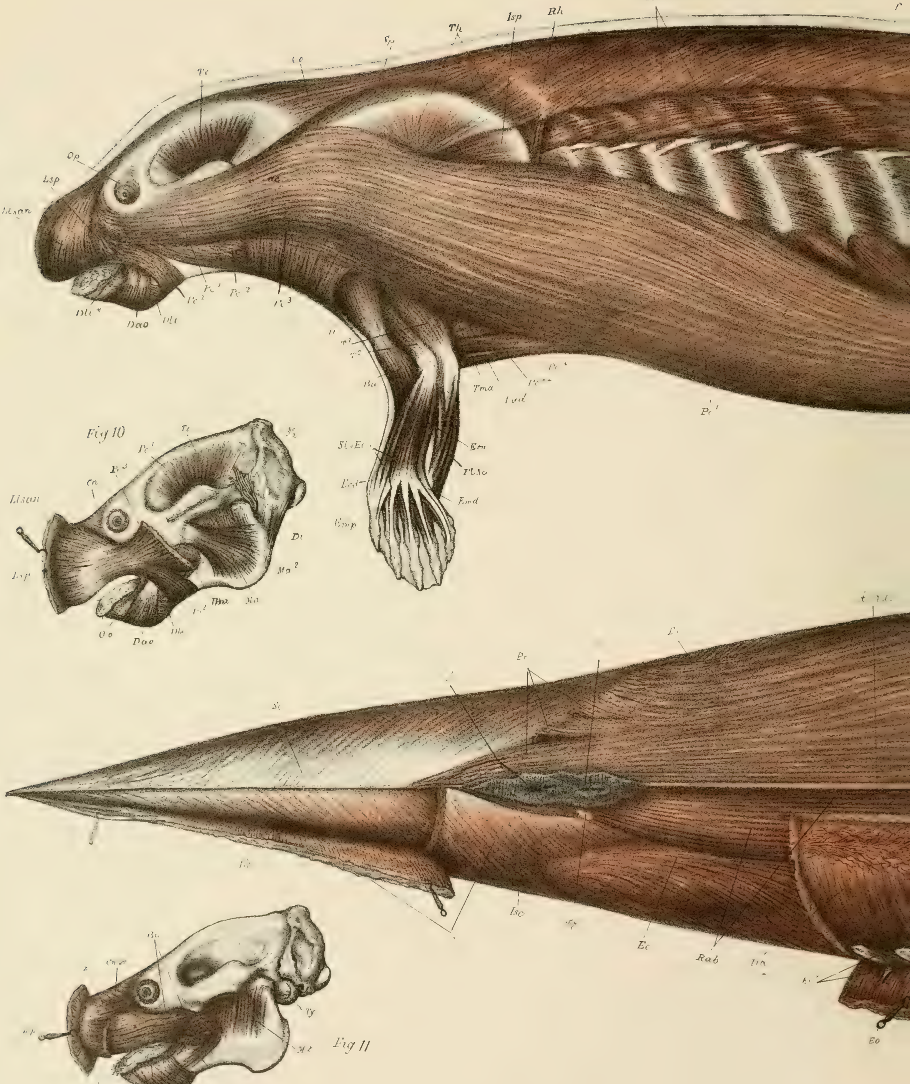
J Murie



MYOLOGY SUPERFICIA

Fig 8.

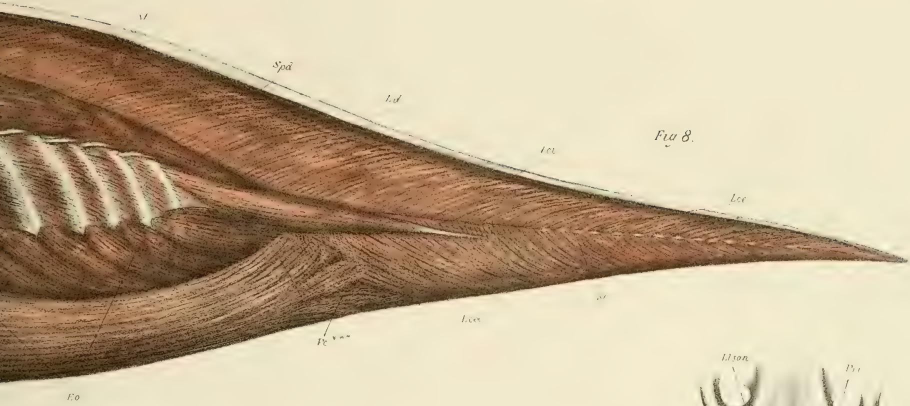
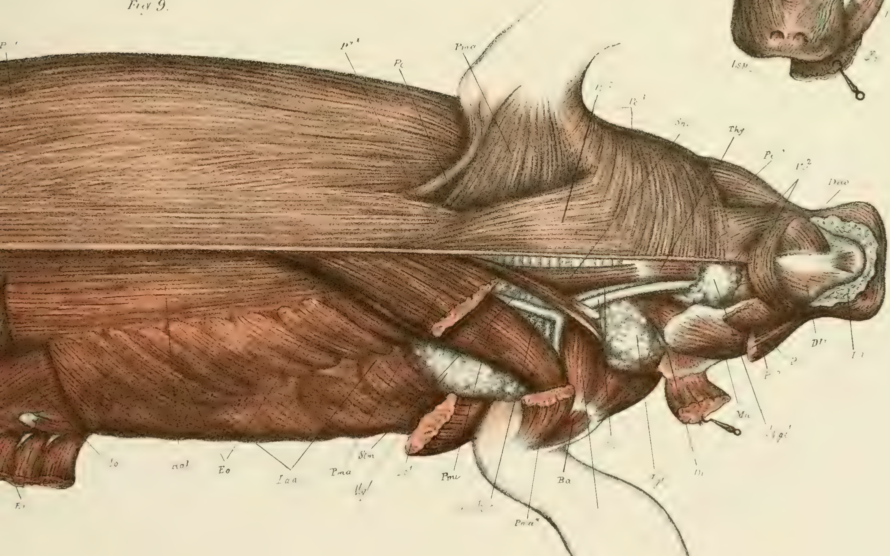


Fig 12

Fig 9.



P LAYERS ♀ ¼ Nat Size

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J. Murie

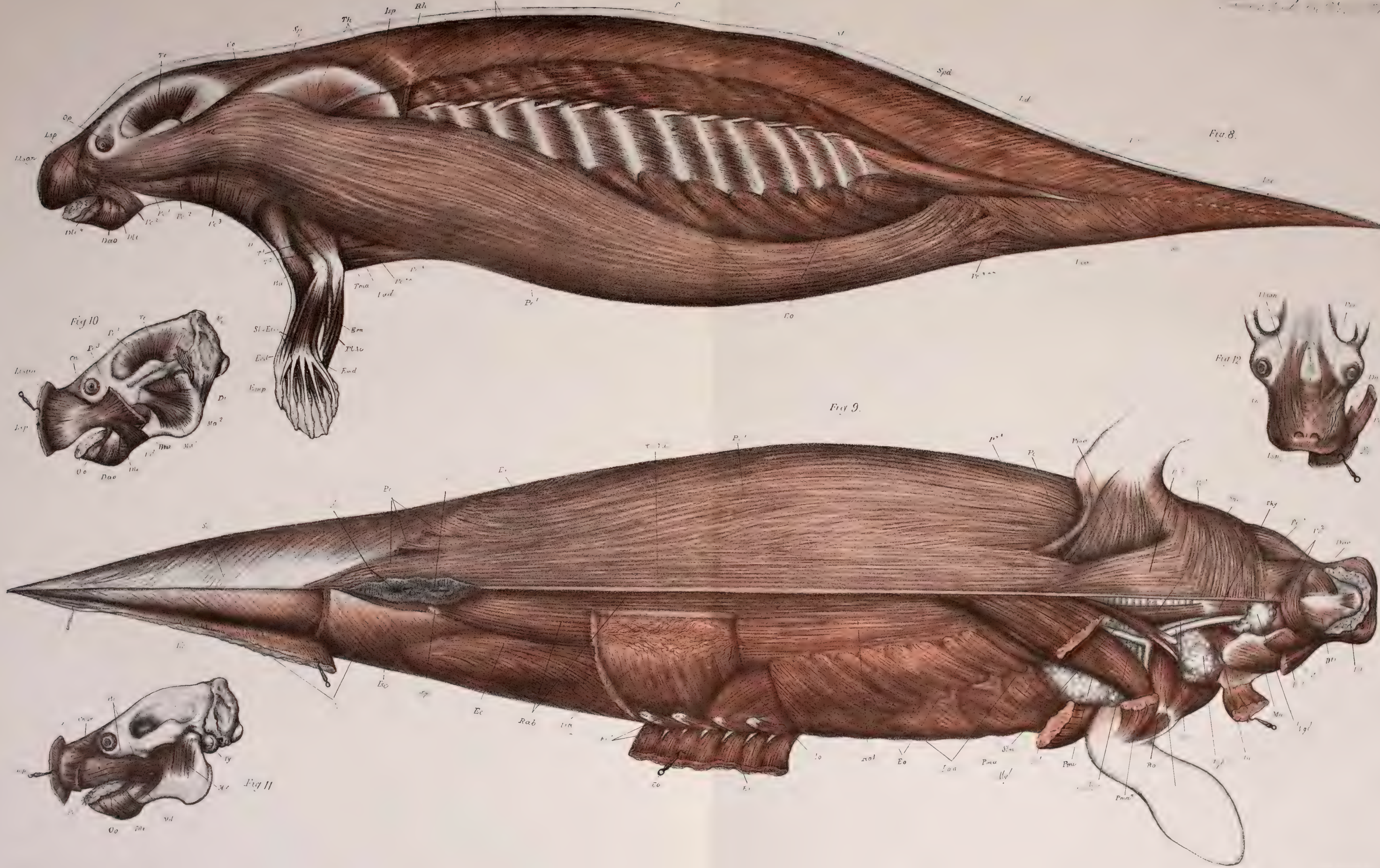
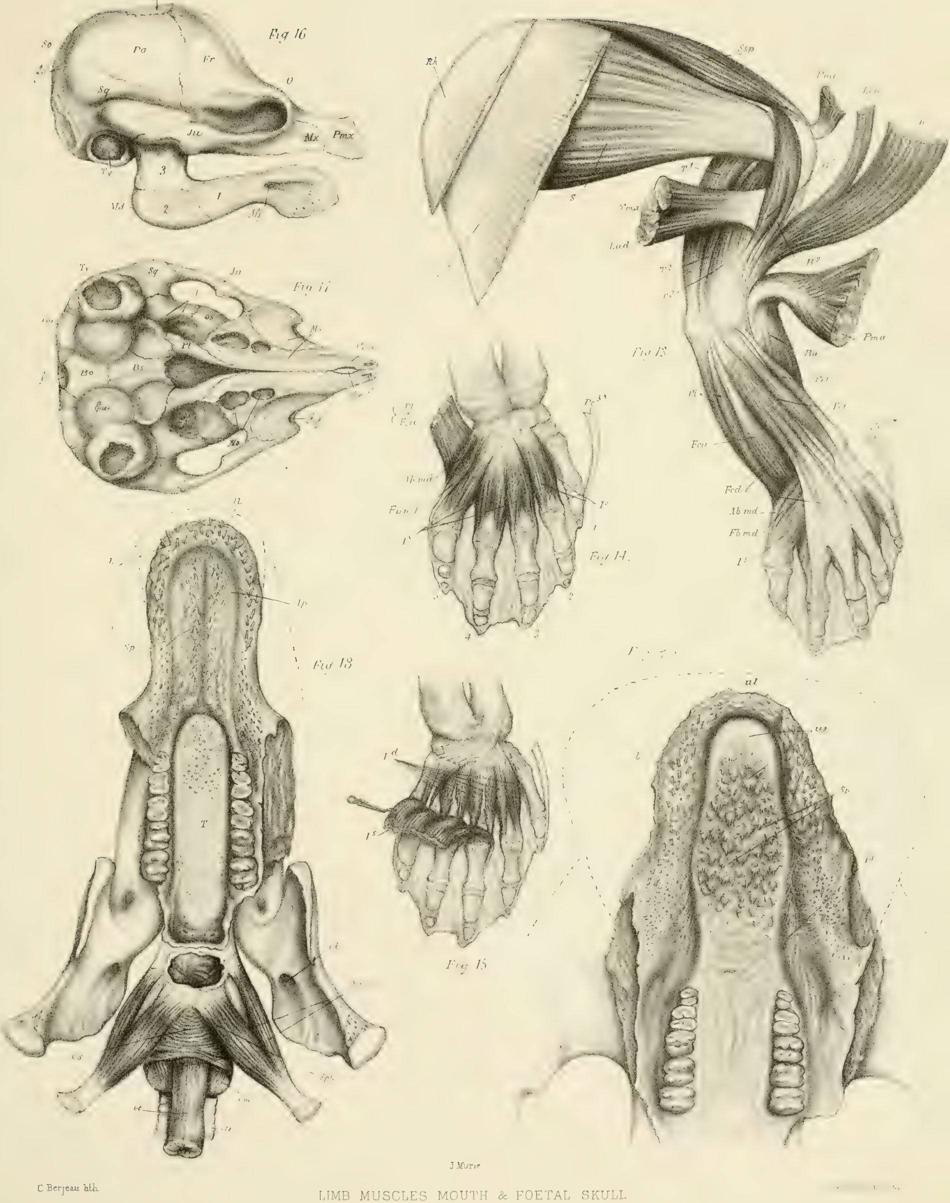


Fig 8. Fig 9. Fig 10 Fig 11 Fig 12

MYOLOGY SURPERFICIAL & DEEP LAYERS ♀ ½ Nat. Size.



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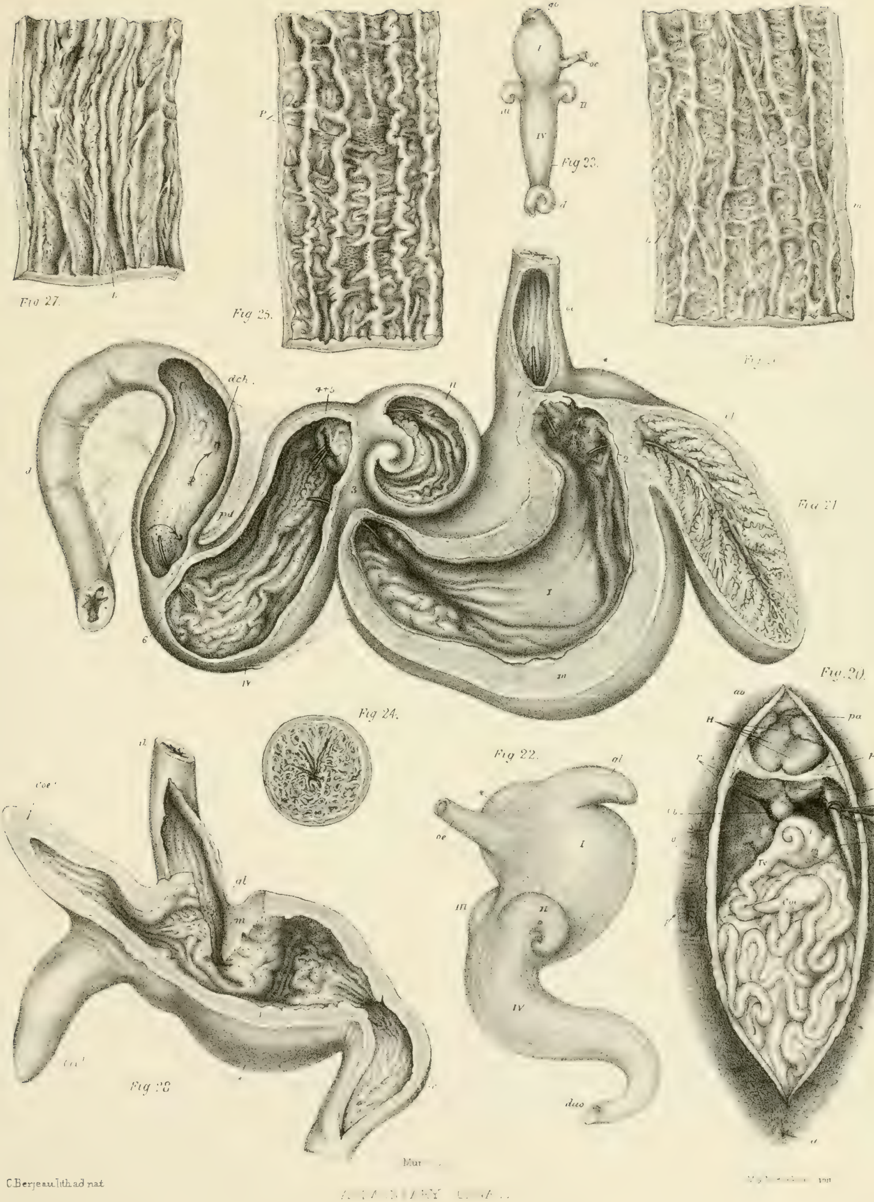
C Berjeau lith.

LIMB MUSCLES MOUTH & FOETAL SKULL



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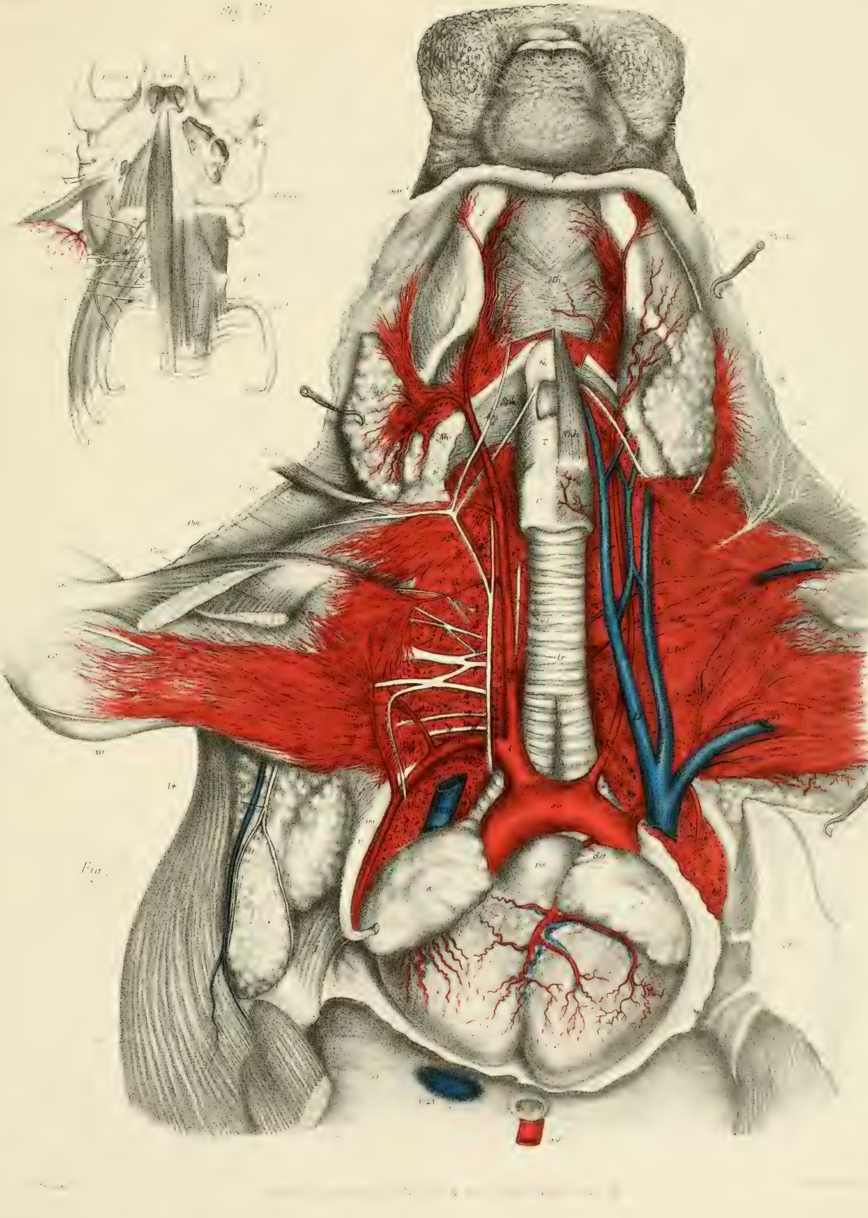

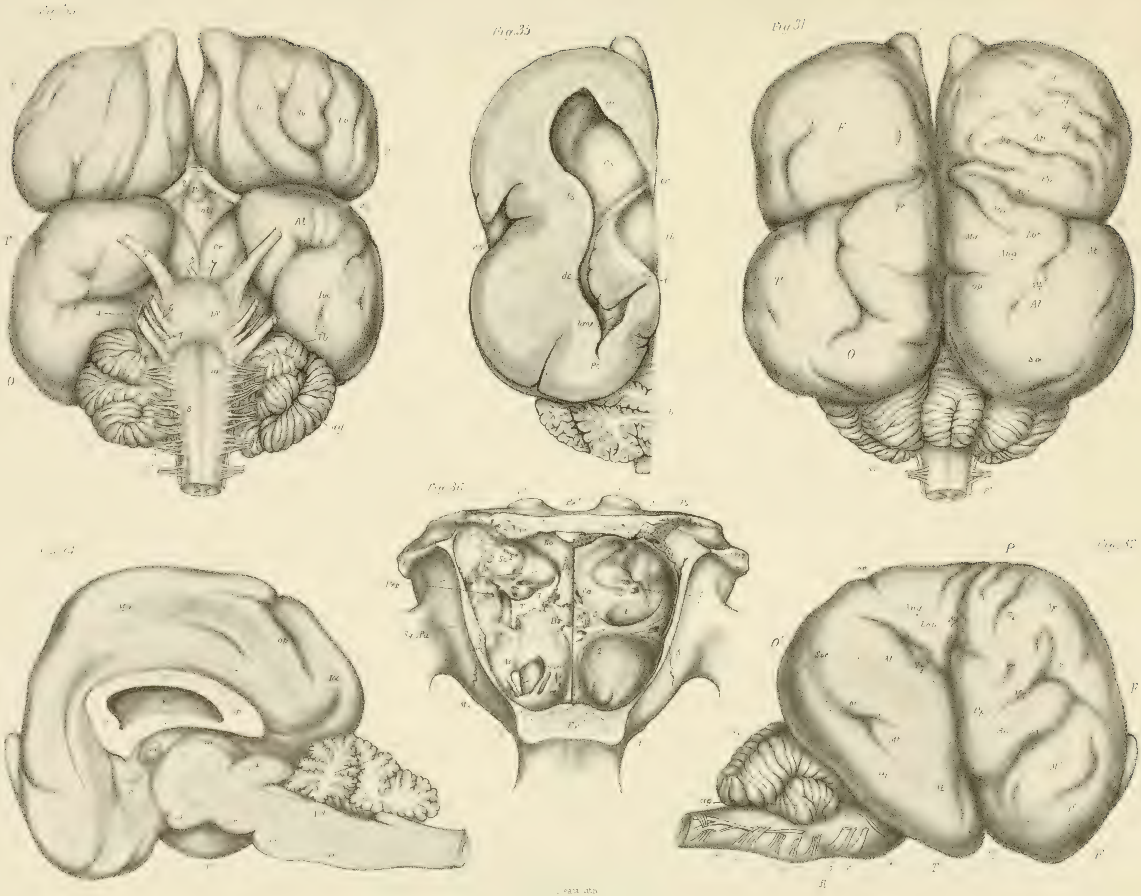

THE BRAIN *Nat. size and* CRANIAL CAVITY *reduced*

J Murie

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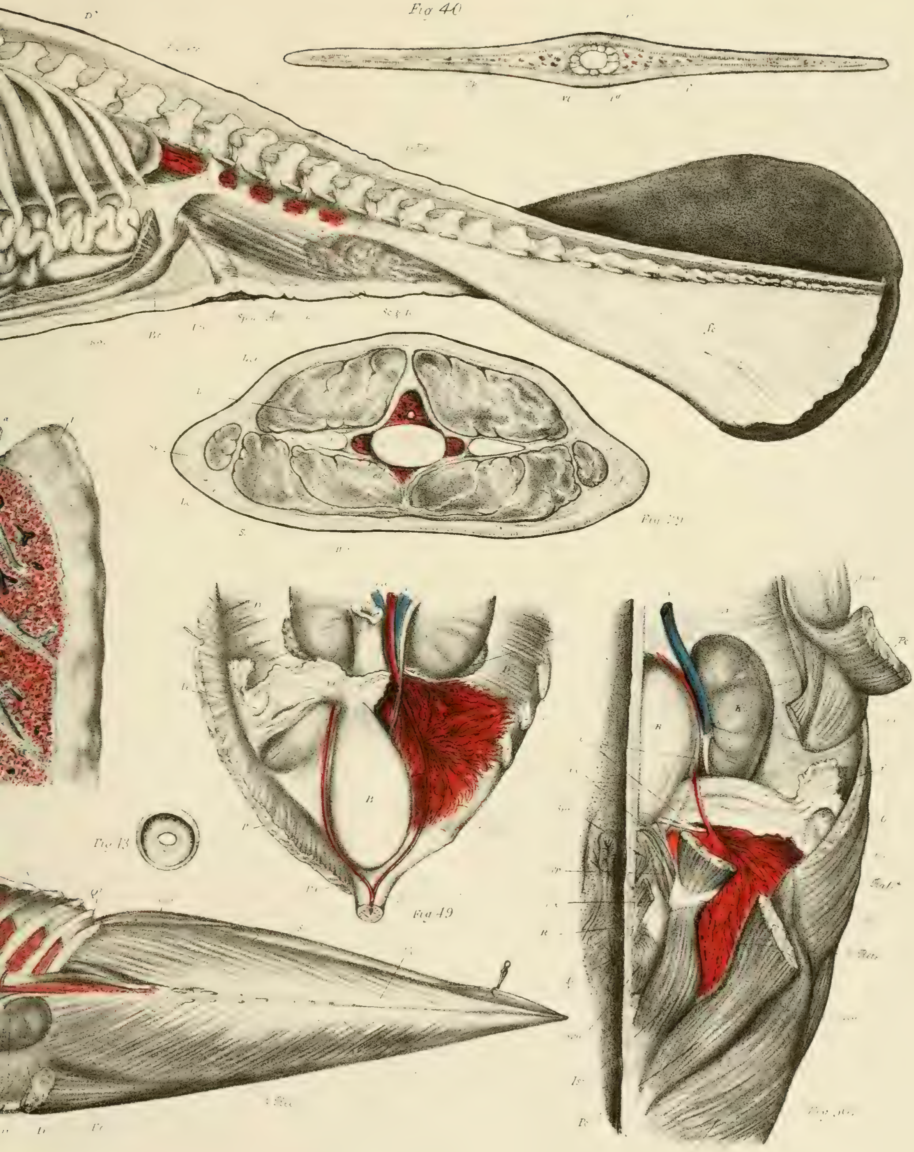
Fig 40
Fig 13
Fig 49

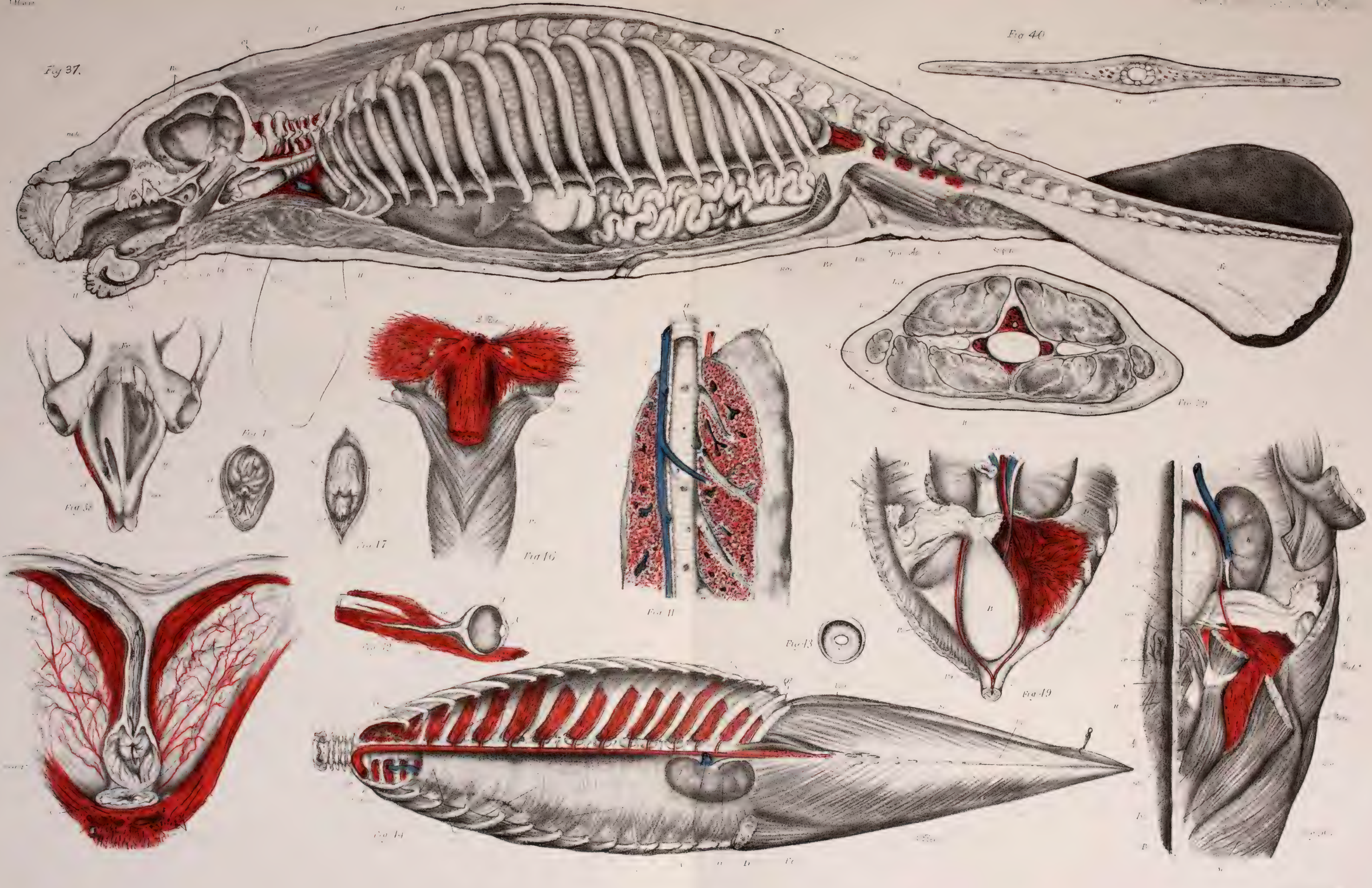
Fig 37.
Fig 40
Fig 17
Fig 16
Fig 11
Fig 43
Fig 49