

a common dark stripe edged externally with whitish (at least on the fore wing, where the costa is suffused with whitish between the stripe and the apex) extends from the costa of the fore wings to the inner margin of the hind wings at about two thirds of the length of the wing; near the base of the fore wings is a similar stripe, more oblique, and diverging from the other, not reproduced below; tails of the same shape as in *S. brachyura*, and edged with darker, as are also the fringes of the wings; a narrow pinkish line runs down the greater portion of the tail in the male; the tails in the female are much more broadly edged with darker for two thirds of their length; near the outer stripe of the fore wings runs a row of four small vitreous spots, edged with yellow and black, within which are two smaller detached spots in the female and one in the male; the vitreous spots are larger, and the yellow edging less distinct in the female than in the male; hind wings with five similar but smaller spots within the stripe, placed irregularly. Underside similar, but paler; basal stripe of fore wings absent. Body extending for half the length of the hind wings in the male, and for three quarters in the female, tails not included. Antennæ with very distant pectinations."

EXPLANATION OF THE PLATES.

PLATE XII.

- Fig. 1. *Saturnia iole*, p. 144.
 2. — *arnobia*, p. 142.
 3. — *sciron*, p. 143.
 4. *Castnia erycina*, p. 141.

PLATE XIII.

- Fig. 1. *Saturnia (Eudæmonia) argiphontes*, p. 144.
 2. — *sergestus*, p. 143.
 3. — *hyperbius*, p. 143.

3. On the Elephant Seal, *Macrorhinus leoninus* (Linn.).

By WILLIAM HENRY FLOWER, LL.D., F.R.S., P.Z.S., &c.

[Received January 4, 1881.]

The Museum of the Royal College of Surgeons of England has lately received from the Falkland Islands a very fine skull of an adult Elephant Seal. As this is a larger specimen than any with which I am acquainted, I have thought that it might interest the Fellows of the Society to see it; and I have availed myself of the opportunity afforded me by its exhibition to put together some notes regarding certain points in the structure and affinities of an animal which, notwithstanding its former abundance and wide distribution, and its great zoological interest, is still very imperfectly known anatomically, and very poorly represented in collections.

The skull was presented by Mr. Herbert Mansel, at the kind suggestion of Mr. F. Coleman, Secretary of the Falkland-Islands Company, who has made such excellent use of his opportunities in connexion with these islands to advance our knowledge of their zoology. Mr. Mansel has been good enough to furnish me with the following information about the animal from which the skull was obtained:—"I cannot now give you the exact date when the Elephant was killed, but it was sometime in 1879. The particulars of the capture are these. I was riding one afternoon along the south coast of the east island, about 45 miles west of Stanley, the principal settlement, when I perceived what I took to be a long boat turned upside down on the beach. On approaching nearer I discovered it was an enormous Seal asleep. I thought at first it was dead; but while watching I saw it half-open one eye. I then threw a stone at it; and when struck, it suddenly reared itself up on its flippers to the height, I should think, of 8 or 10 feet, opening its enormous mouth to its widest extent. After this I kept at a respectful distance, pelting him until he thought he had enough of it, and he made slowly for the water, making as much fuss as a large steamer. On going back to the house, I mentioned what I had seen to one of my men (an old inhabitant), who said it must have been an Elephant. He had never seen one, but said he had heard old sealers say they killed them by finding them asleep, giving them a poke in the side, and on their rearing up in the manner described firing into their mouth. He went out the next morning with his gun, and found the animal in the same place, and despatched him in the manner I have mentioned. I have been living in the Falkland Islands upwards of five years, and during that time never saw or heard of one having been seen. I may safely say one has not been seen in the Islands for the last ten or twelve years. They were never, I believe, plentiful, and now are extremely rare, as they were much sought after by the sealers on account of the quantity of oil they produced and the value of it, as it brought a much higher price than the oil procured from other Seals. The Elephant in question measured a little over 21 feet, and must have weighed several tons."

In response to further inquiries, Mr. Mansel adds:—"I did not notice the proboscis while the animal was asleep, but when roused it was inflated and very distinct, about a foot in length. The colour was the same as that of most Phocidæ, a dirty blue-black"¹.

It will be observed that the attitude assumed by the animal when disturbed, described by Mr. Mansel, corresponds very much with that of the original figure of the so-called "Sea Lyon" of Anson², of Juan Fernandez, upon which Linnæus founded his *Phoca leonina*, and the jaws and teeth of which, still preserved in the museum under my charge, prove the identity of the species with that now under consideration. The habit of raising the head and fore part of the body,

¹ With regard to the occurrence of the Elephant Seal in the Falkland Islands in former times, see Captain C. C. Abbott, P. Z. S. 1868, p. 189.

² 'Voyage round the World,' 1748.

and widely opening the mouth, is so noticed by Pernetty¹. It may be remarked that the accuracy of Anson's figure as regards the attitude assumed by the animal when attacked, though ridiculed by Péron, is fully vindicated by Mr. Moseley in his interesting account of the Sea-Elephants of Kerguelen's Land².

The skull appears to be that of an adult but by no means aged individual. The sutures between the basi-sphenoid and the basi-occipital on the one side, and the presphenoid on the other, are both still open, as in all the skulls of Elephant Seals I have yet examined. The crowns of the teeth are moderately worn; and the root of the great upper canine has not yet closed in at the base, which, judging from many specimens examined, it appears only to do in extreme old age.

Its relative size to that of other known skulls of animals of the same species may be estimated by the following figures, giving the length from the fore end of the premaxillaries to the occipital condyles in millimetres:—

	millim.
Skull presented by Mr. Mansel, No. 3921 A	564
The largest skull in the Museum of Comparative Zoology, Cambridge, Mass., U. S. A., from Heard Island ³	510
Largest skull in the Museum of Natural History, Paris ⁴ ..	508
Largest skull in the Berlin Museum, obtained in Kerguelen by the German Transit-of-Venus Expedition ⁵	490
Skull in Mus. Roy. Coll. Surgeons, No. 3921, locality unknown	463
Skull in Mus. Roy. Coll. Surgeons, No. 3920, locality unknown	438
Largest skull in the British Museum	380 ⁶

¹ "Lorsqu'ils aperçoivent quelqu'un approcher d'eux, ils s'élèvent ordinairement sur leurs deux pattes-nageoires, tels qu'on les voit dans la figure 1 Pl. IX. Ils ouvrent une gueule à recevoir, aisément une boule d'un pied de diamettre; et la tiennent ainsi béante, en gonflant l'espèce de trompe qu'ils ont sur le nez."—*Histoire d'un Voyage aux Iles Malouines fait en 1763 & 1764*, edit. 1770, tome ii. p. 45. The figure referred to is an unacknowledged copy of that of Anson. A still older observer, W. Funnell, mate to Captain Dampier, says, speaking of the "Sea-Lion" (as it was then generally called, because, as the author conjectures, "his Roaring is not unlike that of the Lion") of Juan Fernandez, in 1703:—"If they are hard pursued, they will turn about and raise their Body up with their Fore-fins, and face you, standing with their Mouth wide open upon their Guard: so that when we wanted to kill one to make Oil, we used commonly to clap a Pistol just to his Mouth, as it stood open, and fire it down his Throat."—*A Collection of Voyages*, vol. iv. p. 15 (1729).

² Notes by a Naturalist on the 'Challenger' (1879), p. 201.

³ J. A. Allen, 'History of North-American Pinnipeds' (1880), p. 748.

⁴ For this information I am indebted to Dr. H. Gervais. It was brought home in 1831 by D'Orbigny. That figured in Blainville's 'Ostéographie,' if not the same specimen, is of the same dimensions.

⁵ Kindly communicated to me by Dr. Peters.

⁶ The Museum of the University of Oxford possesses the anterior portion of the skull of a young male from Burchell's South-African collection, and the complete skeleton of a still younger female. The species is at present not represented in the excellent Osteological Museum at Cambridge.

The dimension given above does not express the whole length of the largest skull, though it does of the smaller ones, as in the older animals the occipital ridges become so greatly developed as to project backwards beyond the condyles. This takes place to such an extent in the case of the new skull as to give an extreme length of 597 millimetres, or $23\frac{1}{2}$ inches. In very young skulls, on the other hand, the most posteriorly projecting part is the middle of the squama occipitis, at or above the upper margin of the foramen magnum. This expresses the preponderance of the brain-case over the other parts of the skull at this stage of development. In the next stage the growth of the condyles outruns that of the brain-case; and finally the development of the great crests for muscular attachment give a very different general aspect to the cranium.

The remaining principal dimensions of this skull are the following:—

	millim.
Extreme width across zygomatic arches	384
Width between occipital crests	242
Greatest width of palate	185
Width of maxillæ across middle of rostrum	176
Width between outer sides of base of upper canines	158
Width between apices of upper canines	120
Width between outer sides of base of upper lateral incisors	60
Width between outer sides of base of lower canines	93
Length of palate, from notch in middle line behind to incisor teeth	272
Length of ramus of lower jaw	375
Greatest width between condyles of lower jaw	352

I have great hopes of obtaining, if not the whole skeleton, at least some of the principal bones belonging to the skull now described, as Mr. Mansel informs me that, after securing the head, he left the remainder of the body above high-water mark at the spot where it was killed. We shall then have the means of verifying his estimate of 21 feet, which I presume includes the length of the hind feet or flippers, and which will probably be not far from the maximum to which the animal reaches.

It is probable that, as in many of the Pinnipedia, and indeed in animals of almost all other groups, there is some variation in the size attained by adult specimens; and the head, especially of the males, continues to increase in magnitude some time after the animal has apparently reached maturity, by the addition of bony outgrowths, ridges, and crests for the attachment of muscles, and by the enlargement of the alveolar portions of the jaws for the support of the increasing roots of the great canine teeth. But the statements of those voyagers who ascribe a length of 25 or even 30 feet to some individuals of this species must of course be taken with considerable reserve, and require to be verified by the accurate measurements of actual specimens. It would be strange if the natural tendency to

exaggerate the size of every thing large had not had its influence in this case, as it undoubtedly has with Cetaceans, Sirenians, and other marine "monsters."

Skeletons are far more valuable than skins or stuffed specimens for giving dimensions, as the latter are susceptible of considerable factitious enlargement. Unfortunately there is not, as far as I can learn, any skeleton of a perfectly adult male Elephant Seal in any museum in Europe. The largest appears to be that at Berlin, of which I have given the size of the skull above, and of which the stuffed skin, according to Mr. J. W. Clark¹, measures 14 feet 6 inches in length from tip of nose to tip of tail, and 16 feet $3\frac{1}{2}$ inches to the extremity of the hind flippers, taking the measurement along the curve of the back. Dr. Peters gives the length of the vertebral column of this specimen as 3700 millims.², which, added to the length of the skull (490 millims.), gives 4190 millims., or 13 feet 9 inches for the whole length. Whether allowance has been made for the intervertebral spaces or not I do not know. Mr. J. A. Allen gives the length of the skeleton (nose to tail), allowing for the probable length of the intervertebral cartilages, of a male, said to be adult, from Heard Island, in the Museum of Comparative Zoology at Cambridge, Mass., as 4340 millims., or 14 feet 3 inches³. The skull of this specimen is 480 millims. long. Skeletons of very young animals, between four five feet in length, are common in museums.

Dentition.—Leaving out of consideration the exceedingly aberrant and specialized Walrus, the teeth of the Elephant Seal are more reduced in number, size, and form than those of any of the Pinnipedia, the only other member of the group which agrees with it in most of these characteristics being the closely allied *Cystophora* of the northern seas.

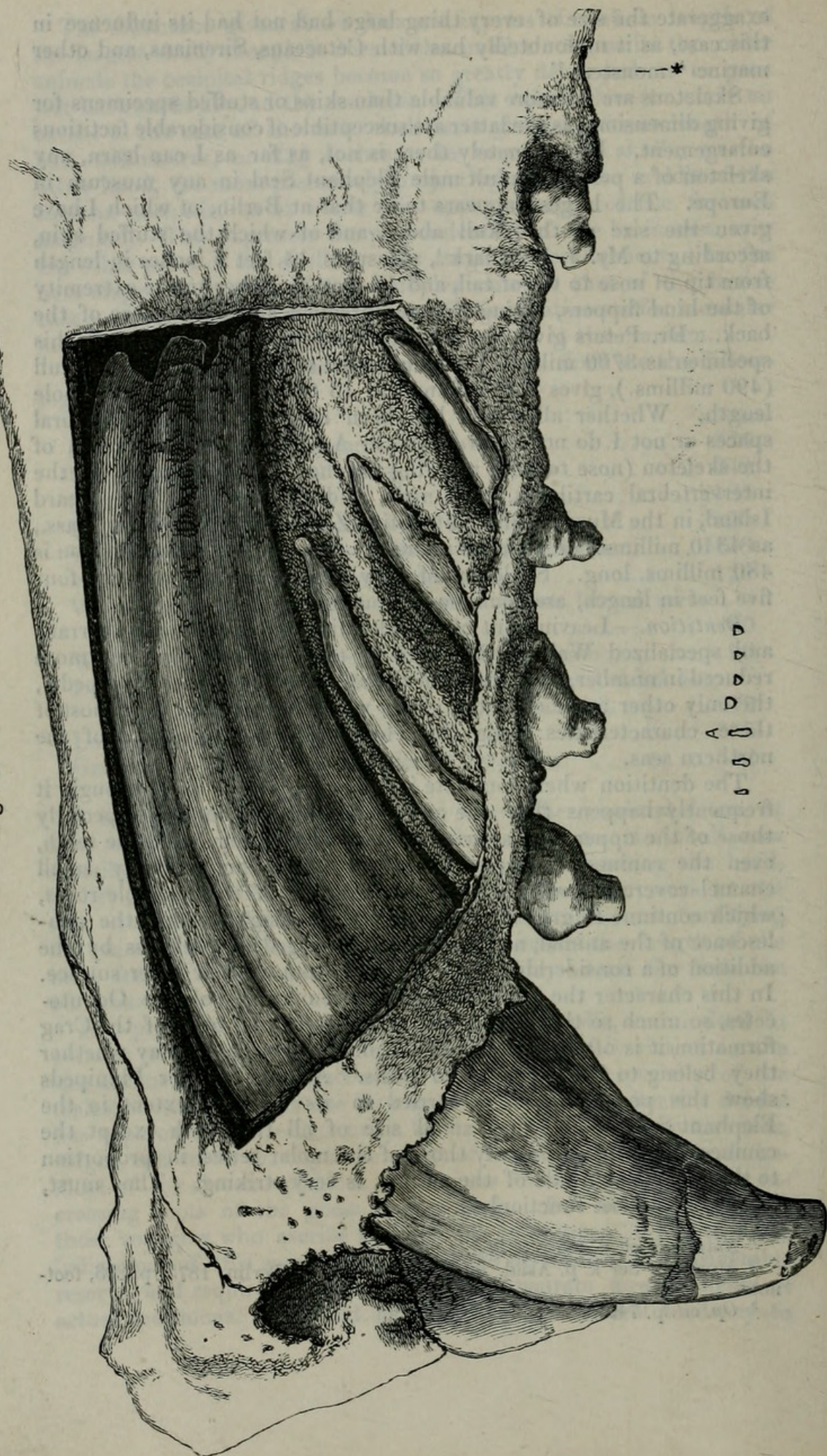
The dentition when complete is *i.* $\frac{2}{1}$, *c.* $\frac{1}{1}$, *pm.* $\frac{4}{1}$, *m.* $\frac{1}{1}$, though it frequently happens that one or more of the true molars, especially those of the upper jaw, are rudimentary or wanting. All the teeth, even the canines, are remarkable for their comparatively small enamel-covered crowns, and for the large size of their simple roots, which continue to grow in width as well as length during the adolescence of the animal, and are further enlarged in thickness by the addition of a considerable layer of cementum to their outer surface. In this character the teeth resemble those of many of the Odontocetes, so much so that in the case of isolated fossil teeth of the Crag formation it is often very difficult, if not impossible, to say whether they belong to Cetaceans or to Seals. Although other Pinnipeds show this peculiarity, it is carried to its greatest extent in the Elephant Seal. The very small size of all the teeth except the canines, and more especially those of the molar series, in proportion to the great magnitude of the animal, is very striking. They must, in fact, be almost functionless.

¹ Nature, Sept. 2, 1875, p. 366.

² Monatsb. der k. p. Akad. der Wissenschaft. zu Berlin, 1875, p. 393, footnote.

³ *Op. cit.* p. 749.

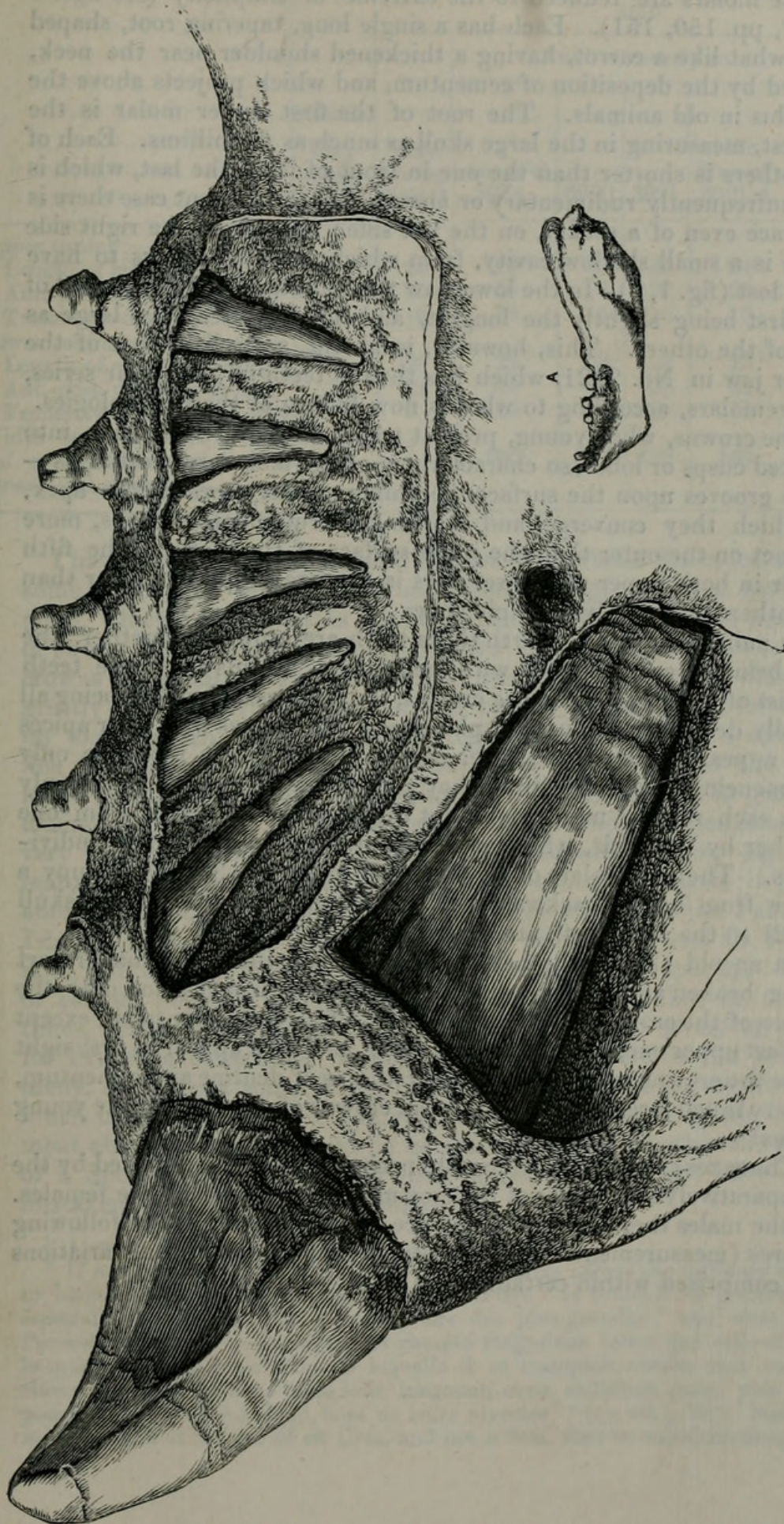
Fig. 1.



Side view of upper teeth of adult male Elephant Seal (*Macrorhinus leoninus*), natural size.

* Socket for rudimentary molar; A, calcified milk-teeth of fetal female Elephant Seal, also of the natural size.

Fig. 2.



Side view of lower teeth of adult male Elephant Seal (*Macrorhinus leoninus*).
 A. Lower jaw, with milk-teeth of foetal female Elephant Seal, natural size.

The molars are reduced to the extreme of simplicity (see figs. 1 and 2, pp. 150, 151). Each has a single long, tapering root, shaped somewhat like a carrot, having a thickened shoulder near the neck, caused by the deposition of cementum, and which projects above the alveolus in old animals. The root of the first upper molar is the longest, measuring in the large skull as much as 60 millims. Each of the others is shorter than the one in front of it, to the last, which is not unfrequently rudimentary or absent. In the present case there is no trace even of a socket, on the left side; though on the right side there is a small shallow cavity, from which a tooth appears to have been lost (fig. 1, *). In the lower jaw the roots are more equal, that of the first being slightly the longest, and the fifth nearly as large as any of the others. This, however, is absent, as well as that of the upper jaw in No. 2921, which has thus $\frac{4}{4}$ teeth of the molar series, all premolars, according to what is now known of their homologies.

The crowns, when young, present traces only of the division into pointed cusps or lobes, so characteristic of the molars of most Seals—mere grooves upon the surface, becoming deeper towards the apex, to which they converge, and marking off rudimentary cusps, more distinct on the outer than the inner surface of the tooth. The fifth molar in both upper and lower jaws is of more simple character than the others, often only a simple cone.

In animals soon after birth these teeth are crowded together, the first being placed in contact with the canine. In this stage the teeth consist of little more than the crowns, the incisors and molars being all equally developed and in their places, and the canines with their apices only appearing above the level of the alveolus; the roots are only commencing to calcify; but as they grow in length and width, not only does each require more room, but they become separated from one another by intervals, which are most extended in the oldest individuals. The five molars of a very young male (No. 3934 A) occupy a space from before backwards of 44 millims. In the largest skull (3921 A) the same teeth are spread over 116 millims.

In an old skull in the Leiden Museum (of which, the hinder part being broken away, I am not able to give the length) not only the whole of the crowns, but even the necks, of all the molar teeth, except the last upper one, have been worn away, and what appear at first sight to be the crowns are merely rounded stumps of dentine and cementum, of very much larger size than the real crowns of the teeth of the young animal.

The sexes even of the youngest specimens can be recognized by the comparatively small sizes of the crowns of the canines in the females. In the males there is some difference in this respect, as the following figures (measurements in millimetres) show, though the variations are comprised within certain limits:—

	<i>Female.</i>	<i>Male.</i>					
		Adult or nearly so.					Largest of Mr. Mose- ley's spe- cimens.
		Very young 3934.	Very young. 3934 A	Anson's. 3923.	3920.	3921. Mr. Mansel's. 3921 A.	
Upper canine :—							
Length of enamelled crown	17	29	28 ¹	25 ¹	30	24 ¹	26 ¹
Ant.-post. diameter at base	10	21	18	18	21	21	21
Transverse diameter at base	8	16	16	16	18	18	20
Lower canine :—							
Length of enamelled crown	15	29	28 ¹	23 ¹	31	25 ¹	...
Ant.-post. diameter at base	10	21	20	19	23	22	...
Transverse diameter at base	7	...	16	15	19	17	...
Width between outer borders of upper canines at base of enamelled surface.....	44	54	100	107	128	140	...

I have examined many isolated canines of Elephant Seals, including some which Mr. Moseley has been kind enough to put at my disposal, which he selected as the largest he could find from a number of skulls lying on the beach at Heard's Island, and find none with crowns materially larger than those mentioned above, or differing greatly in the form or size of the root. I have, in fact, seen no tooth which, crown and root together, measures in a straight line between the apex of the crown and the middle of the root more than 6 inches, or 150 millims., or which exceeds in greatest diameter 1.6 inch, or 40 millims., though these dimensions are very nearly reached in all the specimens which show signs of maturity. I am therefore not disposed to attach the same importance to Pernetty's statement of teeth of this animal in the Falkland Islands 7 inches long² and 3 in diameter, which my friend Dr. Peters does, and to infer from it the existence of a distinct species. It is, of course, possible, though as yet without proof, that in former times, before these animals were subjected to the severe struggle for existence occasioned by the remorseless pursuit of the sealers, many, or at least some favoured individuals, may have acquired a much larger size than at present; but before accepting the statement above quoted, it would be necessary to know whether the tooth of a Sperm Whale, or some other Cetacean, may not have been mistaken for that of a Sea-elephant.

¹ Apex worn.

² If measured along the curve, this would scarcely exceed the ordinary size as to length; but the "trois pouces de diametre" is difficult to understand, especially as he adds, "Ce n'est pas une des plus grandes;" and what does Pernetty mean by "nous en avons compté vingt-deux telles que celle-ci dans la mâchoire d'un de ces lions, à laquelle il en manquoit encore cinq ou six; elles étoient solides dans toute leur longueur, et ne sailloient guère plus d'un pouce ou d'un pouce & demi, hors de leurs alvéoles"? (*op. cit.* p. 48). Surely it must have been the jaw of an *Orca*, and not a Seal, that he was describing!

Milk-Dentition.—As is well-known, in the Seals generally the milk-teeth are extremely rudimentary in size and form, and perfectly functionless. They mostly never cut the gums, and are actually absorbed before birth. In a specimen of *Phoca vitulina*, which was born in the Society's Gardens in 1868, and which survived its birth exactly one week, the only traces of milk-teeth remaining were small rudiments of the upper canine and one molar on one side only. All the permanent teeth were in a nearly equal state of development¹. The same condition has been observed in all the other species which have been examined. In *Cystophora cristata*, the nearest ally of the Elephant Seal, the milk-teeth, as observed by Reinhardt, are still more rudimentary². On the other hand, in the Eared Seals (*Otariidæ*), which more nearly approach the terrestrial Carnivora in many points in their structure as well as habits, the milk-teeth are better developed and less evanescent than in the true Seals, the canines especially being of moderate size and retained for several weeks.

In the youngest skulls of the Elephant Seal which I have been able to examine, and which, from their size and general development, must be little more than new-born, the whole of the permanent teeth are fully in place, except the great canines, of which the apices only are appearing above the alveoli; and I am not aware of any observations upon the milk-teeth of these animals, except one, which I was fortunate enough to make some years ago³, and which, from its extremely interesting nature, may be worth repeating here, especially as I am enabled to exhibit the specimen to the Society for comparison with the huge skull and teeth of the adult animal (see figs. 1A and 2A, pp. 150, 151). A foetal Seal is preserved in the stores of the Museum of the Royal College of Surgeons, only 11 inches (28 millims.) long from nose to end of hind feet, whence obtained I am not able to say, but which presents all the external characteristics of the species under consideration, and which, it should be mentioned, is of the female sex. It has no hair, except the whiskers and tufts over the eyes. The five short conical nails are all developed upon the fore feet. On the hind feet the position of all the nails is indicated by extremely minute depressed dots in the skin a little distance from the end of the skin of the toe; in the three middle toes, which are of nearly equal length, these dots are scarcely 2 millims. from the extremity. In the two outer, longer toes they are about 9 millims. from the end, and more conspicuous than the inner ones. I mention these because it is often stated that there are not even rudiments of claws on the hind feet of the Elephant Seals.

The jaws contained a set of very minute calcified teeth, viz. *i.* $\frac{2}{1}$, *c.* $\frac{1}{1}$, *m.* $\frac{3}{3}$, on each side, being the complete number of milk-teeth which the species would have; for the incisors and canines should

¹ See W. H. Flower, "Notes on the First or Milk-Dentition of the Mammalia," Trans. Odontological Society, vol. iii. 1871, p. 211.

² "Om Klapmydsen's ufødte Unge og dens Melketandsæt," Naturhist. Vidensk. Meddelelser for 1864.

³ See 'Journal of Anatomy and Physiology,' vol. iii. 1869, p. 270.

be of the same number as the permanent set, and the milk-molars of all Seals, and indeed of the Carnivora generally, are $\frac{3}{3}$, corresponding to the second, third, and fourth premolars of the second dentition. There was, in addition, in the upper jaw a small cap of dentine, in the situation of the apex of the first permanent premolar—a tooth which, in its development, is almost coeval with the milk-teeth, and has no predecessor. The permanent dental formula of the Elephant Seal is thus determined to be $i. \frac{2}{1}, c. \frac{1}{1}, p. \frac{4}{4}, m. \frac{1}{1} = 30$, as given above.

The incisors and canines are cylindrical, with rounded, rather truncated crowns, and are open at the base. The upper canine, which is the largest tooth, and of which the whole of the crown and greater part of the root are calcified, measure 3 millims. in length and 1 millim. in greatest thickness. The second upper incisor is about half this size, and the first still smaller. The molars consist only of a rounded crown, scarcely more than 1 millim. in diameter, with the commencement of a single root, which, however, is not calcified.

As the crowns of teeth, once calcified, never enlarge in diameter, we may presume that these rudimentary teeth had attained their full dimensions, except, perhaps, as to the length of the root in some of them. They therefore, in contrast to the size of the animal and of the permanent teeth, represent one of the most rudimentary conditions in which it is possible to imagine the existence of a set of milk-teeth complete as to number; and they form the last term known at present of a series, beginning with the ordinary terrestrial Carnivora, such as the Canidæ, and passing through the Bears, the Otariidæ, and the other known members of the Phocidæ. The step from this condition to the completely monophyodont state of the Cetacea is not very great. These teeth probably disappear long before birth; but foetal Elephant Seals at later stages of development are greatly required, in order to trace the progress of dentition.

Auditory Ossicles.—The auditory ossicles of the Elephant Seal have been described and figured in the elaborate memoir by Mr. Alban Doran on these structures¹, which merit more attention than they have hitherto received as guides to affinity. Before the publication of this memoir, or the formation of such a collection as that now to be seen in the Museum of the College of Surgeons, it was impossible to appreciate their value, as it is only by studying the modifications of any part in a tolerably extensive series of forms that its essential characters can be deduced and separated from those that are variable and comparatively unimportant, and the true relative value assigned to the different modifications met with.

The auditory ossicles of the Seals generally differ from those of their allies, the terrestrial Carnivora, in their large size and the massive and exuberant growth of the bone composing them. It is very remarkable, and may perhaps indicate some, though not yet understood, relation to the conditions under which these animals live, that in this respect they resemble the other aquatic mammalia, the Cetacea and the Sirenia.

But it is only in this, perhaps an adaptive character, that the

¹ Trans Linn. Soc. 2nd series, Zoology, vol. i.

resemblance consists: the bones are constructed upon quite a different type; and though the similarity is masked by this curious overgrowth or hypertrophy of bone in certain parts, it can be shown, by the existence of intermediate forms, that their resemblance is, on the whole, to those of the land Carnivora. As might be expected, the intermediate forms are found in the Otariidæ; and nothing can display so strikingly the importance of the characters derived from these bones than to see the retention in *Otaria*, with the external pinna and scrotum, and power of use of the hind limbs, an incus and stapes far more resembling the corresponding bones in the Ursidæ than in the Seals.

Macrorhinus, on the other hand, has extremely modified ossicula. The stapes is a simple subcylindrical mass, and, being thicker and more rounded towards the incudal than at the attached end, has almost a bell- or bottle-shape, with scarcely a trace of division into crura. In this respect it resembles that of the Walrus alone among the Pinnipedia. The incus is a very remarkable bone, its ordinary characters being quite masked by the immense globular development of the posterior and outer part of the body, or that which lies over the processus brevis, and which throws the articular surface quite away from its normal upward aspect. Owing to this bulky form of the body, the bone is larger than that of any other known mammal, except *Manatus*. A deep elongated pit or groove, running in the internal face from the middle of the articular surface, is another characteristic. A similar, though less extreme, dilatation of the body is found in all the true Seals, but the peculiar pit only in the *Stenorhynchinae*; indeed, as Mr. Doran has pointed out, it is to the incus of these, rather than to the (in so many respects more nearly allied) *Cystophora*, that this bone of *Macrorhinus* bears most resemblance. After remarking that this bone is "only a caricature," so to speak, of that of *Phoca*, as its posterior part assumes and exaggerates the Phocine type, the form of the long crus induces Mr. Doran to believe that the incus of *Macrorhinus* is a truly central form. But the form of this crus is obviously very variable, even in the series of closely allied Seals figured at the top line of plate lx. of the memoir; and it may be doubted whether the peculiar long slender and subcylindrical limb of the incus in *Macrorhinus* should be regarded as retention of a generalized form, as it certainly is not exactly paralleled in any other.

The malleus also more resembles that of *Stenorhynchus* than that of any of the other Seals.

Systematic Position and Affinities.—In any natural arrangement of the existing Pinnipeds, the Elephant Seal appears to me to form the extreme term of the series, as it is the one which combines in itself in the fullest degree all the characters by which the Seals are distinguished from the terrestrial Carnivora. It is, if I may so say, the most "seal-like" of all the Seals. The Walrus as regards its dentition is more highly specialized, but in a direction peculiar to itself; and in other characters, as those of the limbs, it retains a more generalized form. The Elephant Seal and, though perhaps to a slightly less degree, the Bladdernose have kept nearer to the

direct line of modification, only carrying it out to a more complete extent than have the ordinary Seals.

As far as our imperfect knowledge of its osteology allows us to judge, in all points in the anatomy of the limbs in which the Phocidæ differ from the land Carnivores, such as the general proportions of the bones, especially the shortness of the femur, the want of development of the calcaneal process, the articulation of the fifth metacarpal with the proximal row of carpal bones, the Elephant Seal presents the extreme of modification. The true Seals (*Phocinæ*) have well developed claws on both the fore and hind feet; and the toes of the posterior limbs are subequal, the first and fifth being only slightly longer than the others; and the interdigital membrane does not extend beyond the toes. In the Elephant Seal the claws of the fore limb are reduced, and in the hind limb are absent or excessively rudimentary; the first and fifth toes of this limb are greatly enlarged beyond the others, and the skin prolonged in lobes beyond the true end of the digit, producing a much greater modification of the whole foot from the terrestrial type, and causing a considerable superficial resemblance to the forked caudal appendage of a Cetacean or Fish. This character of the pedal extremity is possessed also by the *Stenorhynchinæ*, which are in many respects intermediate between the *Phocinæ* and the *Cystophorinæ*. Another and still more important character in the structure of the limbs, in which the Seals resemble the Cetacea and differ from all other known mammals, is most strongly marked in the Elephant Seals, as is well seen in the young skeleton mounted in the Museum of the College of Surgeons. It is that all the phalanges of both limbs (except the ungual phalanges) are ossified from three centres, an epiphysis being developed for each extremity, instead of a single epiphysis at the proximal extremity, as is the rule throughout the class. How far this occurs in other Pinnipeds is not certainly known. *Stenorhynchus leptonyx*, as shown in the not quite adult skeleton from New Zealand, presented to the Museum of the College of Surgeons by Mr. W. L. Crowther, F.R.C.S., resembles the Elephant Seal in this respect. In the true Seals of our hemisphere (*Phocinæ*), if it occurs, it is as a much less obvious and more transient condition, as I have not been able to detect the double epiphysis in any of the young skeletons in the Museum¹.

The modifications of the *ossicula auditus* have been already referred to as showing that the Elephant Seal presents an extreme form, though here also *Stenorhynchus* is its nearest congener.

In the dentition also it has been shown that the characters by which Seals differ from other mammals are carried to their fullest extent in the Elephant Seal. The Leopard Seals (*Stenorhynchus*) may be regarded as showing the greatest perfection of the type, in the even row of exactly similar, finely developed, and sharply cusped, two-rooted molars; while in the Elephant Seal the same type has under-

¹ In the pes of a young *Phoca vitulina* in the Oxford Museum there are traces of epiphyses on the distal as well as the proximal end of the metacarpal of the hallux.

gone its greatest degradation, a few more stages of which would leave the animal little better provided with these organs than are the Ziphioid Cetaceans.

The form of the brain-cavity of the Elephant Seal, as shown by the casts in the Museum of the College of Surgeons, is remarkable for its great width posteriorly compared with its length, and presents the greatest contrast, among the Seals, to that of *Otaria*, which differs but little from that of the terrestrial Carnivora. The short, globular form of the brain, as well as the numerous and closely packed convolutions of the surface of the hemispheres, is one of the many characters by which the Seals resemble the Cetacea. There is much in the general appearance of the skull of the Elephant Seal, especially the fore part, with its short nasal bones, broad depressed muzzle, wide flat palate, and simple, conical, recurved teeth, which presents some resemblance to the Carnivorous members of that group, such as *Orca*; and it is singular, if only as a coincidence, that Mr. Mansel's large specimen shows a want of symmetry in the form of the anterior nares, the ossified septum being bent to the right, which recalls one of the peculiarities which distinguish the skull of most of the toothed Whales¹. In the small development of the coronoid process of the lower jaw the Elephant Seal surpasses any of the Phocine series, and is furthest removed from the land Carnivores.

As far as can be gathered from the narratives of those who have had the opportunity of observing this animal alive, its habits confirm the views derived from its structure. It appears to be more helpless on land and more active in the water than the other members of the group².

All the characters hitherto mentioned have been only modifications or exaggerations of those met with in other Seals, and are shared by some one or other of the group. There is one remarkable evidence of specialization which it possesses in common only (with modifications in detail) with its near ally *Cystophora cristata*—the dilatable sac connected with the nasal passages, developed (like so many of the singular pouches accessory to the respiratory organs) only in adult males.

As I have had occasion to mention many structural points in which the Elephant Seal appears to approach nearer than other members of the group to the Cetacea, I must guard myself against being supposed to infer that it is genealogically in any way a connecting-link between the two. The Seals appear to me so distinctly an offshoot of the terrestrial Carnivora, that any consanguinity between them and the Cetacea must be excessively remote; and if the Elephant Seal is the most modified and specialized of the group, and

¹ Prof. Huxley points out several characters in which the Seal's skull is "strikingly Cetacean" ('Manual of Anatomy of Vertebrated Animals,' 1871, p. 425).

² See Péron, 'Voyage de découverte aux Terres Australes,' 1816, tome ii. p. 45; also Scammon, 'The Marine Mammals of the North-west Coast of North America' (1874), p. 117; Weddell, 'A Voyage towards the South Pole' (1825), p. 136. This is also the opinion of Mr. Moseley, one of the most capable and observing of naturalists who have come into contact with Sea Elephants in their native haunts.

therefore, in all probability, a comparatively recent form, it must be one of the most distant instead of nearest in true relationship, and all its resemblances to the Cetacea must be purely analogical and adaptive to existence under similar external conditions.

Apart from these speculations, the facts which have been brought forward will, I think, be sufficient to induce practical zoologists to revise their systematic classifications of the Pinnipeds, in which this genus is almost invariably placed either in the middle of the group or next to the Otariidæ. I would suggest that it ought to be placed as far as possible from the latter, the whole of the other Seals and the Walrus coming between. After its most close ally, the Bladdernose (*Cystophora cristata*), the Leopard Seals of the southern hemisphere (*Stenorhynchinae*) come nearest to it.

Generic and Specific Designation.—Since the dismemberment of the Linnean genus *Phoca* by Nilsson in 1820, the Elephant Seal has been placed by various authors either in the genus *Cystophora* (Nilsson, 1820), *Macrorhinus* (F. Cuv. 1824), or *Mirounga* (Gray, 1827), modified by its author in 1847 to *Morunga*. The latter, founded upon a native Australian name mentioned by Péron, is clearly inadmissible, being exactly synonymous with *Macrorhinus*, which antedates it by three years, and which is now very generally used by the best authorities¹.

The question between *Cystophora* and *Macrorhinus* depends upon the varying estimate of the value to be assigned to a generic distinction. If the Bladdernose and the Elephant Seal are held to be sufficiently distinct in their organization to require separate generic appellations, the one will be called *Cystophora* and the other *Macrorhinus*. If otherwise, they will be both included under *Cystophora*, the older and equally appropriate designation. The differences between them have been carefully pointed out in Allen's recent monograph, and chiefly consist in the comparatively larger size of the crowns of the molar teeth, the frequent doubling of the root of the posterior, and occasionally of the penultimate, upper molar in the smaller species, combined with the greater prolongation of the palate backwards, the presence of claws upon the hind limbs, the less emargination of the distal border of the hind feet, the greater size of the pelvis and posterior extremities generally (which, according to Allen, are very feebly developed in the Elephant Seal), and the different form of the nasal appendage of the adult males. Differences of the auditory ossicles have also been pointed out by Mr. Doran. In all these characters, it will be observed, the Elephant Seal has undergone a further stage of specialization than the Bladdernose.

It is a case in which, if they had never been separated, I, for one, should have been inclined to allow them to remain in the

¹ It should be mentioned that F. Cuvier, as was his custom, only used the French form "*Macrorhine*" in the article in the Mém. du Mus. 1824, xi. p. 200. which gives some countenance to the citation of his first use of the genus *Macrorhinus* (as in Agassiz, 'Nomenclator Zoologicus') in the 'Dictionnaire des Sciences Naturelles,' xxxix. 1826, art. *Phoque*, and therefore to the priority of Latreille's use of the same name in the Fam. Nat. du Règne Animal, 1825, for a genus of Coleoptera.

same genus, especially as each subdivision contains but a single well-marked species; but as the separation has now been so generally adopted, and the name *Macrorhinus* has become so deeply rooted in zoological literature, perhaps more inconvenience would result from an attempt to reunite them than to retain them as distinct genera, and we may be content to show their close affinities by their union in one subfamily, *Cystophorinæ*.

The Elephant Seal has been known in zoological literature by three specific names, viz.:—*leonina*, Linn., founded on the so-called "Sea-Lyon" of Juan Fernandez, described and figured in Anson's Voyage, 1748, and undoubtedly the species under consideration; *elephantina*, Molina, 1782, revived by Gray; and *proboscidea*, Péron, 1815. The former, though, perhaps, the least appropriate, is clearly the first in point of time; and as in using it we are not resuscitating a name that has become obsolete, or been entirely superseded by another that has met with general acceptance, it may be adopted with equal respect to the laws of priority and convenience; in fact all recent zoological literature shows that this name is gaining ground over both the others which have been proposed as substitutes.

Unity or Plurality of Species.—The Elephant Seals which inhabit the Pacific coast of North America, formerly abundant, but now extremely reduced in numbers by the persecutions of the sealers, are supposed by Theodore Gill to be specifically distinct from those of the southern hemisphere, and have received the name of *Macrorhinus angustirostris*¹.

In J. A. Allen's valuable and exhaustive monograph on the North-American Pinnipeds this distinction is adopted; but although the author speaks of the two species as presumably distinct, he says that, "so far as can be determined by descriptions, the Northern and Southern Sea-elephants differ very little in size, colour, or other external features." From evidence not very satisfactory, he supposes the southern species to be on the whole somewhat the larger of the two. The osteological characters upon which Gill bases his distinction are derived from the comparison of the skull of a probably full-grown female Californian Seal with the figure given by Gray in the 'Zoology of the Erebus and Terror,' of a two-thirds grown male (the one now in the British Museum) from the South Seas. This is incorrectly described by Gray as an "adult female;" and Gill has accepted this determination without question, although the characters of the skull, as seen in the drawing, the unworn condition and size of the canines, and open state of the sutures are sufficient to throw much doubt upon it. Unfortunately there is no skull of an adult female Sea-elephant in this country available for comparison; but from what may be inferred from other species of Seals, and from the evidence afforded by young specimens, it may be considered almost certain that the very character on which Gill has chiefly relied for specific distinction is a sexual one. The comparative narrowness of the muzzle is associated with the smaller deve-

¹ Proc. Essex Inst. v. 1866, p. 13; Proc. Chicago Acad. Sci. i. 1866, p. 33.

lopment of the canine teeth, as can be well seen in the figures of the type skull of the female *M. angustirostris*, as given by Allen. On comparing the upper surface of this with a series of male skulls, it will be seen that the difference consists chiefly in the extent to which the maxillæ project beyond the sides of the præmaxillæ, which in the former is almost *nil*, and in the latter very considerable, to allow room for the roots of the great canines on each side of the præmaxillæ. Even in the youngest skulls this difference in the sexes is seen. The variations in the proportion of the breadth of the rostrum measured at the middle, halfway between the nasal orifices and the ends of the præmaxillæ, in different specimens, are shown in the following table:—

	Length of skull.	Breadth of middle of rostrum.	Proportion, length of skull being 100.
	mm.	mm.	
Very young female, No. 3934, Mus. Roy. Coll. Surg.	204	46	22·5
The type specimen of <i>M. angustirostris</i> (according to Allen's fig.), female	24·3
Very young male, No. 3934 A, Mus. Roy. Coll. Surg.	233	59	25·3
Adult male, No. 3920, Mus. Roy. Coll. Surg.	437	144	33·0
Adult male, No. 3921, Mus. Roy. Coll. Surg.	463	154	33·3
Adult male, No. 3921 A	564	176	31·2

There is certainly one character by which the type specimen of *M. angustirostris*, judging from Gill's description and Allen's figure, differs from any of the skulls of southern Elephant Seals with which I have compared it. This is the shorter antero-posterior extent of the palate-bones, and the deeper emargination of their hinder border. Before this distinction can be accepted as a specific character, it should be known whether it is constant. There is much variation in the size of the palate-bones of the southern forms: the length from before backwards between the palato-maxillary suture in the middle line and the spine in the large skull No. 3921 is but 35 millims.; in the somewhat smaller skull, No. 3920, the same distance is as much as 51 millims.; and in the largest skull (No. 3921 A) it is 65 millims., therefore about double that of the skull which comes nearest to it in general size.

When the idea prevailed that each species was separately created in the region which it inhabits, geographical reasons were stronger than now for assigning specific distinction. But Allen fully admits, indeed suggests himself, that the two presumed species, though long isolated, have been derived from one stock, "the southern being an

offset of the northern, because the only other known species of the *Cystophorinæ* is also northern."

Now it seems to me that if we are to accept the presumption that they are distinct upon geographical grounds alone, we must bid adieu to what little still remains to us, after the revolution of the last twenty years, of our conception and definition of a species. For how long in time and how far in space must two branches of one stock of animals be separated in order to constitute a claim to specific distinction? I should answer this question by saying, only either when they have become so far physiologically differentiated as no longer to interbreed (a point on which it is, of course, extremely difficult to get evidence), or when permanent recognizable differential structural characters have been established. Until we are sure that they are either physiologically or morphologically distinct we have no grounds for separating them. In fact, by doing so, we are concealing or ignoring a most important zoological fact, viz. that under certain circumstances members of a group may become and remain for a long period of time isolated from the parent stock without appreciable variation from the original type taking place. Show any character in which the one has departed from the other, however small, so that it be constant and universal, then the case is altered, and it becomes a subject for consideration whether the amount of variation is sufficiently great to be consistently admitted as specific. But even this stage does not appear to be yet reached in the case of the northern and southern Elephant Seals.

The evidence upon which Dr. Peters has based the four supposed species of southern Elephant Seal, viz. *leonina*, *falklandica*, *proboscidea*, and *kerguelensis*, is still more shadowy; but these were only put forth by him as suggestions of possibilities, not as ascertained facts.

P.S. Since the greater part of the above was written, I have heard from my friend Prof. Turner of Edinburgh that he has in his hands for description the skeletons of a male and of a female Elephant Seal from Kerguelen, and a skull of a large male from Heard Island, brought home by the 'Challenger' Expedition. The latter, Mr. Moseley informs me, he selected as one of the largest out of hundreds which lay on the beach at the time of the 'Challenger's' visit, Feb. 6, 1874; it is, however, considerably smaller than the specimen described above, having a condylo-premaxillary length of 20 inches (483 millims.) and an extreme length of 19 inches (508 millims.). It is to be hoped that this large additional material will soon be made available for reference. A good figure of the skull of an adult female is at present an especial desideratum.



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