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STUDIES OF TASMANIAN CETACEA.

PART I.

(*Orca gladiator*, *Pseudorca crassidens*, *Globicephalus melas*)

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Plates I.-IX.

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PRELIMINARY.

As the present paper is the outcome, in the main, of presentations made to scientific societies by one who was intimately connected with the Tasmanian whaling industry, it has been thought fit to commence with a brief historical review of this interesting period. Also, in view of the fact that this paper is intended to serve as an introduction to further studies of the *Cetacea* which we hope to mutually conduct in the future as opportunities present themselves. The chief references in the accounts of the early voyages relate to the pursuit of the "black whale" (an unfortunate vernacular name at best). As far as Tasmania is concerned the industry began to assume commercial importance about the year 1818, and at that time it was no uncommon sight to see whale hunts in the Derwent. As the industry increased the whales were driven further afield, but they still continued to visit the coast at stated intervals. The season usually lasted from May, or June, until November, and as the men engaged in this branch of the industry formed small stations at the coastal bays and there awaited the whales, this method of securing the cetaceans became known as "bay whaling."

There is one instance recorded of a female whale ascending the River Derwent as far as New Norfolk, 24 miles above Hobart, and being killed there <sup>(1)</sup>.

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(1) Bischoff. Sketch History of V.D.L. (1832), p. 27.

Henderson, writing in 1832 (2), states that the "black whale" and the "black fish" are found on the Southern Coasts of N.S.W. "The latter are frequently observed "collected in shoals, at a great distance from any land, "lying motionless upon the surface, as if basking in the "sun beams; while the former resort, during their breeding "seasons, to the deep estuaries of rivers, and particular "bays around Van Diemen's Land, and Bass's Straits, "etc." (3).

The initial system of whaling was continued until 1841, when the "black whales" almost ceased to visit the coast. Attention was then paid to the sperm whales, which usually kept further out to sea as they passed from the westward—often followed by numbers of "black whales." Up till this period the system of ocean whaling had been carried on by vessels from overseas, but the Colony had now to provide its own whaling fleet if it was to derive any profit from the industry. The first of the Tasmanian fleet was the *Maria Orr*, built at Macquarie Point (River Derwent) in 1839. This vessel's career was a limited one as she was wrecked on the Actæons two years later.

As the industry increased, Hobart became a great refitting centre, and as many as thirty or forty whaling vessels have been in port at the same time. The refitting usually took considerable time owing to the lack of docking facilities and the old method of "heaving down" having to be resorted to. This trouble was overcome in 1854 by the erection of a patent slip at Battery Point (4).

In 1857 the late Dr. W. L. Crowther fitted out an expedition to whale in high southern latitudes, and Kerguelen Island was selected as a suitable locality, Captain Robinson being placed in command. His barque—*Offey*—was in charge of the expedition, but owing to the failure of the tenders (the brigantine *Flying Squirrel* and the schooner *Elizabeth Jane*) to keep him supplied with provisions, the venture was not very successful.

In 1860 there were about thirty vessels engaged in the Tasmanian whaling industry, but in ten years this number had diminished by half. In 1870 the rise in price of sperm oil to £120 per tun caused a revival, and many

(2) Henderson. Observations on the Colonies of N.S.W. and V.D.L. (1832), p. 136.

(3) When Mr. Lord and a party were engaged in a collecting trip in D'Entrecasteaux Channel in November, 1916, a whale was noticed in shallow water in Ford Bay. Upon closer investigation it was found to be a female *Balaenoptera* together with a calf.

(4) Erected by Mr. John Ross at Secheron. Afterwards removed by Mr. Ross in 1868, and subsequently purchased by Kennedy and Sons. Messrs. McGregor and Co. also laid down a slip at the Domain.

ships were fitted out. This revival lasted for about fifteen years, and then the decline commenced until in the early nineties the whaler *Waterwitch* was the sole vessel engaged.

It is of interest to recall the fact that William Lanny ("King Billy"), the last Tasmanian male aboriginal, followed the calling of a whaler. He made his final voyage in the *Runnymede*, and was paid off on February 26th, 1869, and died a few days later <sup>(4a)</sup>.

## INTRODUCTION.

Students of the Tasmanian Cetacea have for many years been in search of some Tasmanian records relating to the munificent osteological presentations made to several English scientific institutions by the late Dr. W. L. Crowther. Since the year 1902 Mr. Scott has been working on the Tasmanian *Cetacea* <sup>(5)</sup>, and has been most anxious to obtain Tasmanian records relating to the late Dr. Crowther's collections for the purpose of investigating the question of the comparative anatomy of certain species. Upon Mr. Lord's appointment as Curator of the Tasmanian Museum a thorough overhaul of the Museum store specimens was made with the result that a series of hitherto undescribed specimens were brought to light. As certain of these were undoubtedly portion of the Crowther collection a thorough investigation was decided upon. Upon this being made a considerable amount of interesting data was obtained, which appeared well worthy of being placed on record, and the following notes are therefore the result of our observations.

Between the years 1866 and 1871 the late Dr. W. L. Crowther, of Hobart, who was interested in the whaling industry, collected a large number of skeletal remains of various Tasmanian *Cetacea*, and presented them to several English Museums. Some of these specimens still claim folios in the Catalogues of the British Museum and the Royal College of Surgeons' Museum. Mr. Scott made an effort in 1902 to trace some of Dr. Crowther's specimens in the State, as he was then engaged in publishing a series of articles on this subject. At that time his inquiries did not meet with success, but the matter was always kept in mind. Owing to the recent revision of the Basement stores of the Tasmanian Museum some old boxes which had evidently been stored away from the time they were moved from the old Museum of the Royal Society to the present building

(4a) Bonwick. *The Last of the Tasmanians*, p. 395.

(5) Scott, *Launceston Courier*, 1902. Scott, *Notes on a fossil whale from Wynyard*, *Pap. and Proc. Roy. Soc. Tas.*, 1913, p. 167.

were discovered. These were found to contain interesting osteological specimens, the majority of which related to the Crowther presentations.

A rough examination disclosed that the collection consisted of three more or less complete skeletons probably relating to *Globicephalus*, the skull and portion of a skeleton of a killer whale. Also included there were two skeletons (without skulls) of the Dugong (*Halicore australis*). In addition to the foregoing a skull from the Museum store collection labelled "*Epidon chathamensis*" (6) was examined for purposes of comparison, and also an articulated skeleton of a "Killer," made in 1868, together with a larger skull.

When we recall the fact that the late Dr. W. L. Crowther from the year 1866 onward continued to collect and forward to the Museum of the Royal College of Surgeons a wonderful series of Cetacean remains—that in total embraced 34 Catalogue folios and in Classification 8 genera of whales—it would have been remarkable if he had not presented some specimens to the local Museum. The late Dr. Crowther's gifts to the greatest Museum of comparative anatomy in the world, included no less than 15 full skeletons of whales—splendidly prepared and ready for articulation upon arrival in England. The Tasmanian Scientific world seems to have largely lost sight of the enthusiasm thus manifested by one who lived and worked amongst us, and we wish to appreciatively recall Dr. Crowther's extensive and practical studies among the Tasmanian *Cetacea*.

Before concluding these introductory remarks it is of interest to note that Dr. Crowther forwarded from Tasmania to the Museum of the Royal College of Surgeons a representative of the genus *Clymenia*. As this species has not been placed on the Tasmanian list the donation by Dr. Crowther is worthy of attention, and efforts should be made to trace this species in Tasmanian seas. There is a chance, however, that the specimen forwarded to England may have been obtained by one of Dr. Crowther's whalers on the high seas many miles from Tasmania.

The particular species referred to is figured in the Zoology of the Voyage of the Erebus and Terror, Mammalia, Vol. I., Pl. 15, and is there designated *Delphinapterus peronii*. It is notable for the absence of the dorsal fin, and the fact that the beak, pectoral fins, and under part of the body are white.

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(6) Lord. Notes Mammals of Tasmania, P. and P. Roy. Soc. Tas., 1918, p. 29.

## CONSPECTUS.

In the present instance our investigations extended to the following specimens of the Tasmanian Museum collections:—

1. One complete articulated skeleton which was labelled "Skeleton of Killer (*Orea pacifica*) from Adventure Bay, Tasmania. Prepared and articulated by T. Roblin, Curator of the Museum 1868."

2. One skull complete with lower jaw, which was labelled "*Pseudorca meridionalis*, Doner, W. L. Crewther, Esqr."

This specimen was in a splendid state of preservation.

3. One skull, similar character to No. 2, but not in such a good state of preservation. The lower jaw and teeth are missing.

4. A large portion of the skeleton belonging to the previous skull.

5. Complete skeleton, including skull of *Globicephalus melas*. (Adult male.)

6. Ditto. (Immature male.)

7. Ditto. (Female—skull missing.)

8. Skull of *Globicephalus melas*.

9. Skull of Beaked whale labelled "*Epodon chathamensis*."

In the present instance we have dealt with the first eight of this series, and it is our intention to consider the characteristics of the remainder in future papers, together with such facts relating to other members of the Tasmanian *Cetacea* as may be obtained from time to time.

## PSEUDORCA CRASSIDENS

(Plate No. I.)

*Phocaena crassidens*, Owen, British Fossil Mammals and Birds, p. 516 (1846).

*Pseudorca crassidens*, Reinhardt, Recent Memoirs of Cetacea, Ray Society (Nov. 7th, 1862).

*Orea meridionalis*, Flower, Proc. Zoological Society of London, p. 420 (1864).

Attention was first paid to specimen No. 1, which consisted of a complete articulated skeleton bearing the label "Skeleton of Killer" (*Orea pacifica*) from Adventure Bay, Tasmania. (Prepared and Articulated by T. Roblin, Curator of the Museum 1868).



Upon a comparison being made of the two skulls (Specimens No. 2 and 3) with this articulated specimen, and an examination of the leading generic characters of both, it was resolved to make a rough comparison between this skeleton and the dimensions given in the original description (7) of the *Pseudorca crassidens* of Reinhardt. The results showed such a striking similarity between the two specimens that a series of comparative measurements were made, as shown in the following tables. These proved conclusively that the articulated skeleton was a good example of *Pseudorca crassidens*. As we know it came from Adventure Bay it is almost certain to be portion of the Crowther collection and to be one of the mixed school which came ashore there. It is known that the school consisted of representatives of the following species:—*Globicephalus melas*, *Orca gladiator*, and *Pseudorca crassidens*. At the time when these specimens were being prepared in Tasmania (the latter '60s) communication with the centres of scientific research was a matter of months and not of weeks as at the present day. We can well imagine that there was some confusion as regards the exact nomenclature of the species, not only on account of the difficulties of correspondence, but also on account of several specimens of different species being obtained from the same locality at the same time. Further, we must remember, that at the time when these specimens were collected the authorities in England appeared to be accentuated by a keen desire to create species. Many of these were based upon slender evidence, and were due to sex and age characteristics and not to specific distinctions. The Tasmanian form, for instance, was at first raised to specific rank as *O. meridionalis* but has since been merged into *Pseudorca crassidens*. Furthermore, the vernacular designations of the whaling fraternity were undoubtedly the cause of further confusion, as several genera and species of whales were loosely grouped under the term "Blackfish" (8). This all assisted to confuse the issue which in some respects, especially in regard to our local specimens of these species, needed clearing up even at the present time. With the examination of the specimens under review and the tabulated results given in this paper before them the students of Tasmanian Cetacea will, we hope, find the exact classification of certain of our local species an easier task in the future, than it has been in the past. The articulated specimen of *P. crassidens* in the Tasmanian Museum appears to be a very typical representative of its species for use as a comparative model, as

(7) Trans. Recent memoirs of Cetacea. Ray Society 1864.

(8) Among others the pigmy sperm whale.

well as being an extremely valuable Museum exhibit. (See Plate No. I.)

### PSEUDORCA CRASSIDENS.

General osteological notes upon the Tasmanian skeleton, and a comparative table of measurements of the largest, lumbar vertebræ of that skeleton, with Reinhardt's male from Middlefart.

The skull in a wide sense is that of a small "*Orca*," and the teeth conform to the *Orca* type, in having recurved crowns, but of course are much smaller, as indicated by the following comparison with a true *Orca*'s teeth, measured directly for this special purpose.

PSEUDORCA.						ORCA.
						inches
(9) Total length of the largest tooth in the					inches	
upper jaw	...	...	...	...	1	2
Girth of same	...	...	...	...	3½	3½
(9) Length of largest tooth in the lower jaw	...	...	...	...	1½	2½
Girth of same	...	...	...	...	3½	4

The parietal, and squamosal moieties of the fossæ temporales in the *Pseudorca* are quite unlike those of *Orca*, being compounded in the following way. The squamosal contributes a narrow practically, even strip, about 2 inches wide, set at an angle, and continued to near the vertex. In the *Orca* the squamosal is wide, and irregular, and takes a larger share in the formation of the fossa (upon either side). One *Orca* skull, however, in the Museum collection, makes a nearer approach to *Pseudorca* in this respect. The parietal wings of *Pseudorca* are bent backwards at a slight angle, to the line of the skull, exactly as in *Tursiops*, while in the *Orca*, the whole boundary walls of these fossæ bend outwards, as continuous outgrowths of the occiput.

In the skeleton it may be noted that five of the cervical vertebræ are strongly ankylosed together, and two are quite free.

A metapophysis appears—faintly indicated—upon the second dorsal, and well marked one upon the fourth. The seventh dorsal develops these processes at the upper level of the neural arch, in other words at the base of the neural spine. Unlike the smaller dolphins, these processes are not eliminated from the vertebræ in the region of the dorsal fin, but continue to gradually decrease after the

(9) This is ex-alveolar, enamel surface measurement.

sixth lumbar has been reached, eventually ending, *in toto*, at the ninth vertebra from the caudal extremity. The manus is wider than that of such dolphins as *Globicephalus* and *Tursiops*, and the longest finger only develops seven phalanges, instead of eighteen, as in the case of *Globicephalus*. The ossicles present are apparently the following:—

Proximal row—Scaphoid. Lunare. Cuneiform.

Distal row—Trapezoid. Magnum. Unciform.

In each hand the cuneiform is closely attached by immersed cartilage, to the ulna, and as the whale was immature it might have ankylosed later in life had the animal continued to live.

*Pseudorca crassidens.*

Comparative skulls of well authenticated specimens.

Skull and skeleton in Tasmanian Museum, Hobart, Tasmania.	Adult skull in the Royal College of Surgeons' Museum, London.	Skull of Reinhardt's Specimen ♂	Prof. Owens fossil skull.
SKULL.	SKULL.	SKULL.	SKULL.
inches	inches	inches	inches
Beak to condyles ... .. 24	23 $\frac{1}{4}$	24	<div style="display: flex; align-items: center;"> <div style="font-size: 3em; margin-right: 5px;">{</div> <div> mutilated  <i>circa</i>  24 </div> </div>
Maxillary notch to tip of beak ... .. 12	11 $\frac{1}{4}$	11	
Breadth across the zygomatic processes of the squamosal 15	13	14 1-12	<div style="display: flex; align-items: center;"> <div style="font-size: 3em; margin-right: 5px;">{</div> <div> No data  given  No data </div> </div>
Height at vertex of the skull 10	8 $\frac{3}{4}$	No data	
Breadth across ridges of fossæ temporalis ... .. 8 $\frac{3}{4}$	No data	8 $\frac{1}{4}$	No data
Breadth of beak at notch ... 7 $\frac{3}{4}$	7 $\frac{1}{4}$	8 1-12	
Breadth across the beak in region of third tooth from end of series ... .. 7 $\frac{1}{2}$	No data	7 $\frac{1}{2}$	8
Breadth of the intermaxillaries and the intervening space 5 $\frac{1}{8}$	4 $\frac{1}{2}$	<div style="display: flex; align-items: center;"> <div style="font-size: 3em; margin-right: 5px;">{</div> <div> No data  5<math>\frac{1}{2}</math> </div> </div>	5 $\frac{1}{2}$
Length of right ramus of the mandible, tip to posterior edge of last tooth ... .. 9 $\frac{1}{2}$	9 $\frac{3}{4}$		
Length of the dental series of the upper jaw ... .. 10	No data	9 $\frac{3}{4}$	10
Height of right ramus at the coronoid process ... .. 5 $\frac{3}{8}$	5	No data	No data
Total length of the right ramus of the mandible ... 19 $\frac{1}{4}$	19	18 $\frac{1}{2}$	21



*Pseudorca crassidens.*

Comparative measurements of the Tasmanian and North Sea specimens.

— *Skeletons.* —

Tasmanian Specimen from Adventure Bay.				Reinhardt's male specimen from Middlefart.	
	feet	inches		feet	inches
Total length of the skeleton ... (10)	14	6		13	5
Length of seven cervical vertebrae ...	0	3½		0	3½
Length of lumbar series to the vertebrae with the first hamapophysis ...	3	5¾		3	5
Total length of caudals ... (10)	5	8½		5	3½
Breadth of the largest lumbar ...	1	0½		1	0 5-6
Height of scapula from middle of articular cavity to middle of supra-scapular rim ...	0	8½		0	7½
Greatest breadth of the scapula ...	0	11½		0	10 5-6
Length of Humerus ...	0	4½		0	4½
Do. of Radius ...	0	5		0	4 7-12
Do. of Ulna ...	0	5		0	3½
Distal width of both arm bones ...	0	5½		0	5½
Length of the manus in a recent and undried condition ...	no data			1	0

## ORCA GLADIATOR.

(*Orca capensis.*)

## PLATES II., III., IV., V., VI., VII., VIII.

For detailed synonymy see:—

Gray, B.M. Cat. Seals and Whales (1866), p. 278-290.

The prevailing opinion seems to favour the reduction of the representatives of this genus to one species—*Orca gladiator*. We have adopted this view and made *Orca capensis* a synonym of *Orca gladiator*. Should, however, *capensis* be again raised to specific rank we are of opinion that the Tasmanian forms should be included, as they appear to have the characters at one time allotted to *capensis* in order to separate it from *gladiator*. We formed this opinion after comparing the Tasmanian skulls with the figured ones of *Orca capensis* reproduced by Gray in the Zoology of the Voyage of the Erebus and Terror. (Plate IX.)

Unfortunately portions of the skeleton examined by us had disappeared. This is greatly to be regretted, es-

(10) In this articulated skeleton (Plate I.), the intervertebral pads are thick, in fact exceptionally so, and if this excess is allowed for, the two skeletons are of almost similar length.

pecially as the mandible was one of the missing portions. As a recompense, however, there was a second complete skull, in a splendid state of preservation, which permitted a series of comparative measurements being taken. This skull formed part of the Crowther collection, and bore eloquent testimony regarding the confusion of species previously alluded to. It was labelled "*Pseudorca meridionalis*—Donor, W. L. Crowther, Esqr.," but there can be no doubt that its correct classification is that of *Orca*. Whether *gladiator*, or *capensis*, is a matter of individual opinion, but we would again draw attention to the fact that whales vary greatly as regards sex and age characteristics, and far too many species in the past have been created on insufficient evidence. We desire particularly to refrain from adding further to the confused nomenclature, and prefer to treat the present example as a member of the cosmopolitan species *O. gladiator*.

#### ORCA GLADIATOR.

A detached skull, and a skull with many of the associated bones of the skeleton, exist in the Museum collection, and unless otherwise stated the notes given herewith relate to the latter.

##### *Skull.*

The skull is extremely heavy in build, following the general contour of the true dolphins with wide, even massive, squamosal regions, notched beak, and maxillary bosses two inches—or more—in thickness. The vertex gives characters that by reason of its squared ridges distinguish it immediately from *Globicephalus*, and in part from the *Pseudorca*.

This skull—which unfortunately is devoid of a mandible—is three feet three and a half inches long, two feet two inches wide, and one foot five and a half inches high, from the par-occipital processes to the vertex. Its greatest maxillary width is in the region of the pre-orbital process of the frontal, where it yields a measurement of twenty-two inches, it then contracts to twenty inches at the notch (if we still follow the outline of the skull). Across the actual notch itself, we get a measurement of twelve inches nearly—and rather more at the middle of the beak.

Viewed from below, it is of interest to note, that the intermaxillaries appear in the palate as a well marked pair of wedge shaped strips, some fourteen inches long—or half of the total palatal length. The vomer appears for four inches only, its apex being eleven inches from the tip of the beak. In *Globicephalus* the intermaxillaries only

obtrude upon the palate for three inches, out of a total length of fourteen, and the vomer is continued outwards to within two and a quarter inches of the tip of the beak. As far as it is possible to determine from the articulated skeleton of *Pseudorca*, this latter whale followed the *Orca*, and not *Globicephalus* in this respect, in any case it certainly followed *Orca* in having fairly extensive palatine moieties instead of the palatal bones being reduced to the merest strips as in *Globicephalus*. This character alone is sufficient to quickly separate skulls of *Pseudorca* from those of *Globiocephalus*.

The second skull in the Museum collection (Plate II.) is an extremely well prepared specimen, evidently cleaned under Doctor Crowther's strictest instructions—the teeth are all *in situ*, the membrane of the hard palate having been left for the purpose of their protection—nothing could exceed this method of making a museum specimen, as far as it relates to the teeth, but a central area left open to reveal the vomer, and intermaxillaries, would be a desideratum. In point of size, this second skull closely resembles the one just passed in review, but as it is in much better condition the table of measurements appended was compiled from it, and not the skull with the associated appendicular bones.

Skull of an *Orca*, presented by Dr. W. L. Crowther,  
F.R.C.S.

Plate II.

	ft.	in.
Total length ... ..	3	1 $\frac{3}{4}$
Width at maxillary notch ... ..	1	1 $\frac{1}{2}$
Width at pre-orbital process of the frontal ... ..	2	2 $\frac{1}{4}$
Width of maxillary at this point ... ..	1	10
Height from par-occipitals to vertex ... ..	1	5 $\frac{1}{2}$
Greatest width of palate inside teeth ... ..	0	10 $\frac{1}{2}$
(Midway between the last two)		
Width at seventh pair of teeth ... ..	0	9 $\frac{1}{2}$
Total length of tooth line ... ..	1	1 $\frac{1}{2}$
Width of pterygoids ... ..	0	6 $\frac{1}{4}$
Tips of pterygoids to the occipital condyles ... ..	1	1 $\frac{1}{2}$
Width of fossa temporalis ... ..	0	6
Height of fossa temporalis ... ..	0	6 $\frac{1}{2}$
(Both of the above taken from the palatal aspect.)		
Total length of malar bone ... ..	0	11 $\frac{1}{4}$
Diameter of blowers taken from the palatal aspect		
—antero-posterior measurement ... ..	0	4 $\frac{1}{4}$
Transverse measurement ... ..	0	5 $\frac{3}{8}$

	ft.	in.
Occipital condyles along the curve—vertical measurement ... ..	0	8
Ditto transverse measurement ... ..	0	4 $\frac{1}{4}$
Total width of the articular and space taken along the curve ... ..	0	10 $\frac{1}{2}$

*Skeleton.*

The cervical vertebræ, and the first dorsal, make such a compact series that for both illustrative and descriptive purposes they are here considered together (Plate III.). The first three cervicals are completely ankylosed, and the rest are quite free, this is in contrast to the *Pseudorca*, and *Globicephalus*, in which whales all the series are welded together into a solid mass. The neural spine of the axis slopes backwards at an angle of 45 degrees, and being some five inches in length, approaches the spine of the dorsal to within an inch and a quarter. The whole block measure nine and a quarter inches in antero-posterior extension, and the first pair of diapophyses yield a measurement of fifteen and a half inches across. The neural canal, taken through the atlas, is three and a half inches wide, and two and three-quarters high, and the first dorsal vertebra gives practically similar results.

For the general contour of this block of vertebræ see the illustration, it being only necessary to add that the block is ten inches high, to the top of the neural spines.

*Dorsal Series.* (Plate IV.)

Four vertebræ of the dorsal series are illustrated to show general outline, and the progressive rise of the metapophyses upon the neural spines. The length of this block is twelve and three-fourth inches for the three, and the height of the neural spine of the tallest vertebra is thirteen and three-quarter inches, from the keel of the centrum. The reversed vertebra is that which of the series is nearest to the skull, and therefore the transverse processes (Diapophyses) are extremely short. As a guide to size, it may be said that the neural canal of this vertebra is four inches across, and the centrum measures four and three-quarters in either direction.

*Lumbers.* (Plate V.)

Four early lumbers are shown, and a sequent fifth, reversed as in the other illustrations. These vertebræ do not carry hæmapophyses (Chevróns), and are, of course, ribless. The metapophyses are still strongly developed, although from their position they perhaps might be called zygapophyses.

In the evolution of whales, the true zygapophyses on the dorsal series have been overlapped by the metapophyses, that have in consequence suffered a complete atrophy.

*Chevron-bearing Vertebrae.* (Plate VI.)

These vertebrae beautifully illustrate the reduction of the metapophyses upon the neural spines as we advance tailward. Hæmad, they carry bony arches to protect the extensive blood vessels that go to nourish the powerful tail—such bones which relate to the vertebral hæmal arch may be designated either “hæmal arches,” or chevron bones.

*Sternum of Orca.* (Plate VII.)

An excellent illustration of the sternum of this Orca is depicted. As will be noted the anterior moiety (manubrium) is penetrated by a fossa, an inch and seven-eighths long, and one inch wide. The articular facets of four ribs are manifest, the next few pairs being articulated by cartilage to the distal (or ziphoid) end of the sternum. This arrangement is to be seen in the articulated skeleton of the pseudorca shown in connection with the description of that animal.

*Ribs.* (Plate VIII.)

To practically illustrate the awful fights that “Killers” indulge in, and their incidental results, some of the ribs of this Orca have been photographed. These ribs are paired, and therefore the mutilated rib can be directly compared with its normal congener. Apparently this particular specimen was unusually unlucky, for having early in life broken several ribs upon one side, and tided over the misadventure, he lived to face a second similar, but more extensive, fracture upon the other side. This second accident was responsible for the awful distortions shown in the picture.

**GLOBICEPHALUS MELAS.**

(For detailed Synonymy see Gray, B.M. Cat. Whales, p 313, *et seq.*)

The specimens representing *Globicephalus* (Nos. 5, 6, 7 and 8) consisted of three skeletons, of which two were complete, and a non-associated skull (Plate IX.). These are undoubtedly specimens presented by the late Dr W. L. Crowther, and were evidently carefully prepared in order to show certain essential data. The three specimens may be classed as follows:—

A. (No. 5) shows the characters of an adult male.

B. (No. 6) shows the characters of an adult female.

C. (No. 7) shows the characters of an immature *Globicephalus*.

As the sex characters of all whales need working out, these specimens will supply data of extreme interest, and it is felt that the comparative tables given in the following pages will prove useful to students of the *Cetacea* in the future.

It is of interest to note that the immature characters are well marked off from the mature. Of this characteristic little or nothing has previously been published as far as we are aware.

In the past whales belonging to the genus *Globicephalus* have been confused with specimens of *Pseudorca*. When they are compared casually this is not to be wondered at. Their similar size, colour, and general external appearance all lend their aid to the confusion which has undoubtedly existed. Even Ziphoid whales have at times been incorporated.

While the examination of the present series will, it is confidently hoped, prove of value, it is to be regretted that there are certain missing links. For the last fifty years apparently these valuable specimens have been stowed away. From time to time there have been alterations in the stores, and there is evidence which goes to show that a number of the missing parts relating to these skeletons were evidently stored separately, and were disposed of some years ago as useless odd examples. This is greatly to be regretted, but sufficient remains, especially in the case of this species, to allow an examination of its chief characteristics, both as regards sex and age.

#### LOBICEPHALUS MELAS. (Plate IX.)

As *Globicephalus* skulls have been confounded with those of the *Pseudorca*, it is important that their comparative osteology should be made clear. The palatine character given under the heading of *Orca*, in this paper, will always serve to separate the skulls unless extreme mutilation (as in the case of a fossil specimen) makes it impossible to apply this test—under such extreme circumstances the following data may be consulted.

#### Comparative Characters.

(1) In *Globicephalus* the maxillary wings practically cover the frontal upon all its faces, except at the vertex, where a narrow strip is left exposed.

(2) In *Pseudorca* the frontal is well exposed all round, namely, for anything from half to three-quarters of an inch, the greater amount being at the vertex, and the lesser along the orbit and fossa temporalis.

(3) In *Globicephalus* the pre-frontal moieties are



large, well rounded bosses, even in immature skulls, but in *Pseudorca* they are small, and are closely associated with the frontals—and we strongly suspect in old skulls would ankylose to extinction with the frontals.

In point of comparative sizes, it may be said—An immature *Globicephalus* whale, in whose skeleton the epiphyses are quite free, will have a skull as large as that of an adult *Pseudorca*, in which all the vertebral epiphyses are ankylosed to extinction.

As has been pointed out, in the introduction to the osteology of the *Orcas* skull, in the Museum collection, many valuable cetacean remains have been rejected in past years, and as the skulls belonging to Dr. Crowther's specimens were too large to store in the cases that carried the skeletons, they were either put on view in the Museum, as detached exhibits, or else stored at the back of the Museum (somewhat exposed to the weather!). In this way, the skull of the matured female of Crowther's donation became lost, and the matured male's skull was disassociated from its skeleton, and the same happened with the immature skull. Both of the latter have now been restored to their respective skeletons, and a third (old male) non-associated skull has been brought to light. As a result therefore of this confusion the adult female of Crowther's donation is minus its skull, while a spare male skull is available. The following table will show the comparison between the two adult male skulls, and that of the immature *Globicephalus*.

### Comparative skulls of *Globicephalus*

In the collection of the Tasmanian Museum, Hobart.

Dr. Crowther's specimen ♂ associate of the skeleton.					Adult ♂ skull non-associate of any other remains avail- able.	Dr. Crowther's specimen immature skull.
inches					inches	inches
Greatest length	...	...	...	26	26	23½
Height	...	...	...	13¾	14	11
Greatest width	...	...	...	19½	19½	15½
Width at notch	...	...	...	10½	11	8½
Across anterior nares	...	...	...	7½	7¾	5¾
Width of fossa temporalis	...	...	...	5	5	3¾
Height of fossa temporalis	...	...	...	5½	5½	4¾
Width of palatines as they contribute moieties to the true palate, to compare with an orca, giving 2½ inches from the tips of the ptery- goids					1*	½

\* Rather mutilated.

In the above notes it has been our object to supply actual data, and not to repeat the published characters. (11).

### General Notes upon the Skeletons.

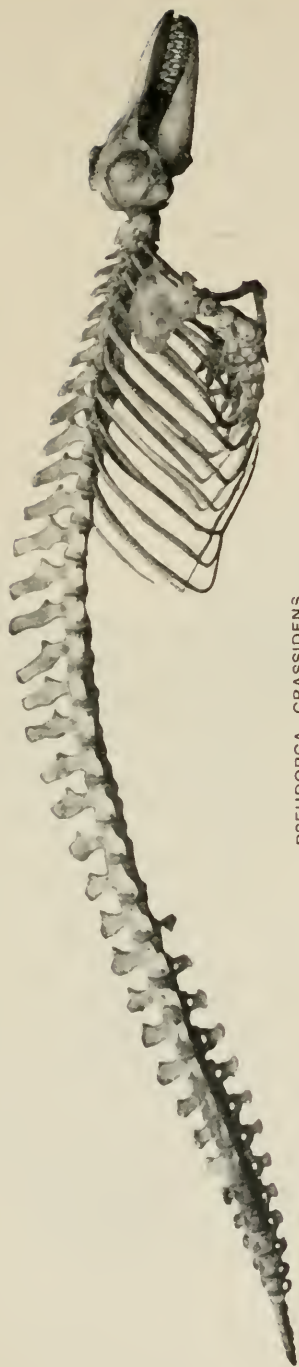
ADULT MALE.	ADULT FEMALE.	IMMATURE. ♂
All cervicals ankylosed, but not to sutural extinction, last two open. No super ossification. (Animal almost adult—compare size of skull with that of the other male.)	All cervicals ankylosed, not to extinction, last two open, much super ossification. Spine of the axis blending strongly with those of the rest of the series.	Cervicals ankylosed—lightly, but firmly, except the 7th, which is loose. Five sutures wide open. Right nemapophysis has not blended with its fellow moiety.
Twelve dorsal vertebræ measure, in antero-posterior extension—3ft. 2in.	Twelve dorsals measure—2ft. 7in.	Twelve dorsals measure—2ft. 5½in.
Epiphyses not ankylosed to centra of vertebrae.	Epiphyses of all vertebrae ankylosed to centra, and sutures extinct.	All epiphyses quite free from the centra.
Total length of vertebral series, minus skull—14ft. 6in.	Length of vertebral series—10ft. 10in	Length of vertebral series—10ft. 10½in.

ADULT MALE.	ADULT FEMALE.	IMMATURE. ♂
Ribs, 11 to 12 pairs.	Ribs, 11 to 12 pairs.	Ribs, 11 to 12 pairs.
inches	inches	inches
Twentieth vertebra from skull, width across diapophyses ... 15	Twentieth vertebra from skull, width across diapophyses ... 11	Twentieth vertebra from skull, width across diapophyses ... 13
Length of body... 4	Length of body ... 3½	Length of body... 3¼
Height to tip of spine ... 11½	Height to tip of spine... .. 9½	Height to tip of spine .. 9½
Across centrum 3½	Across centrum ... 3	Across centrum 3½
Vertical ... 3½	Vertical ... 2¾	Vertical .. 3½
Scapula.	Scapula.	Scapula.
Glenoid to supra-scapular rim ... 10½	Glenoid to scapular rim ... 9½	Glenoid to scapular rim ... 8½
Transverse ... 15½	Transverse .. 13½	Transverse ... 12½

From the above comparative measurements it will be manifest that the adult male exceeds the adult female, in size, by anything up to four feet, or over, and that an im-

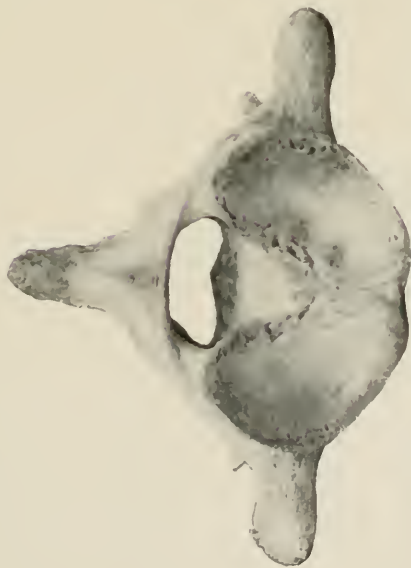
(11) Such as already given by Beddard in *A Book of Whales and The Cambridge Natural History (Mammals)*, etc.



PSEUDORCA CRASSIDENS.



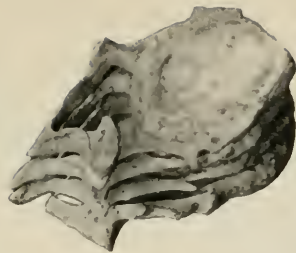
ORCA GLADIATOR.



Anterior Cervicals.



First Dorsal.



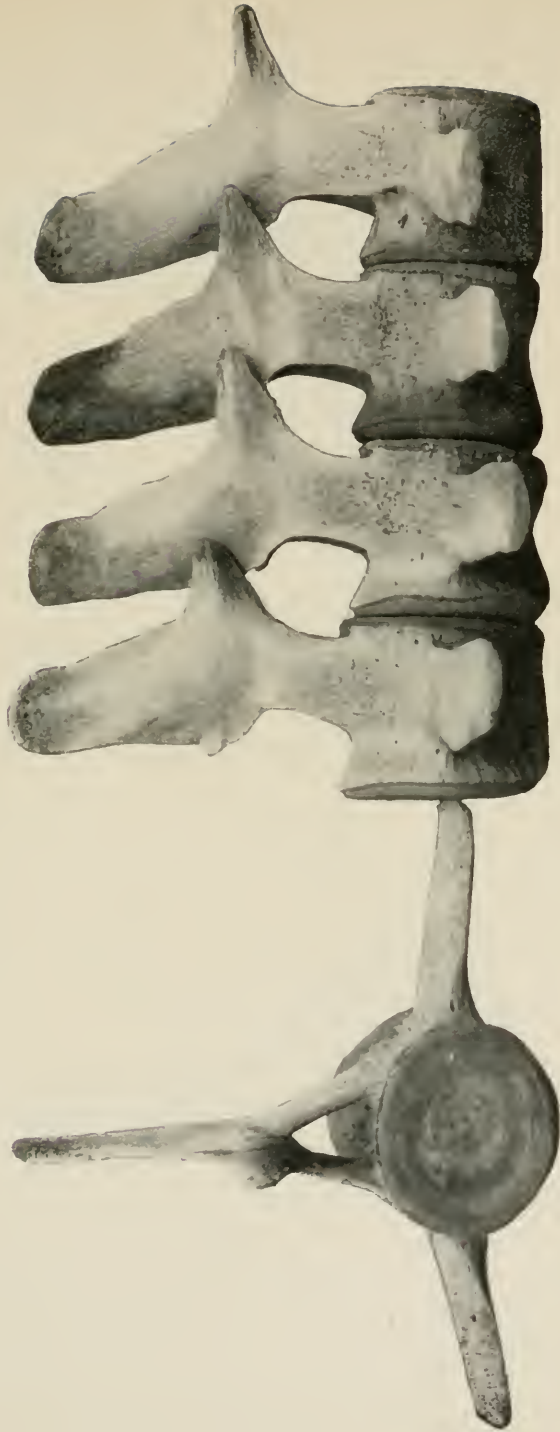
Posterior Cervicals.

ORCA GLADIATOR.

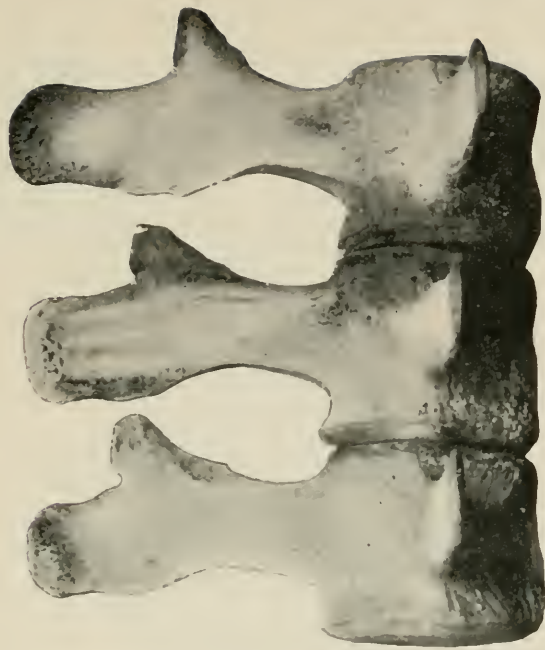


ORCA GLADIATOR.





ORCA GLADIATOR.



ORCA GLADIATOR.



ORCA GLADIATOR.



ORCA GLADIATOR.



GLOBICEPHALUS MELAS.

mature male, with all the epiphyses of the vertebræ open, is close to the stature of the female. The following characters were noted, as marking the female off from the mature and immature males.

1. Diapophyses of the dorsal ribs longer than in the other two animals.

2. First, cervical, neural spine covers more vertebræ.

3. No bicipital groove between head and trochanter of the humerus. Articular surfaces set at a more oblique angle (12).

4. Supra scapular rim was centrally elevated, and not depressed, and the pre, and post, scapular fossæ made a nearer approach to the roughened fossæ of *Tursiops* than either of the other specimens here detailed.

We hope in our next paper to give exhaustive data relating to sex variations in the genus *Tursiops*, and the notes here supplied will receive added value from the light thus thrown upon a vexed question.

In conclusion, we desire to express our thanks to Mr. John Arnold, Chief Assistant of the Tasmanian Museum, for the willing and courteous assistance rendered to us during the examination of the specimens.

## DESCRIPTION OF PLATES.

### PLATE I.

Articulated skeleton of *Pseudorca crassidens* from Adventure Bay, Tasmania.

### PLATE II.

Skull of *Orca gladiator*.

### PLATE III.

Cervical vertebræ and first dorsal of *Orca gladiator*.

### PLATE IV.

Four vertebræ of the Dorsal Series (*O. gladiator*).

### PLATE V.

Five vertebræ of the Lumbar series (*O. gladiator*).

### PLATE VI.

Four chevron bearing vertebræ (*O. gladiator*).

### PLATE VII.

Sternum of *Orca gladiator*.

### PLATE VIII.

Series of Ribs of *Orca gladiator* (showing broken ribs).

### PLATE IX.

Skull of *Globicephalus melus*.

(12) These arm bones are only provisionally associated with this skeleton, and may not belong to it. Various dolphin remains—evidently odd scraps of later date than Dr. Crowther's specimens—had been added to the box from time to time; these included some *Tursiops* bones of no value.