ZIPHIUS CAVIROSTRIS.

STUDIES OF TASMANIAN CETACEA.

PART II.

(*Ziphius cavirostris.*)

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Plate X.

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INTRODUCTION.

We had contemplated dealing with the genus *Tursiops* in the first portion of the present paper, but, owing to several unforeseen circumstances, we propose to place on record certain data compiled in relation to the species *Ziphius cavirostris* before proceeding to deal with *Tursiops tursio* as a Tasmanian species.

ZIPHIUS CAVIROSTRIS, Cuvier.

For detailed synonymy see :—

Gray, Brit. Mus. Cat. Seals and Whales, *Epidon*, p. 340 *et seq.* (1865).

And for later nomenclature, etc. :—

True, Bulletin 73, U.S. Nat. Museum, p. 30 (1910).

As with the majority of the Cetacean order, the nomenclature is involved, and the species described are numerous. Fortunately, in this instance it was recognised rather sooner than in others that there was probably only one species, and that this was practically cosmopolitan in distribution.

Mr. F. W. True has given an excellent account of this species [1] and we have pleasure in the present instance in adding to the existing knowledge by describing a skull in the collection of the Tasmanian Museum.

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(1) True, Bulletin 73, U.S. Nat. Museum, 1910.

This skull was obtained from the Tasmanian Coast. This fact is of interest, for, although the species under review has on several occasions been recorded from New Zealand, (2) we are aware of no previous record from Australian seas. It is an unfortunate fact that the Tasmanian skull has been stored away for many years without any reference being made to it. In the latest work dealing with zoogeography (3) the following reference to this species occurs. In dealing with the mammals of the North Atlantic:—

> "Cuvier's beaked whale (*Ziphius cavirostris*), "although but seldom met with, appears to be "of world-wide distribution. It is distinguished "by the two conical teeth at the tip of the lower "jaw, as well as by the circumstance that only "the first three vertebræ of the neck are fused "together." (4)

And in dealing with the Indo-Pacific and its shores:—

> "Cuvier's beaked whale (*Ziphius cuvieri*) is also "probably an inhabitant of the Indo-Pacific." (5a)

There can be no doubt that the same species is intended, but it is unfortunate that the nomenclature should not agree, even in the same work, for this cetacean. The synonymy is sufficiently involved without such additions as these. Another point to be noticed is that the ankylosis of the first three cervical vertebræ mentioned by Lydekker is not a constant feature for this species. It probably varies with age.

Dr. S. F. Harmer has recently given an account (5b) of *Ziphius cavirostris* from the Irish Coast, and also stated his intention of publishing a further account, but we are not aware if this has yet appeared. In dealing with the distribution of *Ziphius* he states that the best available evidence "leads to the conclusion that *Ziphius cavirostris* is "a cosmopolitan species which inhabits the open oceans "of the world, and is occasionally stranded."

True has recorded (6) where more than three of the cervical vertebræ have been ankylosed. Except in such instances as *Hyperoodon*, where all the cervical vertebræ are ankylosed, the fusing of more or less of the cervicals does not appear to be a generic constant.

Considerable research has yet to be done in order to

(2) For instance, see Trans. N.Z. Institute, Vol. 9.

(3) Lydekker, Wild Life of the World.

(4) Lydekker, Wild Life of the World, Vol II., p. 246.

(5a) *Id.* Vol. III., p. 327.

(5b) Proc. Zoo. Soc. of London, 1915, p. 559.

(6) True, Bulletin 73, U.S. Nat. Mus., p. 38 (1910).

exactly establish the exact generic and specific characters of the ziphoid whales in general. It may be taken for granted, however, that representatives of such genera as *Ziphius*, *Hyperoodon*, *Mesoplodon*, and *Berardius* visit Tasmanian seas, but probably only at rare intervals. Owing to the rugged nature of our coasts and the failure to report stranded whales to the proper authorities, it is only on very rare occasions that specimens are obtained for scientific investigation.

HISTORY OF THE TASMANIAN MUSEUM SPECIMEN OF *ZIPHIUS CAVIROSTRIS*. (TAS. MUS. REG. NO. D 589.)

When the revision of the basement stores of the Museum took place (previously alluded to in Part I. of this series) this skull was brought to light. At a later stage the mandible also was found. Fortunately, the records relating to the specimens could be traced, and the following facts show the locality and date whence the skull was obtained.

The Museum records show that this skull (classified as *Epiodon chathamensis*) was presented by J. Boyd, Esq., in 1868. It was obtained at Port Arthur (on the South-East Coast of Tasmania). Apparently the specimen has been stored away for fifty years, and the knowledge of this species' occurrence in Australian seas withheld from the scientific world for a corresponding period.

OSTEOLOGY.

Skull.

Before attempting to discuss the osteology of this specimen, it is necessary to point out a homological error that the late Sir Julias Von Haast fell into, in his paper on *Epiodon Nova-Zealandia* [7], which is a synonym of *Ziphius cavirostris*, as already pointed out. This published statement of Von Haast's has been copied by other authors, without question, and, therefore, it is necessary to correct it, the more so as he cited Prof. Owen as his authority, while Owen's writings do not substantiate, and.

(7a) Trans N Z Institute, Vol. 9, p. 420.

(7b) In connection with the New Zealand specimen of *Ziphius cavirostris* in the Canterbury Museum, we desire to express our thanks to Mr. R. Speight, the Curator of that Institution. In order to assist us with the comparative osteology, Mr Speight had several excellent photographs taken for our benefit These were of material assistance to us, and we, therefore, have pleasure in placing on record our appreciation of Mr Speight's action in this matter in fact, contradict it! Von Haast says:—"The pre-frontals (of Owen) begin 6.50 inches from the anterior point of "the rostrum." This is the *vomer*, and was never called anything else by Prof. Owen. Owen's use of the words *pre-frontals*, as applied to whales, can only be understood by recalling the fact that he restricted the word *ethmoid* to the nasal sense capsules, and the term pre-frontals to the whole of the ethmoidal elements that remained. Now let us look for Owen's *pre-frontals* in the toothed whale. In his description of *Orca brevirostris* (cited by Gray) (8a), Owen says:—"The *vomer* extends to within 1¼ inch of the "end of the pre-maxillaries, and behind these intervenes "upon the bony palate between the maxillaries, along a "strip of 2 inches and three lines across the broadest part. "This palatal part of the vomer is the lower convexity of "the canal formed by the spout-shaped bone; the hollow "of the canal is exposed at the upper interspace of the "pre-maxillaries. Here also is seen 2 inches *behind* the "fore end of the *vomer* the rough, thick anterior border "of the coalesced *pre-frontals*, which contracts as it passes "into their upper border, forming the septum of the nos-"trils, expanding below and behind to form the back "wall of the nasal passages."

It will be obvious that Owen here uses the terms *vomer* and *pre-frontals* for the bones named by Flower, *vomer* and *ethmoid*, and also that while the *vomer* extends forward almost to the tip of the beak, the *ethmoid* or *pre-frontals* are enclosed by the *vomer*, which latter is drawn backwards at the base of the skull to cover the spheno-sphenoidal suture. As touching the nasal cavity, the nasal moieties of the *vomer* extend nearly half-way to the vertex, and here coalesce with the *ethmoid* or *pre-frontals*, whichever we care to call them.

True, in his exhaustive monograph on the *Ziphiidæ*, missing this point, says (Bulletin 73, U.S. Nat. Mus., pp. 50 and 51):—"The proximal end of the *vomer* is anky-"losed with the anterior face of the nasals, and reaches up "to the nasal bosses, etc." This should have been the proximal ends of the pre-frontals, ankylose with the anterior face of the nasals.

As a second proof that Owen never confounded the vomer with the pre-frontals, he says at p. 425, of his Anatomy of the Vertebrates, Vol. 2:—"The pre-frontals in the *Beluga* are large, and ascend into view at the back part of the nostrils, where they coalesce with the frontals." This is the common condition in the order *Delphinidæ*.

(8a) Gray, Brit. Mus., Cat. Seals and Whales, p. 285.

and as the pre-frontals at times (as we will deal with in a later paper) coalesce with the nasals, it is wise to call these bones—so marvellously reduced in size—*pre-fronto nasals*. In our skull of *Ziphius cavirostris* the pre-frontals do not reach the nasal bosses by an interval of 30 mm. in the medium line, a condition of things always found bridged in dolphins' skulls by cartilage (8b), until late in life, after which ossification takes place. A glance at the Tasmanian skull is enough to show that a cartilaginous bridge existed there also, but was lost by cleaning and bleaching.

This note of immaturity in our skull takes us naturally to another point, viz., the non-ossification of the ethmo-vomerine cartilage, which apparently is also dependent upon age factors, and not sexual ones. Culling a note from the human subject, we find that the ossific centre that gives rise to the ethmo-vomerine cartilage (as far as it is touched by ossification), the *crista galli*, and the cribriform plate does not complete its activities until half the period of adolescence has been passed. In whales, the sense of smell has atrophied, and the ossific powers of the centre named turns its activities upon the ethmo-vomerine cartilage—in the ziphoid whales—but apparently not till late in life. In most of the *Delphinidæ* the cartilage remains as such throughout life, but in very old dolphins it may manifest some ossification at its proximal end.

This question of the reduction of the senses in whales is one of the things that warrants considerable attention being paid to it, if we are to unravel the complexities that surround the group origins of the *Cetacea* as a whole. Briefly it may be said in passing that the retention of the nasal organs in whales cuts them off from dolphins, and that the *Ziphiidæ*, to some extent, are midway between them. To bring our specimen into line with the ten ziphoid skulls that True listed, and monographed, we will here quote the description of the specimen that comes nearest to our own, viz., his specimen No. 20971. This was the skull of a female whale that was captured at Barnegat, New Jersey, U.S.A. Of this True says:—"Adult female. "Majority of sutures open, but those on superior surface "of rostrum between maxillæ and pre-maxillæ partly anky-"losed. Vomer nearly all ankylosed to rostral portion of "pre-maxillæ. It presents a slight median elevation, but "there is *no mesirostral ossification*. Right pre-maxillæ "in front of nares flat and horizontal; left, nearly so, but "with a quite broad longitudinal groove. Opposite maxil-

(8b) We have evidence as to the origin of this cartilage, and shall in due course deal with the same.

"lary notches, pre-maxillæ nearly on a level with adjacent "parts. Orifice of anterior nares level with the lower "end of the nasal boss. End of rostrum quite acute and "broader than deep. Rudimentary alveolar groove dis-"tinct distally. Proximal end of vomer (*Sic!*) is anky-"losed with anterior face of nasals and reaching up to "nasal boss, which has a sharp median ridge completing "the nasal septum superiorly. Anterior face of nasal "boss slightly concave on each side of the median "line." (9) In our skull the alveolar groove can be traced throughout its length, but everything else is duplicated in True's description. Apparently this American animal was slightly older at the time it came ashore than our specimen was when captured in Tasmania, for the reason stated, when dealing with the cartilaginous bridge between the pre-frontals and the other elements at the vertex of the skull. In the matter of the ethmo-vomerine cartilage, both skulls yield similar evidence, and in a word True's data makes it absolutely manifest that the ossification of the rostral cartilage has been pushed to an extreme point, as a factor of taxonomy, since the real truth is that it may or may not ossify, and if it does, it is usually late in life in the female sex—but slightly earlier and more strongly in the male. There is a temptation to hazard the guess that the almost total reduction of the dental apparatus in ziphoid whales and the consequent diversion of nutriment and nerve energy to a more central line may have had something to do with the extra ossific energy that acted upon the ethmo-vomerine cartilage. At the tip of the beak, upon the right side, there is a foraminal groove, most likely vestigial, and obviously the remaining one of a pair, that at one time were functional. This groove ended about an inch from the functional foramen that passed facial nerves to the beak during the life of the individual under study. The alterations to the beak areas by the reduction of the tooth line and its alveoli have caused the nerves to traverse the beak superficially and the bony tissue is grooved to receive them. A very slight pressure upon the probe (10) that was passed into the vestigial canal caused it to carry through and appear in the fossa in front of the functional foramen. These canals are functional (and symmetrical) in dolphins' skulls, and apparently relate to the teeth. In the higher mammals the vomer and its incidental pressure upon part of the septal cartilage determines the amount that ossifies—extra pressure causing reduction and suspension of the ossific activ-

(9) True, Bull. 73, U.S. Nat. Mus., pp. 50-51.

(10) This probe was at the time it appeared externally 17½ inches through the bony tissue of the beak.

ity. The skulls of the ziphoid whales are loosely constructed, and the ethmo-vomerine cartilage would accordingly receive far less pressure than obtains among the *Delphinidæ*. This is merely a suggestion in passing, and is not regarded by us as being more than a tentative note.

Owing to mutilations in our skull, we are unable to compare the whole of True's cranial measurements with our specimen, but a considerable number are hereunder appended, and none of these involved any restorations. If, by the most careful deductions that can be made by comparative osteology, we restore the mutilated portions of our skull, we find them to fall into line with True's data in a most remarkable way, and even a casual glance at the table supplied will show the similarity of the two specimens.

Some of the mutilations referred to, as, for instance, the sawing off of the occipital condyles and part of the occiput, evidently pre-dated the gift of the skull to the Museum, but the loss of the pterygoids, ear bones, and all the teeth suggests unfair usage in the days when this and other whales' skulls were left to weather in the backyard, owing to want of proper storage space.

AMERICAN AND TASMANIAN SKULLS OF *ZIPHIUS CAVIRÒSTRIS.*

Name of the measurement made.	True's American specimen. MM.	True's American specimen. Inches.	Tasmanian specimen in Hobart Museum. MM.	Tasmanian specimen in Hobart Museum. Inches.	Remarks.
Total length	945	$37\frac{3}{8}$	890	35	Our specimen is devoid of occipital condyles.
Length of the rostrum ...	550	$21\frac{3}{4}$	540	$21\frac{1}{4}$	Our measurement is from the pre-orbital foramen to tip of beak.
Breadth between centres of the orbits	476	$18\frac{3}{4}$	465	$18\frac{1}{4}$	
Breadth between zygomatic processes	503	$19\frac{3}{4}$	485	$19\frac{1}{8}$	
Breadth between temporal fossæ	302	$11\frac{7}{8}$	297	$11\frac{5}{8}$	
Breadth of rostrum at its base	307	$12\frac{1}{4}$	307	$12\frac{1}{4}$	
Rostrum in the middle (width)...	112	$4\frac{3}{8}$	102	4	
Width of pre-maxillæ at the same point ...	62	$2\frac{3}{8}$	54	$2\frac{1}{8}$	
Depth of rostrum at middle	77	3*	77	3*	*Approximately.
Breadth of the pre-maxillæ in front of nares...	176	$6\frac{7}{8}$	166	$6\frac{1}{2}$	
Greatest breadth of anterior nares	76	3*	70	$2\frac{3}{4}$	*Approximately. True gives the mandibular symphysis of another skull as 170 mm., and one at 176 mm., the latter being, upon the whole, the most reliable, as it was of the same species, but a male instead of a female.
Greatest length of temporal fossæ	143	$5\frac{5}{8}$	145	5 11-16	
Greatest depth of temporal fossæ	80	$3\frac{1}{8}$	80	$3\frac{1}{8}$	
Anterior end of orbit to the maxillary notch ...	82	3 3-16	82	3 3-16	
Length of the mandibular symphysis	No data		170	$6\frac{5}{8}$	

GENERAL NOTES.

The *Ziphiidæ* manifest a primitive character that has apparently less in common with the *Prozeuglodonts*, than it has with the hypothetical generalised, ungulate progenitor of Professor Flower. This is the presence of both a malar plate (as well as the jugal style common to dolphins) and a lachrymal bone, of extensive area. Nothing akin to this is found in the carnivora, but the like is common to existing ungulates, and in the genus BOS, the malar plate overlaps the lachrymal in a similar way to that obtaining in the cetacean skull. The lachrymal is always an important face bone in ungulates, being, where necessary, modified to meet the needs of the scent glands, but in the hippopotamus, which Flower regarded as the nearest living congener of the pro-ungulates, the lachrymal is a fairly solid plate-like bone, well up to the middle line of the face.

Our illustration of the skull is sufficiently good to supply all the ordinary data for a comparative study of *Ziphius*, with other whales, but it may be wise to add the following notes:—

1. The overhanging pre-fronto-nasal bosses, of *Ziphius*, cut it off from *Berardius*.
2. The shorter and stouter skull segregates it from *Mesoplodon*.
3. The males, according to True, have—in addition to the ossified rostral cartilage—wide narial basins, and teeth with roots 25 to 30 mm. across, as against 10 to 14 mm. for females.
4. Ziphoid whales have lower jaws longer than the upper, by anything up to 60 mm.—measured in position.
5. The pterygoids are extremely large and thin, but in our skull they are sadly mutilated.

NOTES TO STUDENTS.

(1) The origin of the Cetacea is not a solved problem, and, in spite of a vast amount of writing in this direction, even the group origin still awaits solution. Any information that can be culled from the crania of the existing whales (that relates to the pro-mammalian skull) should be useful data, and years ago Mr. Scott set out to prepare Dolphins' skulls by a long and roundabout process, having for its object the preservation of cartilaginous and imperfectly ossified vestiges, that are not commonly pre-

served in Cetacean skulls as prepared for museum specimens. In dealing with the Tasmanian Dolphins such data as we have collected will be passed in review.

(2) In times past the Ziphoid whales must have visited the shores of Tasmania, much as they do to-day, and it is of interest to note that, in this connection, the miocene strata of Table Cape has yielded an arm bone and some mutilated vertebræ of one of these whales. Although obviously nearer to *Ziphius* than to the genus *Mesoplodon*, it does not fit in with either genus, and it may be possible to extract more material from this specimen than that already published in the proceedings of the Royal Society of Tasmania in 1913. For the present, it is of interest to note that these ancient whales have a place upon our Tasmanian lists that relate to the Natural History of the past.

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