

RAY SOCIETY.

RECENT MEMOIRS

ON THE

CETACEA.

BY

PROFESSORS ESCHRIGHT, REINHARDT, AND LILLJEBORG.

1866.

Issued to the Subscribers for the Year 1866.

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LONDON :

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J. A. M.

RECENT MEMOIRS

ON THE

CETACEA

BY

PROFESSORS ESCHRICHT, REINHARDT AND LILLJEBORG.

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MUS. COMP. ZOOLOGY
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EDITED BY

WILLIAM HENRY FLOWER,

F.R.S., F.R.C.S., F.L.S., ETC.,

CONSERVATOR OF THE MUSEUM OF THE ROYAL COLLEGE OF SURGEONS OF ENGLAND.

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P R E F A C E.

BY THE EDITOR.

It is almost needless to repeat a statement with which nearly every work treating of the anatomy or zoology of the Cetacea commences, viz., that of no order among the vertebrated animals is our knowledge at present so scanty, and of none are the difficulties which meet the investigator so numerous and hard to overcome. The fact is known to every naturalist, and has been a sufficient reason to induce the Council of the Ray Society to undertake the republication, in English, of the present memoirs, which, being written in the Scandinavian languages, and not hitherto translated into any other, have remained inaccessible to the greater number of European zoologists. Moreover, the animals treated of in these memoirs belong, most of them, to the British, all to the North European Fauna, and have, therefore, an important claim upon our attention; one of them especially, the Greenland Right-whale, has for centuries engaged a large share of the energies and capital of British seamen and British merchants.

Some difficulties presented themselves at first in the way of procuring a translation linguistically correct, and at the same time free from technical errors.

These were, however, to a great extent removed by the kindness of Professor Reinhardt, whose extensive and accurate acquaintance with the English language is well known to all who have had the pleasure of corresponding with him. At the request of the Council of the Society, he undertook the superintendence of the translation of the three Danish memoirs, his own and those of his friend the late Professor Eschricht, and his careful supervision is a guarantee for the fidelity of the rendering of the facts. The translation having been made with literal accuracy, necessarily abounded in modes of expression which, though generally intelligible, have an unfamiliar sound to the English ear. It has been my task to correct this defect as far as practicable; but feeling that in a scientific work an accurate representation of the author's meaning is of far greater importance than polished phraseology, I have been careful to avoid any chance of altering the sense, even at the risk of leaving many quaint and occasionally inelegant pieces of composition. The indulgence of the reader is especially requested in these cases.

The translation of the Swedish memoir by Professor Lilljeborg was made in the same manner, under the supervision of the author.

In correcting the press I have carefully compared all the measurements, names, and quotations, with the original memoirs. As the former are very numerous, it has been thought advisable to leave them as they stand in the original instead of reducing them into English feet and inches, which would have involved innumerable calculations, with corresponding risk of error. Both Danish and Swedish feet and inches are so nearly the same as our own that for practical purposes they suffice, with the slight allowance that can easily be made mentally in each case, it being borne in mind that the Danish foot is slightly longer than the English, viz., 1.0298 of our foot, or 12.357 English inches. The Swedish foot, on the other hand, is about as much shorter, being 0.9742 of our foot, or 11.690 English inches.

The following approximative table may be convenient for ready reference :

Danish Feet.	English Feet. Inches.	Swedish Feet.	English Feet. Inches.
5	5 $1\frac{3}{4}$	5	4 $10\frac{1}{2}$
10	10 $3\frac{1}{2}$	10	9 9
20	20 7	20	19 6
30	30 $10\frac{1}{2}$	30	29 $2\frac{3}{4}$
40	41 $2\frac{1}{4}$	40	38 $11\frac{1}{2}$
50	51 $5\frac{3}{4}$	50	48 $8\frac{1}{2}$
60	61 $9\frac{1}{4}$	60	58 $5\frac{1}{2}$
70	72 $0\frac{3}{4}$	70	68 $2\frac{1}{4}$
80	82 $4\frac{1}{2}$	80	77 11
90	92 8	90	87 8
100	102 $11\frac{1}{2}$	100	97 5

A few words on the special characters of the different memoirs may not be out of place.

I. *On the Greenland Right-whale (Balena mysticetus)*. By D. F. Eschricht and J. Reinhardt. —This work was originally published in the ‘Transactions of the Royal Danish Society of Sciences’ for 1861, under the title “Om Nordhvalen.” Its origin is sufficiently explained in the author’s preface. It is certainly a very remarkable circumstance that of an animal so important so little was really known before the publication of these researches. That its osteology had never been completely described is sufficiently accounted for by the fact that of the thousands annually slaughtered no skeleton had ever been sent to any European museum, until Eschricht succeeded in obtaining those which form the subject of this memoir from the Danish colony at Holsteinsborg, in Greenland. The history of its migrations and geographical distribution has been chiefly collected by the authors of the present essay from sources almost inaccessible to any one but themselves. Unfortunately, both the lithographic stones and the wood-blocks used to illustrate the memoir in the ‘Danish Transactions’ had been destroyed; they have, however, been reproduced for this edition with great accuracy, the former by Mr. E. M. Williams, the latter by Mr. W. Searson.

In selecting a vernacular name for the animal treated of I have been guided by the following considerations. Although the *Balena mysticetus* is certainly the most exclusively confined to the Arctic regions of all the known Cetaceans, yet the term “North whale,” preferred for it by the

authors of the memoir, seems scarcely sufficiently distinctive. "Greenland whale," by which it is spoken of by Scoresby and most other English writers, would also scarcely separate it from the Hump-backs and Fin-whales found in the seas near that country. The term "Right-whale," understood and used by all whalers, and having its equivalent in the Danish "Rethval" and the French "Baleine franche," forms a convenient English term for the restricted genus *Balæna*. Greenland Right-whale has the advantage of retaining one of the most familiar distinctive appellations of the animal, while it is correct in implying that its main habitat is in the seas lying both to the east and west of Greenland, where, as far as is yet known, no other species of true *Balæna* or Right-whale is found.¹

To render this memoir as complete an exposition of the osteology of the species as available materials will permit, I have appended some notes upon a fine skeleton lately added to the Museum of the Royal College of Surgeons, and obtained from the same source as those described in the work itself.

II. *On the Species of Orca inhabiting the Northern Seas.*—This was the last production of the pen of Professor Eschricht, who devoted the greater part of an active life to the study of the Cetacea. The second part of the essay was still unfinished at the time of his lamented death, but was yet thought worthy, in its incomplete state, of publication in the 'Proceedings of the Danish Royal Society.' All the killers or grampuses (genus *Orca*) of the northern seas had generally been supposed to belong to a single species. The proposition made in this essay to divide them into three will be the more readily accepted by zoologists, being the final result of the labours in this field of so exact and cautious an observer as Eschricht, who has certainly never shown favour to the excessive multiplication of species.

III. *On Pseudorca crassidens.*—In this essay Professor Reinhardt has given a careful and detailed description of the external and osteological characters of a remarkable form of Cetacean, hitherto only known by a skull exhumed from a fen in Lincolnshire, and therefore thought to have been long extinct. The sudden appearance of several individuals of this species on the coast of Denmark in 1862 shows how much may still be unknown of the Cetacean life, even in seas most frequented by civilised and observing man.

The wood-blocks used to illustrate this essay and the preceding are, with two exceptions, those used in the originals, and have been kindly lent for the purpose by the Danish Royal Society.

IV. Professor Lilljeborg's essay on the Scandinavian Cetacea is chiefly based on observations upon the skeletons of animals of this order contained in the various museums of Sweden and Norway.

The most important novelties are the description of two perfectly distinct species of large whales found in a subfossil state in the former country. The woodcuts illustrating some characteristic parts of one of these are not in the original, but have been engraved from drawings

¹ The species is called by Anderson "Der rechte Grönländische Wallfisch," 'Nachrichten von Island,' &c., 1746.

supplied for the purpose by Professor Lilljeborg. Some few alterations have been made in the text of this essay by the author during the translation, and some notes not found in the original are added. The latter are distinguished by being placed in brackets [], with the date 1865. The few notes that I have thought necessary to add throughout the work are distinguished by the initials W. H. F.

27th June, 1866.

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ON

THE GREENLAND RIGHT-WHALE.

(*BALÆNA MYSTICETUS*, LINN.),

WITH ESPECIAL REFERENCE TO ITS GEOGRAPHICAL DISTRIBUTION AND
MIGRATIONS IN TIMES PAST AND PRESENT, AND TO ITS EXTERNAL
AND INTERNAL CHARACTERISTICS.

BY

D. F. ESCHRICHT, M.D.,

Professor of Physiology in the University of Copenhagen; Member of the Royal Danish Society of Sciences, and of the Imperial Leopold-Caroline Academy of Naturalists; Corresponding Member of the Royal Academies of Stockholm, Upsala, and Berlin, and of the Academy of Natural Sciences of Philadelphia; Honorary Member of the Society of Natural History and Medicine of Dresden, of the Scientific and Medical Union of Hamburg; Member of the Societies of Naturalists of Danzig and Heidelberg, of the Medical Societies of Copenhagen, Christiania, and Stockholm; Corresponding Member of the Philomathic Society of Paris, of the 'Société du Muséum d'Histoire Naturelle' of Strasburg, of the Societies of Naturalists of Rostock and Freiburg, and of the Medical Societies of Vienna and Antwerp, etc. etc.;

AND

J. REINHARDT,

Professor and Inspector at the Zoological Museum of the University of Copenhagen; Member of the Royal Danish Society of Sciences; Foreign Member of the Zoological Society of London; Honorary Member of the British Ornithologists' Union; Corresponding Member of the Imperial Academy of Medicine of Rio de Janeiro; Member of the Society of Naturalists of Halle, and of the Imperial and Royal Zoological and Botanical Societies of Vienna.

(Translated from the Danish.)

FROM THE 'KONGELIGE DANSKE VIDENSKABERNES SELSKABS SKRIFTER, 5TE RÆKKE, NATURVIDENS-
KABELIG OG MATHEMATISK AFDELING,' 5TE BIND, 1861.

THE HISTORY OF THE

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P R E F A C E .

SEVERAL years ago one of the authors of the following essay, Mr. Eschricht, laid before the Royal Danish Society of Letters and Science the result of some researches on the geographical distribution and anatomical structure of the Greenland whale, or *Mysticetus*, but the publication was at that time postponed by the author, as he hoped that by collecting new and more complete materials he might bring his researches to a more satisfactory conclusion. This hope has been fulfilled, though not in the way that he at that time expected. He was relying on the continued assistance of his friend Captain Holböll,¹ to whom he was already indebted for the greater part of the materials on which he had founded his first researches upon the Greenland whale as well as all his former essays on the northern Cetaceans. This faithful friend set out for Greenland on the 25th of March, 1856, with the best promises, but neither he nor the vessel in which he sailed with one of his sons has since been heard of.

Thus Mr. Eschricht's expectations from that quarter were disappointed in a most deplorable manner. But at the same time an opportunity offered itself of procuring for the society a more complete monograph of the Greenland whale than his first work can be said to have been. For the second of the authors of this memoir had also for several years investigated the same subject quite independently, and, like his fellow-labourer, worked out the distribution and structure of the Greenland whale; a new-born animal, preserved in brine, which Major Fasting, then Inspector

¹ Charles Peter Holböll, a son of the worthy gardener at the botanical garden at Copenhagen, Frederick Lewis Holböll, was born 31st December, 1795. The objects amidst which he grew up awakened in him an early love of nature and natural history; first he began to study botany, and then, no less sedulously, zoology. He was destined to be a naval officer, and at a comparatively advanced age he obtained his commission as lieutenant, in the year 1821. In the following year, being acknowledged as a clever practical zoologist, he was sent by the government upon an expedition of two years' duration to Greenland, partly to make himself acquainted with the whale fishery, partly to make collections of objects belonging to the fauna of this Arctic country for the Royal Museum of Natural History. After his return he was, in 1825, appointed "Inspector (Governor) of the Settlements and the Whale Fishery in North Greenland." In 1828 he was removed to South Greenland. At his first appointment, in 1825, he had left the navy with the title of "Captain-Lieutenant" (Commander).

(Governor) in North Greenland,¹ had brought with him from Godhavn at considerable personal sacrifice, and presented to the Royal Museum of Natural History at Copenhagen, having afforded materials for his researches. His results, in all essential points, agreed with those arrived at by the first-named author; but being partly founded upon some other facts, and derived from other sources, they might at any rate be said to furnish some supplementary information not unimportant to the researches of Mr. Eschricht.

Both the authors soon agreed that they would best serve science by uniting their essays into one common work, and thus they now place them before the society and the public. The investigations have been made, or at least thoroughly revised, in common between them, and both the authors are thus in every respect equally responsible for the results, and the views founded upon them; but in finally committing their thoughts to writing, Mr. Eschricht has principally taken upon himself the composition of the second part, while Mr. Reinhardt has that of the first.

¹ The Danish establishments in Greenland constitute two "Inspectorates," the northern of which (North Greenland) comprises all the factories down to Egedesminde, this factory included, while Holsteinsborg, and all the still more southern places make the "Southern Inspectorate" (South Greenland).

I.

THE GEOGRAPHICAL RANGE OF THE GREENLAND WHALE
IN FORMER TIMES AND AT PRESENT.

EVEN after it had been proved that the right-whales of the Pacific belong to a species quite different from the Greenland whale, or north whale, and the supposition that the latter is a cosmopolitan animal finding its way through all seas of the globe, was totally abandoned, it was nevertheless believed that it had originally spread much further to the south than in our days, that it had formerly been regularly chased and caught in the temperate waters of the northern Atlantic, and that it was only by the persecutions of the whalers that it had been gradually driven up towards the North Pole.

Now this opinion, once supported by the highest authorities, may perhaps to a great extent have lost its credit; it still, however, has its supporters, in consequence chiefly of the facts and arguments on which it was principally founded having been not always treated with sufficient attention by its opponents.

We therefore feel ourselves called upon to resume the question, formerly treated of by one of us,¹ about the original geographical range of the whale; thus making more complete the contributions to the natural history of the Greenland whale now laid before the Society, the more especially since new light has been thrown on the subject by some important additional information, by means of which we hope that all doubt and uncertainty may be disposed of in a satisfactory way.

Numerous and excellent as the accounts are which at different times have been given to us by whalers about the place and manner of living of the Greenland whale, and greatly as zoology is in this respect indebted to such men as Scoresby, Manby, Zörgdrager, and Martens, yet the nature of the case makes it impossible for us to form a complete idea of the life of the whale in its native seas by information gathered in this way. If therefore we are to learn anything

¹ Eschricht, D. F. Undersøgelser over Hvaldyrene. Første Afhandling. Bemærkninger over Ceto-logiens tidligere og nærværende Skjæbne (Kgl. D. Vidensk. Selsk. naturvid. Afhandl. 11 Deel., S. 129).

² The same. Om de nordiske Hvaldyrs geographiske Udbredelse i nærværende og i tidligere Tid. (i Forhandl. ved de skandinaviske Naturforskeres Møde i Kjøbenhavn i 1847, S. 103).

about the life of the whale during the greater part of the year in which it is not exposed to the persecutions of the whalers, we must have recourse to those countries near the shores of which it regularly appears, and where it may easily be observed from year to year, at any season. For this purpose no place is, perhaps, better adapted than that part of the western coast of Greenland along which the Danish factories and missionary stations are situated.

It is true that the whale-fishery, formerly so profitable to the greater part of these factories, has gradually been discontinued in all of them except in Holsteinsborg; but still the whale appears regularly near the shore, and while it thus may still be observed every year, a treasure of facts relating to its appearance along the very same shore in former days has been collected in the factories. The whale-fishery from the Danish factories was not carried on in vessels in the open sea, but from the so called, "Hvalfangerloger," or "Hvalfangeranlæg," establishments on the coast, provided with the necessary apparatus for trying out the blubber, and, according to the number of the inhabitants, with a greater or smaller number of boats, completely fitted out for whale-fishing. Thus, these establishments might be considered as stationary whaling ships; and as in the ships a look-out is kept from the crow's nest on the mast, so in the factories a constant close watch for whales was kept upon one of the neighbouring rocks. As soon as a whale was observed, the boats were put to sea, weather and ice permitting, and the whale, when killed, was towed on shore, where the flensing took place. The crews of the boats, harpooners included, were mostly Greenlanders, but the administration of the factories was left to Danish functionaries, bound to give an exact account of what took place every day in the factory, and therefore their annual reports, sent down to the Colonial Department at Copenhagen, will be found to contain, not only statements about every single whale killed, or lost after having been harpooned, but most commonly also, of those which were observed from the look-out rocks, even though the weather did not permit the boats to put to sea. The reports also occasionally contained various and not unimportant observations about some of the whales, either captured or only observed. Thus it is clear that, from the Danish establishments in Greenland, generally speaking, very much information may be procured, which it would be difficult to obtain from the other shores, partly desert and partly only inhabited by wild tribes, along which the whale regularly makes its appearance. It will also be easily seen that the situation of Greenland is such as would make it probable that the question whether in the course of time an alteration has taken place in the geographical range of the whale may there be most easily settled. For that part of the western shore of Greenland along which the factories are situated reaches from the 60th to the 73rd degree, in a direction almost due north. Thus, it extends to the considerable length of about 200 Danish miles from the limits of the temperate zone up towards the North Pole, and it is, in its whole extent, washed by a sea which has been the principal scene of a whale-fishery which has twice, during the period of more than a century since the establishment of the first Danish factories, taken a considerable rise, and then, again, sunk down into its present insignificance. It might then be expected that the whale, in this particular region, would have retired further northwards if it had been at all natural for it to endeavour to avoid persecution in this manner.

We shall therefore found our researches in respect to the present and earlier distribution of the whale generally upon its appearance near the coast just mentioned, which appearance is pretty well known to us, partly through the reports of those who have spent more or less time in Greenland, among whom we must mention the names of Captain Holböll and Major

Fasting, but chiefly through numerous journals of the whale-fishery kept at the different factories, the use of which the Department for the Greenland Trade has been liberal enough to concede to one of us.

Although the Greenland whale regularly appears near the west coast of Greenland it only visits a part of this extensive shore. Thus, it does not commonly appear to the south of that part of the coast which is situated between the 66th and 65th degree. At this place, or, more exactly, near the factory called Sukkertoppen (the Sugar-loaf, $65^{\circ} 25'$)¹, it does not appear every year, but, nevertheless, so often that at a place a little more northerly, where this factory originally was situated ($65^{\circ} 38'$), a whaling establishment had been founded, the most southerly of all. This establishment was certainly given up a long time ago, but, as far as it can be ascertained, this was not so much owing to the scarcity of the whales as to the fact that the harpoon-lines were commonly torn on the hidden rocks abounding in that part of the sea, thus causing the loss of the whales. Southwards of these limits the appearance of the whale is only casual, and very rare, and, if we except one instance recorded by David Crantz,² that it once, in the spring of 1756, appeared in numbers off the factory of Godthaab, in all other cases known to us, only a few individuals, especially young ones, have strayed further to the south. Thus, on the 2nd of December, 1805, a young Greenland whale was caught near the factory of Frederikshaab ($62^{\circ} 0'$). In the year 1831 a young one was discovered still further southwards, near Tiksaluk-Næs ($61^{\circ} 25'$), and harpooned, though not successfully; and finally, in the following year a young whale was observed in the same place, and at a season most extraordinary, as the following observations will prove, viz., on the 23rd of July.

Along the remaining part of the coast, on the contrary, northwards of the limits just indicated, the whale appears annually, with great regularity, and enters the larger sounds or fiords, though not every year in the same numbers; but its stay is everywhere only periodical, limited to a certain fixed season of the year, and of unequal duration at different places. Thus, the whale appears near "Sukkertoppen" in the months of December, January, and February, and, it seems, in greater numbers the more severe the winter is and the more the sea is filled with floating ice. About one degree and a half more to the north near the factory of Holsteinsborg ($66^{\circ} 56'$) its appearance is still nearly contemporaneous, although, indeed, even here, its stay is somewhat longer. According to the statements in journals kept in this factory during the space of thirty-six years, the whales make their appearance there in the first half of December, and in rarer instances (more exactly, five times during the said thirty-six years) they have been observed in the last days of November, and sometimes they have not come until the beginning of January. They then remain along the coast and in the larger fiords, as in the Fiords of Amertlok and Nepisene, till the month of March, when they again withdraw, and more frequently in the first than in the latter half of the month. Sometimes, however, they have disappeared by February, which was the case seven times during the period for which we have been able to obtain authentic accounts. Very rarely whales have been observed as late as the beginning of April in

¹ We follow the figures given by Rink, in his work upon Greenland ('Grönland geographisk og statistisk beskrevet,' Kjöb, 1857), which differ a little from the earlier statements to be found in Captain Graah's account of his expedition to East Greenland.

² 'Historie von Grönland,' ii, 835.

ESCHRICHT AND REINHARDT

the Fiord of Amertlok, as on the 3rd of April, 1805, and on the 9th of April, 1820, and sometimes a single whale may have been left behind even a long time after the others have disappeared; thus, in the year 1806 a whale was seen in the Fiord of Amertlok so late as the 14th of April, more than three weeks after all its companions had departed.

To this general sketch of the appearance of the whale at Holsteinsborg we will add a table extracted from the journals kept at the settlement, which will show, for a period of thirty-six commercial years, the dates of the first and last appearances of the whale.

Commercial Years. ¹	Arrival of the Whale.	Departure of the Whale.
1780	Jan. 9, 1780	March 2, 1780.
1781	„ 6, 1781	„ 4, 1781.
1782	Dec. 21, 1781	„ 23, 1782.
1783	Jan. 10, 1783	„ 4, 1783.
1784	„ 14, 1784	„ 13, 1784.
1785	Nov. 22, 1784	„ 6, 1785.
1800	„ 29, 1799	„ 1, 1800.
1801	Dec. 22, 1800	„ 28, 1801.
1804	„ 7, 1803	„ 11, 1804.
1805	„ 3, 1804	April 3, 1805.
1806	„ 5, 1805	March 20, 1806.
1807	„ 9, 1806	„ 5, 1807.
1808	„ 6, 1807	Febr. 26, 1808.
1809	Nov. 28, 1808	March 27, 1809.
1810	Dec. 8, 1809	Febr. 18, 1810.
1811	„ 26, 1810	„ 21, 1811.
1812	Jan. 22, 1812	March 7, 1812.
1813	Dec. 25, 1812	„ 30, 1813.
1814	„ 13, 1813	„ 24, 1814.
1815	„ 8, 1814	„ 27, 1815.
1818	Nov. 30, 1817	Jan. 28, 1818.
1819	Dec. 7, 1818	March 29, 1819.
1820	„ 7, 1819	April 9, 1820.
1821	„ 22, 1820	March 6, 1821.
1822	„ 17, 1821	„ 9, 1822.

¹ The communication between the different factories and the smaller establishments adjoined being extremely difficult, sometimes even impossible during the winter, reports and accounts cannot be closed with the common year of the Church; a commercial year, so called, has therefore been instituted, calculated from the 1st of July till the 30th of the following June, being half a year in advance of the common one. Such are the commercial years alluded to in the table. As we have not been able to obtain for our inspection the journals for an uninterrupted series of years, we could not reduce them into common years. It must be added, that for the first six commercial years the dates mentioned are not those of the appearance and disappearance of the whales, but they point out the days on which the first and the last whale were caught, or at least harpooned; the journals themselves for these years we have not been able to examine, but only an abridgment of them, which was kindly lent to us by a member of the Society, the late Dr. Pingel, and this abridged statement, composed by Jörgen Frederik Egede, then a merchant of the factory, does not give any further information.

ON THE GREENLAND RIGHT-WHALE.

Commercial Years.	Arrival of the Whale.	Departure of the Whale.
1823	Nov. 30, 1822	March 16, 1823.
1824	Dec. 10, 1823	Feb. 12, 1824.
1825	„ 16, 1824	March 8, 1825.
1826	Nov. 30, 1825	„ 15, 1826.
1827	Jan. 5, 1827	Feb. 19, 1827.
1828	Dec. 17, 1827	„ 19, 1828.
1829	„ 16, 1828	March 4, 1829.
1830	Jan. 14, 1830	Jan. 14, 1830. ¹
1831	—	— ²
1832	Feb. 10, 1832	Feb. 18, 1832.
1833	Dec. 7, 1832	March 10, 1833.
1839	„ 17, 1833	„ 12, 1839.

Further northwards, in Disco Bay, about the 69th degree of latitude, the whales appear about the same time as at Holsteinsborg, but their stay lasts a good deal longer. According to the observations obtained near Godhavn (69° 14'), the whale most commonly makes its appearance there in the beginning of December, sometimes even in the last week of November, but then it usually remains until the middle of June. There are, however, instances of its having disappeared towards the end of May; nay, in one year (1818), in which year the numbers of the whales were small, they departed before the end of April, none of them having been seen after the 26th of that month. On the other hand whales may, though very seldom, be seen at Godhavn down to the end of June, but no instance of their having remained there till the beginning of July has been put on record during the long period of thirty-five years, for which we are able to state, most exactly, the days of their arrival and departure.

Commercial Years.	Arrival of the Whale.	Departure of the Whale.
1780	Dec. 13, 1779	May 20, 1780.
1787	„ 5, 1786	„ 29, 1787.
1788	Nov. 23, 1787	„ 20, 1788.
1801	Dec. 2, 1800	June 4, 1801.
1802	„ 14, 1801	„ 2, 1802.
1803	„ 8, 1802	May 12, 1803.
1804	„ 12, 1803	June 25, 1804.
1805	Nov. 17, 1804	„ 12, 1805.
1806	Dec. 2, 1805	May 28, 1806.
1807	„ 2, 1806	„ 18, 1807.
1808	Nov. 19, 1807	June 4, 1808.
1809	Dec. 15, 1808	„ 12, 1809.
1810	„ 11, 1809	May 31, 1810.
1812	Nov. 19, 1811	June 15, 1812.
1813	Dec. 14, 1812	„ 12, 1813.
1814	„ 2, 1813	May 2, 1814.
1818	Nov. 12, 1817	April 26, 1818.
1820	Dec. 12, 1819	June 17, 1820.
1821	„ 19, 1820	May 24, 1821.

¹ Only a single whale was observed this year.

² It appears that this year no whales were seen at Holsteinsborg.

Commercial Years.	Arrival of the Whale.	Departure of the Whale.
1822	Dec. 12, 1821	June 9, 1822.
1823	Nov. 30, 1822	„ 5, 1823.
1824	Jan. 6, 1824	„ 10, 1824.
1825	Dec. 7, 1824	„ 14, 1825.
1826	„ 8, 1825	May 20, 1826.
1827	„ 3, 1826	June 5, 1827.
1828	Nov. 29, 1827	„ 12, 1828.
1829	Dec. 7, 1828	May 19, 1829.
1830	„ 1, 1829	June 1, 1830.
1831	Dec. 13, 1830	May 18, 1831.
1832	„ 16, 1831	June 4, 1832.
1833	„ 2, 1832	May 8, 1833.
1834	Nov. 25, 1833	June 8, 1834.
1835	Dec. 26, 1834	„ 24, 1835.
1836	Nov. 23, 1835	„ 20, 1836.
1837	„ 19, 1836	„ 9, 1837.

Thus, the whale has most commonly disappeared from Disco Bay by the middle of June, but in Omenak Sound, in the 71st degree of latitude, it is found not only through the whole month of June, but it is even mentioned in journals kept during the short period in which a whale-fishery was attempted in that bay (which is almost totally covered with ice during six months of the year) that whales have been seen as late as the beginning of July, and it is particularly stated that in the year 1803, on the 11th of July, a young whale was captured near the Saitok Islands, situated in the innermost recesses of the bay. Between the 72nd and 73rd degree, finally, near the factory of Upernavik and the establishment “Pröven,” situated eight Danish miles further southwards, the whales make their appearance in autumn, considerably earlier than at the more southerly parts of the coast. They have regularly been observed there by the month of October, in some instances even at the end of September; they are then seen throughout November and some part of December, and again towards spring, from April until July. Whether they, during the intervening time, leave these latitudes to go further southwards or no, in other words, whether they visit Upernavik at two different times of the year, or really stay there from September till June, is a question still undecided, but the former alternative seems to be the most probable.

Upernavik (72° 48') is the most northerly Danish factory, and therefore the most northerly spot inhabited by Europeans on the western coast of Greenland. In order to obtain information about the appearance of the whale in Baffin's Bay, in a latitude still more northerly, we shall be obliged to have recourse to travellers who have visited those parts, both in former and in recent times. It will be seen, then, from the statements of such travellers, that the whale is met with in the most northerly part of Baffin's Bay, in the months of July and August, during which time it has disappeared from all parts of the coast along which the Danish factories are situated. Thus, we are told by Baffin¹ that many whales were observed by him in 1616, in the beginning of July, in Whale Sound and Sir Thomas Smith's Sound, consequently about the 78th degree; and in a letter to John Wostenholme, which Purchas has preserved,² he particularly points out this

¹ 'Purchas, his Pilgrimes,' part iii, p. 846.

² Loc. cit., p. 843.

fact, not admitting of any doubt, that the whales he had met with at the places mentioned, and in the recesses of Wostenholme Sound, situated a little more southwards, were of the same kind as those called by the Basques "Grand-Bay whales," which are caught near Spitzbergen, at that time called Greenland. In our days Sir John Ross,¹ on his voyage in the year 1818, found numerous whales at the end of July and in August (16th) between the 75th and 76th degrees of latitude.

The Greenland whale is thus, like other Cetaceans, a migratory animal. As shown by the account given above, it changes its station, according to the season, with perfect regularity; and in some cases even the same individuals have been observed to return annually to the same bays and fiords. Thus, on the 4th of January, 1817, a whale was caught in the Fiord of Amertlok which had frequently been hunted in the preceding year, being readily identified by the loss of a piece of its tail and the growth of a large excrescence from the injured place; and on the 15th of May, 1837, an English whale-fisher caught a whale near Kangarsuk (about a mile from Godhavn) in which was found a piece of the same harpoon by which it had been struck by one of the harpooners of the Danish factory, on the 26th February, 1833. In perfect conformity with the laws of the migrations of polar animals in general, the whale approaches nearest to the Pole in the summer, and it appears in the winter near shores where it is never seen at milder times of the year. During the short polar summer it has been met with as far towards the north, in Baffin's Bay, as the polar expeditions have succeeded in penetrating, while its southward range, in winter time, is always limited by rather a northerly degree of latitude. Thus, it can hardly be doubted but that the whale comes from the north or north-west to its winter stations; and though it has in one place been said that it comes from the south into the Fiord of Amertlok, near Holsteinsborg, this is evidently a mistake, which we should not even have taken the trouble to refute if the statement had not been made by an author² who, having stayed several years in Greenland, may be supposed to be well informed.

In different regions of the globe certain large cetaceous animals have been observed to approach the coast and to enter the bays, in order to bring forth their young ones, remaining as long as the latter are still in a tender condition. Thus, we are informed by Delalande that the Cape whale (*Balæna australis*, Desm.) repairs annually for this purpose to the bays on the south coast of the Cape country, between the 10th and 20th of June, and that it again departs at the end of August or beginning of September; but that very few, except females, approach the coast in this manner, so that there were only two males among some fifty whales observed by him.³ A similar account has since been received by Dr. J. E. Gray from Mr. Warwick, who stayed for some time near Falsebay during the season of whale-fishing, and among sixty whales only met with a single male.⁴ Of the appearance of the right-whale (*Balæna*

¹ 'A Voyage of Discovery in His Majesty's Ships Isabella and Alexander,' &c. Second edition, London, 1819, vol. i, pp. 88 and 154.

² Glahn, 'Forsøg til en Afhandling om Grønlandernes Skikke ved Hvalfiskeriet,' Nye Saml. af d. Kong. Norske Vid. Selsk., Skr. I, Kbhvn., 1784, p. 276.

³ 'Dictionnaire classique d'histoire naturelle,' t. ii, Paris, 1822, p. 159. Cuvier, F., 'De l'histoire naturelle des Cétacés,' Paris, 1836, p. 364.

⁴ 'Zoology of the Voyage of H.M.S. Erebus and Terror,' "Mammalia," parts iii—v, London, 1846, p. 15. 'Catalogue of the Specimens of Mammalia in the Collection of the British Museum,' part i, "Cetacea," London, 1850, p. 16.

antipodarum, Gray) near the shores of New Zealand (though now in very small numbers), we have similar accounts, it being said that scarcely any but females enter the bays.¹ The same seems to have been the case with the whale which, in the last century, was eagerly pursued along the east coast of North America, from Cape Cod to the Bermuda Islands.²

We have, further, a similar statement to the effect that fin-whales annually enter certain bays on the coast of Iceland with the greatest regularity, and it would not be difficult to add to these other instances of a like description.³

It might, therefore, readily be supposed that the visits of the Greenland whales to the Danish factories are also made for the purpose of breeding. In order to decide how far such a supposition is well founded, it will be first necessary to know at what season the whale gives birth to its young ones, and on this point we have a statement of Scoresby, not, however, founded on his own observation, pointing out the end of the summer as the time of sexual intercourse; at the same time, he presumes that it brings forth its young ones in February and March.⁴

This, however, does not quite agree with the observations made in Greenland. According to these, the intercourse takes place in January and February. Thus, it is reported from Godhavn, in the year 1780, that two whales were discovered *in copula* on the 13th of February; the administrator of the factory near Holsteinsborg states in his journal for the 3rd of January, 1819, that it was just then the time at which the sexual congress of the whales takes place, when they are so fierce as not to allow of their being approached, and on the 18th of the same month the same statement is repeated. Finally, Mr. Engholm, once the director of a factory, informs us that he has frequently observed the same circumstance in January and February. The time of bringing forth, too, does not seem to be so early in the year as stated by Scoresby. The cub preserved in brine by Major Fasting, and presented by him to the Royal Museum, about which we shall have to speak hereafter, was evidently only a few days old, and yet it had been caught on the 6th of May, near Godhavn; and on the 29th of April, 1801, a whale was caught at the same place, having in it a fetus fifteen feet long, and perfectly full grown. Instances, however, of an earlier birth have been observed. Thus, on the 18th of March, 1807, a whale was discovered with a new-born cub, near Dogs' Island, at the mouth of Disco Bay; the cub was killed, and found to be no bigger than a beluga (*Delphinus Leucas*, Pall.), consequently only a few days old. According to these observations the supposition seems to be well founded that the time of bringing forth of whales is between the end of March and the beginning of May, and is not, as Scoresby presumes, in February and March; and the time of gestation seems rather to be thirteen or fourteen months than eight or nine,⁵ so that the female will bring forth

¹ Dieffenbach, G., 'Travels in New Zealand,' vol. i, London, 1843, p. 44, seq.

² 'Philosophical Transactions,' vol. xxxiii (1724-25), No. 387, Paul Dudley, "An Essay upon the Natural History of Whales," p. 256.

³ According to the information which Scoresby obtained from a South Sea whaler, the Bay of Coquimbo, in Chili, was also during some years, in the beginning of this century, visited by female right-whales desirous of bringing forth their young ones undisturbed ('Acc. of the Arct. Reg.,' ii, 530).

⁴ 'Acc. of the Arct. Reg.,' i, 470. "The sexual intercourse of whales is often observed about the latter end of summer." . . . "The time of their bringing forth, it is presumed, is in February or March."

⁵ F. Debell Bennett, from the annual visits of the Cape right-whale to the bays on the south coast of Africa, has ventured on a conclusion that the time of gestation of this species does not exceed

only every other year. Now, if, from these considerations regarding the time of gestation and bringing forth of the whales, we return to the question by which they were called forth, they will seem to imply that the visits of the whale to the coast of Greenland and its fiords and bays can scarcely be supposed to be made for the purpose of breeding; for, on the one hand, this would not explain why the whale appears at its southernmost stations, Sukkertoppen and Holsteinsborg, which it leaves before the time of breeding is over; and, on the other, it might be expected, upon this supposition, that its stay would everywhere be of equal duration and contemporaneous; but such, we have seen, is not the case. Besides, in Greenland it has not been observed that the number of females approaching the coast was out of proportion to that of the males, which, as we saw before, was the case with the Cape and New Zealand right-whale. There are, then, no sufficient grounds to state that the wanderings of the Greenland whale in Baffin's Bay, and especially along the coast of Greenland, take place for the purpose of breeding. Nor do these migrations along the coast seem to be undertaken for the purpose of obtaining a supply of food, for no observations have shown that the opossum shrimps (*Mysis*) and other small crustaceans, which, with the limacines, form the nutriment of the whales, are found more abundantly in the Greenland sea at one season than at another. On the other hand, it is not difficult to point out a connection between the wanderings of the whale and the state of the climate, or, more particularly, the motion and drift of the ice in Baffin's Bay; for all observations prove the Greenland whale to be closely and inseparably associated with the ice; nor does it only, while staying near the coast, prefer the water filled with drift ice, or roam along the icy masses edging the coast, crowding in holes and openings of the ice, but its arrival at the coast is in the most remarkable manner contemporaneous with the arrival of those huge masses of drifting ice which, issuing from the northern and north-western part of Baffin's Bay, are known in Greenland by the name of the "west-ice." This is an opinion most frequently borne out by the statements of those who have had an opportunity of observing the life of the whale, and the correctness of which is most strikingly evinced by the examination of the journals kept in the various factories for a considerable length of time, for in these the day is frequently mentioned on which the west-ice had arrived near the coast, or at least became visible from it, and in almost all such cases it will be found that a few days after, if not quite contemporaneously with the appearance of the ice, the first whales have been observed. It is, however, only the smaller part of the drifting ice in Baffin's Bay which is carried over to the coast of Greenland; the chief masses, on the contrary, in drifting follow the opposite coast, and even that part of the west-ice which really reaches Greenland is only scattered along part of the coast of this country. But in this respect we shall also find a remarkable correspondence between the range of the west-ice and that of the whale. For it is principally near the outlet of Disco Bay and the districts belonging to the factory of Egedesminde that the west-ice comes nearest to the coast, and from that place it is scattered downwards to Holsteinsborg and Sukkertoppen.

Further southward the sea is almost free from ice along the coast, even when the winter is far advanced. For the "storiis" (large ice), as it is called, which in February or March comes

twelve months, but he does not prove that it is the same individuals which are annually seen with cubs; and about the time of sexual intercourse he gives us no information. (Vide 'Narrative of a Whaling Voyage round the Globe,' London, 1840, vol. ii, p. 230.)

in enormous masses round the south point of Greenland from the east into Davis Strait, certainly follows the shore upwards as far as the factory of Frederikshaab (62°); but it is generally scattered and carried away before the current takes it further northwards, so that it is seldom seen, even at Godthaab.¹ Thus, we can hardly be mistaken when we see more than a mere accident in this correspondence between the range of the west-ice and that of the Greenland whale. The predilection of the whale for the ice and the waters filled with ice-floes seems to make it perfectly clear why, in its southward migrations at the advance of winter, it never extends its wanderings to the part of the sea south of Sukkertoppen, which is almost always free from ice. Nor is it difficult to point out the reason why, in the very high latitudes near the Pole, it leaves its summer stations towards the close of autumn; for in the winter it would eventually run the risk of being suffocated beneath the huge coherent masses of ice which, at this season of the year, cover the greater part of the polar sea and the northern part of Baffin's Bay. Even in its more southerly winter stations it seems now and then to meet with such a fate, for in a manuscript account by Mr. Geelmuyden of an expedition to Greenland, in the year 1750, on board the *Jubelfesten*,² of which he was the supercargo, we find a statement that in that year the masses of ice in Disco Bay were uncommonly large, staying there until the year was far advanced; that the fishing, therefore, generally speaking, had been very bad, but that the Greenlanders had been fortunate enough near the Dogs' and Whales' Islands, at the outlet of Disco Bay, to find no less than fourteen whales, "som af sig selv under Isen har maattet crepere" (which had perished by themselves beneath the ice), which words can scarcely be interpreted in any other way but that these whales had lost themselves beneath the solid masses of ice covering the bay, and had been suffocated, or, as it were, drowned there.

The statements given above show us the strict regularity with which the whale appears along the western coast of Greenland. But at the same time another question—whether its range has formerly been greater—seems at any rate partially to have been decided by them. For the two tables, as given above, stating the appearance and disappearance of the whale at Holsteinsborg and Godhavn, will show that the whale, at least eighty years ago, made its appearance exactly at the same places and at the same seasons as at present, and that not the slightest alteration has taken place in this respect. If we endeavour to ascertain how the case stood in times of still greater antiquity, it must be admitted that no such detailed accounts as we possess for the last eighty years can now be obtained; but, at the same time, we have a sufficient number of statements to prove that in the year 1721, when the first Danish missionaries began their work, the whale made its appearance at the coast at the same season as now; for this statement seems to be borne out, not only by the circumstance that no whaling establishments have ever been attempted near the southern factories, but also by the reports made by Egede, in reference to his endeavours to bring about a whale-fishery that might remunerate the trading company at Bergen, on which the mission, in the beginning, depended,³ and thus secure the subsistence of the enterprise. He states expressly that neither does the Greenland whale approach to the

¹ Rink, H., 'Grönland geogr. og statist beskrevet,' 2det Bind., Kbhvn., 1857, S. 122.

² It is to the late Dr. Pingel that we are indebted for the use of this as well as of other old papers relating to whale-fishery.

³ Egede, H., 'Relation om den Grönlandske Missions Begyndelse og Fortsættelse,' Kbhvn., 1738, 4to, pp. 48 and 95.

factory founded by him on a small island a little off the present factory of Godthaab, nor further to the south; and, besides, it is seen by a passage in his journal that the Greenlanders from the southernmost part of the country at that time not unfrequently undertook long journeys northwards for the purpose of whaling, which of course would have been unnecessary if the whale had been to be met with near the place of their abode.¹ It is true that Egede, on asking, was informed that whales were to be found near the Pissubik Islands, about seven miles north of his dwelling-place, but those whom he on that account sent thither brought back the intelligence that only humpbacks (“Krepokaks,” *Megaptera boops*, Fbr.), at that time, as at present, were in the habit of visiting these islands.² As Egede would not believe this discomfiting news, he went to the place himself on the 8th of November, 1723, but was forced to acknowledge that the information given him was true. Yet his journey was not quite in vain, for on that occasion he was informed, on good authority, that the Greenland whale, or, as he expresses himself, “de store Hvale af den rette Sort, som har store Barder” (the large whales of the right sort, having large whalebone), must be sought for about eight days’ journey further northwards, near the small island of Nepisene (two or three miles south of the factory of Holsteinsborg), where the Greenlanders used to catch them during the winter, in the months of February and March;³ exactly the place where afterwards one of the most important establishments of whale-fishing was founded, near the Fiords of Nepisene and Amertlok, the only one still remaining on the coast.

But when once it has been settled that at the time of Egede the whale was not to be found beyond its present southern limits, no further proofs are needed that in times of greater antiquity the whale did not transgress those limits, and that its range in the sea along the west coast of Greenland has never been different from the present; for it was not until the year 1719 that the European nations, and more especially the Dutch, began regularly, every year, to send a part of their whaling vessels into Davis Strait.⁴ The whale-fishery of the Greenlanders themselves being too insignificant to be taken into account, the whales had, until the arrival of Egede, been almost undisturbed in the sea at present under consideration. Supposing it even to be true that the whale, by constant persecution, might be chased further northwards, yet nothing of the kind has taken place here, and thus the only grounds are taken away on which a supposition might be founded that the range of the whale’s visits along the coast in question had been altered. Having, however, been brought into a regular train in this sea, the whale-fishery has been carried on with great eagerness until the latest time. During a long series of years Davis Strait and Disco Bay have been the principal places of resort of the whalers, and in the course of fifty-nine years (from 1719 until 1778) the Dutch alone caught 6986 whales in these places.⁵ It is true that the political changes occasioned by the French Revolution at the close of the last century put a stop to the Dutch whale-fishing trade, but, at the same time, the English began to carry on a brisker trade, which they extended, from 1817, to the most northerly part of Baffin’s Bay as well as to Lancaster and Barrow Straits, the old fishing-places having begun to yield smaller profits. During four years only, from 1827 to 1830,

¹ *Loc. cit.*, p. 98.

² *Loc. cit.*, p. 121.

³ *Loc. cit.*, p. 122.

⁴ Scoresby, W., ‘An Account of the Arctic Regions,’ vol. ii, p. 64.

⁵ De Jong, Kobel, Salieth, ‘De Walvischvangst, met veele Byzonderheden daartoe betrekkelyk. Tweede Deel,’ p. 113, seq.

3391 whales¹ were caught, and the persecution was carried on with great success and very extensively, until the profits, some twenty years ago, began to diminish, and the fishing trade gradually to dwindle away, until it reached its present comparatively unimportant state. Not less in Davis Strait and in Baffin's Bay than in the sea between Spitzbergen and Greenland has the whale been pursued; and if we now ask what influence this violent war of extermination, continued during more than a century, has had upon it, the answer has already been given above; for we have seen that the whale, until this day, appears within precisely the same limits in which it was found at the beginning of the persecution,² but in numbers so diminished that the fishing, at least in the ordinary method and with the whaling-vessels hitherto used, will hardly repay the trouble and expenses attending it.³

Finally, to close this sketch of the appearance of the whale along the western coast of Greenland, by a short statement of the most essential results that may be derived from it, we consider it to be proved, beyond doubt—(1) that the Greenland whale is a migratory animal, penetrating furthest to the south in winter time, although it does not, even at that season, leave that part of the sea which is filled with drift ice, and more or less closed by great masses of ice; and (2) that the numbers of the whales cannot but have been diminished along the coast mentioned by the whaling expeditions, *the original range of the whale, at the same time, remaining perfectly unaltered*. It must, however, be allowed, that the continued persecutions have made the whale, naturally a timid animal, so shy that it will no longer allow the boats to approach it, but that, as soon as it perceives them, it seeks a hiding-place beneath the floes or the solid cover of ice.

As regards the appearance of the whale in the remaining part of its extensive range no such complete information can be obtained as that derived from Greenland. As we have already mentioned, our information upon this subject can only be obtained from whalers and accounts of polar expeditions. But fortunately the latter, if not so detailed as we might wish, are still sufficient to show that the laws regulating the appearance of the whale in Baffin's Bay, along the western coast of Greenland, are essentially the same as those that regulate its appearance and movements in the remaining part of its native seas.

Some exceptions, however, must be made. We have already seen that the whale instinctively keeps close to the ice, whether it be the solid ice or great masses of drifting ice and ice-floes, and that not even during the coldest time of winter does it allow itself to be driven from the waters filled with ice. It is therefore not to be expected that the southward range of the whale should everywhere be limited by the same degree of latitude; we should rather be inclined to suppose that it would follow pretty nearly the undulating

¹ Leslie, Jameson, and Murray, 'Narrative of Discovery and Adventure in the Polar Seas and Regions,' &c., third edit., Edinburgh, 1832, p. 419.

² Between the years 1849 and 1851 six whales were caught near Holsteinsborg; during the next three years none were caught, but again, in the years 1855 and 1856 three, and in 1858 four, were killed.

³ Recently, as is well known, the English have tried to employ screw-steamers for whaling, and to unite this trade with that of seal-hunting. This year several such steamers have been fitted out; it must therefore be supposed that the earlier attempts have been remunerative. But the whale-fishing trade can hardly rise to any considerable height in Baffin's Bay or the sea round Spitzbergen.

line, changing according to the seasons, which defines the southward limits of the polar ice. And such, in fact, will be found to be the case. Even in Davis Strait and Baffin's Bay the range of the whale is not limited by the same degree of latitude along the coast of America as along the coast of Greenland. Thus, while the whale does not commonly appear at the latter coast south of the factory of Sukkertoppen ($65^{\circ} 25'$), it is a well-known fact that on the opposite side of Davis Strait it is to be met with early in the spring, under a more southern degree of latitude, along the northern part of the coast of Labrador, and near the outlet of Hudson's Strait (61° — 62°), where the English, during the prosperous state of the whale-fishery, carried on the south-west fishing, so well known for its dangers and hardships, especially in the sea situated eastward of Resolution Island. Not only does the whale advance a little further south along this side of Davis Strait, but it seems also to remain at this station for some time after it has disappeared from the southernmost stations along the Greenland coast; for the whalers, while the south-west fishing was carried on, used to be at the fishing-places, near Resolution Island, by the beginning of April, and did not usually leave them until the first or second week of June.¹ Nay, we are told by Scoresby that on this station² whales have been caught even so late as in July; and it was on the 28th of June, at about an equal distance from Resolution Island and Cape Walsingham, that Parry discovered the first Greenland whale which he met with on his first voyage in 1819.³ But Scoresby particularly points out the fact that it was only where the ice was still found that he had met with whales; and Parry, too, met the whale just mentioned while his ship was struggling with large floes of ice filling the middle of Davis Strait. Thus, in these cases also the whale proves true to its natural habit of remaining among the floes and near the solid ice; and the difference of its southward migration along the opposite shores of Davis Strait may be explained by the fact that the greater part of the west-ice, or the enormous masses of drifting ice which are carried from the northern and north-western parts of Baffin's Bay down Davis Strait, and which, as we have seen, are closely followed by the whale, when they arrive at the coast of Greenland, not only keep closest to the western side of the strait, but are also driven considerably further southwards along this coast than on the opposite side.

Nor does the period of the whale's stay along both sides of the strait agree more exactly in the northern than in the southern part of the strait. Thus, Parry, in his account of his first voyage, tells us that, on returning home in the beginning of September, he met with some whalers fishing at about 71° , and, more particularly, that on the 5th of September, in the outlet of the River Clyde ($70^{\circ} 30'$), he found more than a dozen large whales, and a whaler from Hull, the *Friendship*, having a fish at its side.⁴ Again, on the 9th of September, he saw several young whales about latitude $69^{\circ} 24'$,⁵ and while the whale-fishery was prosperous in the north part of Baffin's Bay English whalers used always on their return from Barrow Straits and Lancaster Sound to seek the whales along the west coast of Baffin's Bay, if they had not got a full cargo under more northerly degrees of latitude. Ponds Bay (c. 73°), Agnes' Monument

¹ Parry, W. E., 'Journal of a Voyage for the Discovery of a North-west Passage,' &c., London, 1821, 4to, p. 302. Scoresby, W., 'An Account of the Arctic Regions,' ii, 387.

² 'An Account,' &c., ii, 388.

³ 'Journal of a Voyage,' &c., p. 9.

⁴ Loc. cit., pp. 274—276.

⁵ Loc. cit., p. 290.

(c. 70° 30'), and Home Bay (between the 68th and 69th degrees), were their chief stations, and they continued to fish there through the whole month of September and even late in October;¹ that is to say, at a time when in Disco Bay opposite and along the corresponding coast of Greenland not a single whale is to be seen. But in all these cases, also, the whales have kept close to the ice, which is still, at the season indicated, to be found in great quantities along the west coast, while it has perfectly disappeared from Disco Bay. Finally, outside of Baffin's Bay itself, in Fury and Hecla Strait, between the peninsula of Melville and Cockburn's Land (69½°), Parry, on his second voyage, found the whale in the beginning of August, and ordered one to be caught on the 5th of that month;² but these waters, too, are at this time still filled with ice. Thus, while we admit that no certain conclusion can be made from the appearance of the whale along one side of Baffin's Bay, as to its appearance along the opposite coast, it will, at any rate, everywhere be found to be inseparable from the ice.

We have stated above that the whale, along the Labrador side of Davis Strait, comes down at least as far as the outlet of Hudson's Strait, to the 62nd and 61st degrees of latitude (Resolution Island); but is this the utmost limit of its range in these regions, or has it not, at least formerly, found its way considerably further southwards, even as far as the Gulf of St. Lawrence and the sea round Newfoundland? Such an idea has generally prevailed, and as the current takes immense masses of floating ice downwards along the whole coast of Labrador, and as the ice encloses the northern coast of Newfoundland as late as the beginning of May, it could not be said to be contrary to the nature of the whale if, on its winter migrations, it followed the coast of Labrador down to the latitude of Canada, and had a winter station near Newfoundland. In favour of this supposition, it has commonly and without reservation been alleged that a whale-fishery has been carried on in the Gulf of St. Lawrence, and near the coast of Newfoundland, long before Spitzbergen and Jan Mayen were discovered. The question, however, is not to be settled so easily, probable as it is that the whale really has roamed so far southward; for, on a closer examination of the particulars of the whale-fishery in the Gulf of St. Lawrence, it will be found that we can scarcely suppose that all the whales caught there were Greenland whales.

It must be remembered that, although it is true that Newfoundland, as early as the sixteenth century, was annually visited by hundreds of French, Basque, and English vessels, repairing thither partly to fish cod on the banks, but partly also for the purpose of killing seals and walrus or catching whales,³ yet the whole trade on the "Terres neuves," or "la Tierra de los Bacallaos," was carried on in summer. The vessels arrived at the beginning of the mild season, and stayed

¹ Leslie, Jameson, and Murray, 'Narrative of Discovery and Adventure in the Polar Seas and Regions,' &c., third edit., Edinburgh, 1832, p. 413, seq.

² Parry, W. E., 'Journal of a Second Voyage for the Discovery of a North-west Passage,' London, 1824, 4to, pp. 301.

³ Anthony Parkhurst, who, in the latter part of the sixteenth century, made several voyages to Newfoundland, has given in a letter to the celebrated Mr. R. Hakluyt, dated Bristol, the 13th of November, 1578, a statement of the average number of vessels which then annually repaired to this island and the neighbouring banks. According to his statement, there were about 50 English vessels, nearly as many Portuguese, 150 French, and 100 Spanish, besides 20 or 30 whaling-ships from Biscay. Comp. Hakluyt, 'Voyages, Navigations, Traffiques, and Discoveries of the English Nation,' London, 1600, vol. iii, p. 132.

there during the summer; and from this circumstance alone it will be seen that the whale must have remained in the Gulf of St. Lawrence long after the ice had disappeared. This is also expressly stated in accounts, still preserved, of several of these earlier voyages to Newfoundland and the coasts around the Gulf of St. Lawrence. Thus, we read in the account of Jaques Cartier's second voyage, in the year 1535, that the sailors, on the 18th of August, near Assumption Island (afterwards called by travellers Anticosti), saw more whales than they could remember ever having seen before.¹ In John Jane's description of John Davis's third voyage, 1587, we are told that the ship, on its return, met with a great many whales in the middle of August, about latitude 52°, near the coast of Labrador, which was still in sight on the 15th of August; and that on the 17th of the same month they met with a vessel beating against the wind, which they supposed to be a whaler from Biscay.² Still more precise are the statements in the description of a whaling expedition, on which the ship "Grace of Bristol" was sent in the year 1594. This whaler left Bristol on the 4th of April, and arrived at Newfoundland on the 20th of May, where it was lucky enough to find in St. George's Bay the wrecks of two large Biscayan whalers, from which were taken 700 or 800 pieces of whalebone, but it was not particularly fortunate in its own fishing, the people losing the whales harpooned. In the middle of June they went to the Island Naticotec (Anticosti), because they had heard that the whales which were wounded, and escaped their pursuers, were commonly, when dead, drifted ashore there; they, however, sought in vain for the whales which they had struck, and then sailed home again on the 24th of August.³ If, however, we need a witness from a more recent time, we may find one in Charlevoix, who both informs us that as many as fifty whales might be seen at once near the outlet of Mantane in the River St. Lawrence, and that he himself, in the month of August, 1705, at anchor off Tadousac, saw whales swimming round the vessel and coming so near to the boats that they might be reached by the oars;⁴ and furthermore, points it out as an advantage of the whale-fishery in the Gulf of St. Lawrence, that it takes place in the summer, and not in the winter.⁵

But we should at least hesitate before we conclude that the whale tumbling about the Gulf

¹ Marc Lescarbot, 'Histoire de la nouvelle France,' 4me ed., Paris, 1624, p. 285. In this place we read in Lescarbot, "*baillames*." Whether the same word is found in the oldest French text, which we have not been able to compare, and as to whether in that case it is to be considered as a provincialism, or merely as a slip of the pen, we shall advance no opinion. But it seems never to have been doubted that whales were meant by that word, for in the Italian text inserted in the work of Ramusio we read "*balene*," and in the English translation in Hakluyt's work we read "whales." See Ramusio, 'Delle Navigazioni et Viaggi,' volume terzo, p. 377, in the edition printed at Venice, 1606; and Hakluyt, 'Voyages, Navigations, &c.,' 3 vols. (London, 1600), p. 213.

² Hakluyt, 'Voyages, Navigations, &c.,' 3 vols. (London, 1600), p. 114.

³ 'The Voyage of the Grace of Bristol, of M. Rice Jones, a Barke of thirty-five Tunnes, vp into the Bay of Saint Laurence, to the North-west of Newfoundland, as farre as the Isle of Assumption or Naticotec, for the barbes or fynnes of Whales and traine Oyle, made by Siluester Wyet, shipmaster, of Bristol,' in Hakluyt, iii, p. 194.

⁴ Charlevoix, 'Histoire et description générale de la nouvelle France, avec le journal historique d'un voyage fait par ordre du Roi dans l'Amérique Septentrionale,' Paris, 1744, vol. i, p. 540.

⁵ Loc. cit. vol. ii, p. 394. ". . . la pêche (des Balcines) qui est d'autant plus aisée en cet endroit, qu'elle se fait pendant l'été et non pas en hyver."

of St. Lawrence, and along the shores of Newfoundland and Acadia, in the midst of summer, is the same species as the Greenland whale. We have seen that the latter, in Davis Strait, leaves winter stations even much more northerly before this season, in order to go still farther northwards; and it would be quite contrary to all that we know about its nature and manner of living if it regularly and constantly stayed in latitudes so southerly, at a season when the temperature both of the air and of the sea is much higher than that in which it is accustomed to live. Under these circumstances, it is the more important to collect every possible information about the appearance of the Newfoundland whale, in order to see if it really was the same as the Greenland whale. Unfortunately this information is scanty, especially as the old reports from the sixteenth century are quite silent in this respect; but in the description of the whales appearing along the coast of New England, published by Paul Dudley (perhaps the same who in Charlevoix's time was Governor-General of New England) in the 33rd vol. of the 'Philosophical Transactions,'¹ in a letter to the editor, we have a sketch of the "right- or whalebone-whale," in which it is described as a whale sixty or seventy feet long, without back fin, whose new-born cubs have a length of about twenty feet. The whale, when one year old, is called "shorthead;" when two years old, it is called "stunt," and afterwards "scullfish"; and the age of the latter, Dudley adds, can no longer be pointed out exactly, but can only be guessed at from the length of the whalebone, *which will sometimes attain a length of six or seven feet.* This important information about the length of the whalebone is confirmed by a similar but quite independent statement of later date. In a description of the Isles of Nantucket and Martha's Vineyard, by a Pennsylvania farmer, Mr. Hector St. John,² a short list of all the whales known to the Nantucket whalers is given, and in this is also enumerated "the right-whale," or, as it is also called "the seven-feet-bone," which is described as a whale sixty feet long, with whalebone seven feet long, and is said to be found frequently near the coast of the island. Now, the whalebone of this whale seems not only to have been much shorter than that of the Greenland whale, but also to be different in other respects; for it is stated by another author that the whalebone of those whales which, at the end of the last century, were caught near the coast of North America, was considered to be much inferior to that of the Greenland whale, as it was brittle and fragile³ when compared with the latter.

Thus, we have, in the part of the sea under consideration, a species of whale, a right-whale indeed, but a right-whale⁴ with whalebone comparatively short, from which it derived its name of "seven-feet-bone"⁵ and thus totally different from the Greenland whale; and if further proofs should be required of the existence of such a right-whale with short whalebone, in the

¹ "An Essay upon the Natural History of Whales," in 'Philosophical Transactions,' vol. xxxiii (1724, 1725), No. 387, p. 256.

² 'Letters from an American Farmer,' 8vo, London, 1782, p. 169.

³ Anderson, A., 'An Historical and Chronological Deduction of the Origin of Commerce,' &c., A.D. 1771. The quotations are second-hand from Scoresby, as we have not been able to examine the last two editions of this work, but only the first, which stops at the year 1763.

⁴ It is well known to the authors that attempts were also made to catch humpbacks (*Megaptera*) near the Bermuda Islands, in the seventeenth century (see 'Philosophical Transactions,' vol. i, 1665, 1666, No. 1, p. 132). But the usual fishing was for right-whales.

⁵ Hector St. John, 'Letters from an American Farmer,' p. 169.

northern part of the Atlantic, which in single cases may be found straying as far as Davis Strait, they may be obtained from old memoirs relating to the whale-fishery of the Danes in Greenland. In the abridged statement already quoted (p. 6) of a manuscript journal¹ which Jørgen Frederick Egede, a grandson of Greenland's apostle, Hans Egede, kept during the years 1780 to 1785, containing different statements relative to the whale-fishery,² established by him in the European fashion near Holsteinsborg, we find the following passage about a whale caught on the 23rd of March, 1782 :

“Denne var en liden men dog gammel Fisk; Hovedet forskjelligt fra andre Barde-Hvalers, havde kun 5 Fods længste Barder og 16—20 Fade hvid Spæk. Grønlanderne kaldte den en Osterboygds Fisk.”

(This was a small, yet an old fish, the head different from that of other whalebone-whales; had its longest whalebone only of five feet length, and sixteen or twenty casks of white blubber. It was called by the Greenlanders an east-coast whale.)

Such is the short statement found in the journal. We have, however, a more particular account of this case in some manuscript memoirs about a series of attempts, not very successful, made by the Danish Government, between the years 1775 and 1783, to carry on the whale-fishery along the west coast of Greenland by means of vessels wintering there. In some notes added to these memoirs, which, according to the authority of the late Dr. Pingel (certainly quite unexceptionable on this head), were written by the above-mentioned J. F. Egede's uncle, Bishop Paul Egede, and which, if such be the case, have not, indeed, like the passage quoted above, come to us from an eye-witness,³ but certainly from one who may be supposed to have been well informed; in these notes we find the following statement :

“Pontoppidan anfører udi hans Efterretninger om Hval- og Robbefangsten Pag. 56, at der udi Strat Davids gives ligesaa vel smaae og ulige Hvaler, som udi Spidsbergen. Det kan vel ikke nægtes, at der fanges smaae Hvaler i Strat Davids, men disse ere Unger af den store Bardehval, og ikke en særskilt Sort for sig selv. Vel sandt, at der om Vinteren 1782 blev fanget en Hval paa en 10—12 Cordeler Spæk og med 5 Fods længste Barder, men denne var den anden, som i 70 Aar var bleven fanget i Strat David og af Grønlanderne kaldtes en Osterboygds Hval; var og i Skabning forskjellig fra den rette og almindelige Hval, da den havde som en Pukkel bag i Nakken; dens Skind eller rettere Sværd, paa grønlandsk Mattak kaldet, var blaaeagtig, finere og tykkere end de rette Hvalers, der ere ganske sorte og hvide under Bugen. Barderne vare efter deres Længde langt tykkere end den almindelige Strat Davidske Bardehval, og kunde man af alle Dele see, at det var en gammel Hval, dog var dens Spæk finere og ei saa senerigt som en almindelig fuldvoxen Bardehval.”

¹ As we have stated already, we are indebted to the late Dr. Pingel, member of the Danish Royal Society, for the loan of this journal, as also for another and not unimportant document, which will be mentioned afterwards.

² Formerly the Greenlanders' national method of fishing was adopted in the Danish factories. Harpoons to which a sealskin, inflated like a bladder, had been fastened by means of a thong, were employed, which the whale was forced to draw with it in its downward course to the bottom of the sea after having been harpooned.

³ Bishop Paul Egede arrived in Denmark, from Greenland, in the year 1740, and from that time until his death (1789) he lived at Copenhagen.

(Pontoppidan, in his information about the capture of whales and seals, page 56, tells us, that in Davis Strait, as well as near Spitzbergen, small and unequal whales are found. Now, it is true that small whales are sometimes caught in Davis Strait, but they are cubs of the great whalebone whale, and not of different species. One whale, however, was caught in the winter 1782, containing ten or twelve "cordels"¹ of blubber, and whose greatest whalebone had a length of five feet; but this was only the second that had been caught during seventy years, and it was called by the Greenlanders an east-coast whale. Then, it was also different in the shape of its body from the right or common whale, having, as it were, a hump on its neck behind; its skin, in Greenland called "mattak," was bluish, and smoother and thicker than that of the whales of the right sort, which are quite black, and white about the belly. The whalebone was, in proportion to its length, much thicker than that of the common whalebone-whale of Davis Strait, and from all its parts it was easy to see that it was an old whale, yet its blubber was more tender, and not so tendinous as that of a common full-grown whalebone-whale.)

What the Greenlanders meant by calling this whale an east-coast whale will, we think, be very difficult to explain, this name being only a translation, more or less exact, of a Greenlandic word not given by the narrators, nor is this question of any great consequence; but what particularly attracts our attention is that, in the case here narrated, we have another proof of the existence of a right-whale in the north of the Atlantic, easily to be distinguished from the Greenland whale by its smaller quantity of blubber, perhaps also by a different colour, but especially by much shorter whalebone, and, accordingly, a great difference in the shape of the head; and it can hardly be doubted but that we are right in supposing that this whale, whose appearance in Davis Strait is quite an *exception* to the general rule, was the same as the right-whale from Newfoundland and New England mentioned by Dudley and Hector St. John. We shall afterwards revert to this right-whale with short whalebone, of which we have been able to gather much information in works of modern and ancient date; but for the present it will be sufficient to have shown its existence, and we shall now return to the question that occasioned this digression, the question about the limits of the southward range of the Greenland right-whale.

We have seen that a right-whale, totally different from the Greenland whale, and certainly known to have been caught at different times by the immigrated population of New England, has been, and we suppose may still be,² living in the sea along the shores of Acadia and New England, and, no doubt, also near the adjoining shores of Newfoundland. It is almost impossible, but that the Basques must have known it, and met with it on their navigations to Newfoundland in the beginning of the sixteenth century, and it is probable that it was this whale with short whalebone which they used to fish in the sea around this island. For although we are told by Dudley that the proper time for catching it near the coast of New England is from the

¹ The old Dutch whale-fishers used to call the tuns or casks in which the blubber was placed "Cordeel" or "Kardeel." They contained sixty-four gallons each.

² In the Map No. 1 of Series F, of the 'Whale Chart of the World,' compiled by Captain Maury, from a large number of ships' logs, and representing North America, with both the adjoining oceans, down to 20° north latitude and from 1° to 180° west longitude, it is stated that right-whales have been commonly met with in the Atlantic from 35° up to 45° of latitude between the months of May and October.

beginning of the year until the end of May,¹ yet we venture to suppose that it might have remained somewhat longer in the Gulf of St. Lawrence than a little further southwards, and, at all events, this whale, belonging to a temperate sea, is more likely to have stayed in this part during the summer months than an ice-whale, as the Greenland whale may be said to be. This is rendered the more probable since, from Belon's descriptions of the whalebone, we are led to suppose that the enormous whalebone of the Greenland whale, during the first twenty or thirty years after the commencement of the navigation to Newfoundland, was totally unknown, even though other whalebone was already a common and well-known article of merchandise.² For this author, though still misguided by the erroneous statements, descended to us from Pliny, as to the nature of the whalebone, gives a very good description of its appearance, stating its length to be eight feet, and its breadth to be one foot and a half. Now, it is true that Belon, in thus describing the whalebone, states it to be somewhat longer than it is said by other authors to be in this short-bone whale from the coasts of New England, yet the difference is not very great, and, at all events, his measure would appear to be still less applicable to the Greenland whale. It is a rare thing for an author to make the extraordinary and gigantic objects of his description less great and remarkable than they really are, and Belon, had he known the ten- or fifteen-feet-long whalebone of the Greenland whale, would scarcely have described them as only eight feet long. Besides, the breadth, as stated by Belon, is as little applicable to the whalebone of the Greenland whale as the length, and thus the difficulty is not to be removed by the supposition that the whalebone seen by him may have been that of whales not full grown; for the longest blades of whalebone of the Greenland whale never attain the breadth of one foot and a half; even when eleven or twelve feet long (three or four feet longer than those described by Belon) they are only ten inches broad.

The existence, however, of a right-whale, with comparatively short whalebone, in the sea round Newfoundland, does not, of course, preclude the appearance of the Greenland whale in the same sea. The ranges of these two species may have been contiguous in this place, and certainly various statements may be alleged to bear out the supposition that the Greenland whale must also have been caught near Newfoundland, although they give little information as to the details of the cases.

Thus, Mr. Hector St. John, already mentioned, informs us that the Nantucket whalers, besides

¹ 'Philosophical Transactions,' vol. xxxiii (1724-25), No. 387, p. 263.

² In his book 'De Aquatilibus' (1553), he says that the whalebone is a sort of instrument by means of which the whale finds its way in the sea. The following are his words:—"Prætenturas ante oculos habet (sc. balaena), ab id appellatas, quod his sibi prætendat iter" (loc. cit., p. 5). In the French text of the same work, 'La Nature et Diversité des Poissons' (Paris, 1555), he still states this opinion to be generally adopted, but he is himself inclined to believe the whalebone to be the eyebrows of the whale. His words are:—"Ce qu'on appelle la coste de Balene, dont les dames font aujourd'hui leur bustes, et arrondissent leur verdagages, et que les bedeaux d'aucunes eglises portent en guises de baguettes, ce sont certaines pieces coupees et tirees de ce qui sert de sourcilz a la Balene, et lui couvre les yeulx, et est garnie d'un certain poil fort long aux extremités; c'est ce que les Latins appellent Prætenturas, et qu'ilz disent luy servir de mire et conduite dedans l'eau" (loc. cit., p. 5). The origin of these strange errors (also to be met with in Albertus Magnus, in his 'Opus de Animalibus,' Mantua, 1479, liber xxiii; "De natura natatiliū," fol. cclxxxvii) is, as we have said, to be found in Pliny (lib. ix, sect. lxxxviii, Agasson de Grandsagne's ed., p. 204).

that whale properly so called, also know another and larger one, with whalebone twelve feet in length, and found in the River St. Lawrence. That in this passage he is speaking of the Greenland whale is evident enough; yet, if this statement stood alone and by itself, he might be supposed to be mistaken as to the locality, but we can hardly doubt it now, corroborated as it is by other and much older statements given in Purchas' well-known work, his 'Pilgrimes,' to which we shall here direct the attention of our readers. The first statement is to be found in the instructions¹ given by the English Muscovy Company to Thomas Edge, when, in 1611, he was sent on the first whaling expedition which, after the discovery of Spitzbergen, departed for that island. In these instructions a review of all the different sorts of whales, which had been collected from the best sources,² had been inserted for his information, and in the first two species of whales thus mentioned, namely, "The Bearded Whale" and the "Sarda," we easily recognise two right-whales, and the first, largest and best, is the Greenland whale; the other, a smaller species, whose whalebone was only six feet long, is most likely the one with which we have become acquainted in the preceding statements. The amount of train oil and whalebone to be got from the Bearded Whale is accurately stated, and thus it is clear that even before the discovery of Spitzbergen this animal must have been well known to the whalers, who used to hunt it as well as the Sarda; but in this place nothing is stated about the region in which this hunt had formerly taken place. But on this subject we are enlightened by an account of the ten voyages made by Mr. Edge himself to Spitzbergen, in the service of the company mentioned above, written by himself, and printed in the work of Purchas, for in this account we also find a description of the different whales, essentially, indeed, a repetition of the one given in his instructions, in which, however, he has made a few alterations; thus, he no longer calls the whale first mentioned the bearded whale, but the "Grand Bay" whale, and to the description formerly given he adds the information that it received its name from "*Grand Bay, in Newfoundland, as having there been first killed.*"³ Mr. Edge is likely to have obtained this information from the Biscayan harpooners whom he brought with him at least on his first voyage, and who may certainly be supposed to be trustworthy authorities as to the origin of that name, and to have been perfectly able to decide whether the whale known to them by the appellation the "Grand Bay" was the same which they found again near Spitzbergen. But, moreover, it can also be proved in another way both that the Basques, before they found the way to Spitzbergen, also knew, besides the Sarda, another right-whale, to which they gave the name of the Grand Bay whale, and that this was the same which afterwards was caught near this island. For in the letter, already quoted, which Baffin after his voyage in 1616, wrote to John Wolstenholme, one of those at whose expense the expedition had been undertaken, he states expressly that the whales found by him in such great numbers in Whale Sound, Wolstenholme Sound, and other bays, were of that kind *which the Basques call Grand Bay whales, and which are caught near Greenland (or Spitzbergen)*, and he adds, that he is sure that he was not mistaken as to what kind of whale it was, having been twice at Spitzbergen, and knowing the whale found there very well.⁴ Finally, before we leave this question of the appearance of the Greenland whale near Newfoundland, we shall add a communication

¹ 'Purchas, his Pilgrimes,' part iii (London, 1625), p. 709, 710.

² Loc. cit.—"as we have gathered the same by information from men of excellencie in that business."

³ Loc. cit., p. 471.

⁴ Purchas, iii, p. 843.

which one of the authors (Eschricht) has received from Professor Geffroy, at Bourdeaux. In a manuscript essay about the discovery of Newfoundland, composed in 1710, and kept in the archives of the town of Pau, we read that the Basques found a whale in the sea near the Bank of Newfoundland different from that which they knew on their own shores (the *Sarda*), and which they called "*Sardaco-Baleac*," because it moved in flocks.¹

According to these statements, it can scarcely be doubted that the Greenland whales formerly appeared near the coast of Newfoundland; it is therefore likely to be still found there now and then, although we have met with no certain statement to that effect;² but that it has appeared there in numbers in our time is, at all events, contradicted by the fact that the whalers had their southernmost fishing-place two degrees more northerly, near Resolution Island. It is not shown by the above statements at what season of the year the Greenland whale was to be found near Newfoundland; but, from what we otherwise know of its nature and habits, we cannot but suppose that it must have been only at the season when the coasts of Newfoundland are encircled by ice, and that the right-whales, roaming in the bays and the surrounding sea when summer was far advanced, and caught at this season by the ancient whalers in the beginning of the fifteenth century, belonged to the short-bone species.

Supposing this to be the case, it would be easy to explain how it was that the Basques did not become acquainted with the Greenland whale in the years immediately following the discovery of *Tierra de los Bacalao*s, but not till the navigation to this island and the surrounding countries had greatly increased, or perhaps not till attempts at founding settlements had already taken

¹ The whole passage referred to is, according to the copy of the essay so kindly transmitted to us, to the following effect:—"L'usage des compas de route et celui de la balestrille ne fut pas plutot connu, que les Basques, excités par le lucre de cette pêche, s'embarquèrent sur des navires pour chercher le repaire de ces animaux, et ayant connus par expérience qu'étant venus de chez eux faisant la route à l'ouest et ayant trouvé de plus en plus de baleines à mesures qu'ils avançaient sur cette route, ils la choisirent pour diriger leurs poursuites, et arrivèrent ainsi au banc de Terre-Neuve où ils en trouvèrent par troupes et comme l'espèce qu'ils y trouvèrent était différente de celle qu'ils voyaient sur leurs côtes, pour la distinguer ils la nommèrent "*Sardaco Baléac*," qui en leur langue signifie Baleines de troupe."

² It is true that Blasius tells us, in his '*Naturgeschichte der Säugethiere Deutschlands*,' p. 539, that as late as October, 1833, a Greenland whale appeared in the River St. Lawrence as far from the mouth of the river as Montreal, but it is not improbable that this statement (in which, by the way, the year 1833 is given instead of 1823) may prove to be erroneous. It is borrowed from F. Cuvier, who, on the authority of the '*Edinburgh Philosophical Journal*' for 1824, gives this case as a proof of the fact that "*les baleines*," as well as "*les dauphins ou les marsouins*," may live in fresh water ('*De l'Hist. nat. de Cétacés*,' p. 391). But that this "*baleine*" was a Greenland whale, or even a right-whale, M. Cuvier does not say, nor is such a supposition in any way borne out by the original statement, which runs thus:—"Habits of the Whale.—In October last a whale appeared in the river St. Lawrence, as high up as the city of Montreal. The animal was pursued by a number of boats, and was at last taken at Boucherville, a distance of nine miles from town. It was exhibited at Montreal, then towed for exhibition to Quebec. This animal must have come from the Whale Bank off Newfoundland, which is the nearest place where whales are generally found, and have wandered at least 1000 miles in a straight line up the gulf and river before it was taken, 350 or 400 of which must have been fresh water." '*Edinb. Phil. Journ.*,' 1824, April—October, p. 220. [It was probably a Beluga or White Whale (*Beluga leucas*) a species common in the Gulf of St. Lawrence.—W. H. F.]

place; and that, during the first twenty or thirty years, they had only caught the species of whale repairing there in summer time. Perhaps the Greenland whale may never have done anything further than just roam down along the coast of Labrador to the north side of Newfoundland and into the Belle Isle Strait. Something of the kind might seem to be implied by the name, "Grand Bay" whale, given to it, according to Edge and Baffin, by the Basques; for by Grand Bay they understood the south-western, somewhat broader, part of the Belle Isle Strait; and as the bays on the south side of Newfoundland, and especially Placentia Bay, as well as the Belle Isle Strait, from the very earliest time, when the trade on "les Terresneuves" commenced, were fishing-places frequented by great numbers of vessels, it would seem strange, indeed, that the Basques should have denominated the whale by the name of that single bay, had they not wanted by this name to point out the fact that it was not found everywhere in the sea round Newfoundland, but only appeared along the north coast and in the strait mentioned.

If from Baffin's Bay and Davis Strait we now turn to the sea between Greenland and Spitzbergen, it must be considered as a matter of fact that the right-whales which were to be found here at the beginning of every summer, the "eilandsche Walvissch," or "Westys-Vissch," of the ancient Dutch whalers, were of the same kind as the whale of Davis Strait. Their way of living was in every respect the same as that of the latter; for the Spitzbergen whale also, has, ever since the beginning of the whale-fishing at that place, early in the seventeenth century, shown exactly the same inclination to stay near and among the ice, the same peaceable and indolent natural disposition, and the same propensity to a migratory life. Besides, the more ancient descriptions of the Spitzbergen whale agree very well with the whale from Davis Strait, and those parts of the skeleton, especially of the head, which we have received of the former are also quite like the same parts of the skeletons sent from the west coast of Greenland which will hereafter become the objects of our researches. Finally, it has been proved that it is the same whale that is found in Baffin's Bay and near Spitzbergen by those instances, often repeated, in which whales that have been unsuccessfully harpooned in Davis Strait have been killed near Spitzbergen or *vice versa*. Besides the instances of this mentioned by Scoresby,¹ two other such cases, from the year 1805, might be quoted. In one of these a whale was first unsuccessfully harpooned by Captain Franks, in Davis Strait, but, somewhat later in the same year, killed near Spitzbergen, by his son, who found his father's harpoon still sticking in it; in another case, Captain Sadler caught a whale in the last-named place in which the harpoon of an Esquimaux was fixed.² A third instance, which, if it can be completely depended upon, is deserving of particular mention, has been given by Paul Egede, namely, that the commander of a whaling expedition (1787) in Davis Strait found a whale drifting with a harpoon sticking in it, which he recognised as that of his brother, and which, on his return, he learned had been put into the whale near Spitzbergen only two days before he had found it dead in Davis Strait.³

A different question is, the possibility of several species having been confounded under the common appellation of Greenland whale; whether in the sea near Spitzbergen, besides the right-whale, also commonly found in Davis Strait and Baffin's Bay, one or even several other species

¹ 'Account,' i, pp. 10, 11.

² 'Quarterly Review,' vol. xviii, London, 1818, p. 212.

³ Paul Egede, 'Efterretninger om Grönland,' Kbhvn. 1788, s. 122, Anmærkn.

may occur, resembling each other, indeed, but forming different species. Such an opinion has often been put forth. Scoresby has pointed out that several tribes or families of whales dwell on different stations in the sea between Spitzbergen and Greenland, and choose different routes when leaving the region where they were first observed.

Nor is this to be wondered at, for within the wide range of the species the several individuals would, of course, have their separate homesteads, and would not wander about promiscuously anywhere throughout this extensive region. Scoresby, however, believes that he has seen differences between the tribes of whales appearing on different stations. In some cases he considers these differences as dependent on the age of the individuals; nor would this be improbable, supposing the young whales separated themselves from the older ones; but in other instances he is inclined to consider the shoals appearing at different places as different species or varieties. As the most essential distinction he points out a considerable variation in the proportions of the head and the body, the head making, in some individuals, a third part at least of the whole length of the whale; in others, on the contrary, only two sevenths.¹ Now this is certainly a great difference, and it might seem of more importance since the head of the young whale is, comparatively speaking, but little inferior in size to that of the full-grown animal, so that such a difference cannot be accounted for by the difference of age; but, on the other hand, Scoresby does not seem to have been aware of the fact, that the males have much larger heads than the females (as will be shown more distinctly in the second part of this essay), and therefore the difference pointed out by him loses much of its importance. Long before Scoresby's time a Dutchman of great experience, Zorgdrager, fancied that he saw a difference among the right-whales living in the sea near Spitzbergen, and he made a distinction between the "Westys-Vissch," properly speaking, also called "eilandsche Walvissch," and a "Zuidys-Vissch."² Many circumstances contributed to strengthen the opinion that the latter whales came from the east; in the first place they used to make their appearance especially in those years in which the "south-ice," as it was called, was very abundant, coming from the east and round the south coast of Spitzbergen; in the second place, when it finally disappeared, they returned in this direction; and thirdly, they were evidently strangers near Spitzbergen, and as fearless as the Spitzbergen whale, properly so called, had been at the commencement of the fishing in the beginning of the seventeenth century. Moreover, Zorgdrager thought that he observed that these south-ice whales had not such thick layers of blubber as the west-ice whale, that their blubber was softer, and more yellow and tender, so that the harpoons did not stick so fast in them as in the other species; and lastly, that their back was more even than that of the other. Of these peculiarities their eastward peregrinations only prove them to have been natives of other seas; their fearless confidence only shows that in their native seas they were not accustomed to the persecutions of whalers, and even the difference of the quantity and quality of blubber would hardly be sufficient to constitute a difference of species. Important as such peculiarities may be for the whalers, they prove nothing as to the south-ice whale's having a right to form a species by itself, and of characters that might seem important to the zoologist, Zorgdrager only mentions one, and that not very considerable, viz., the difference in the shape of the back.

¹ Scoresby, 'Account,' ii, 211, 212.

² Zorgdrager, 'Bloeyende Opkomst der Aloude en Hedendaagsche Groenlandsche Visscherey,' &c. Amsterdam; 1720; tweede Deel, v, xiii, xiv Hoofdstuk and derde Deel, i Hoofdstuk.

Now, this peculiarity is certainly very far from being decisive; yet we ought not, on the other hand, to leave it totally unregarded, especially as the existence of a species of whale very nearly resembling the Greenland whale, yet distinct from it, seems to be rendered, to a certain degree, probable by a pencil drawing of a fragment of the skull of a whale which Middendorf's fellow-traveller, during his journey in Siberia, found thrown up on the beach of the Okhotsk Sea; for this drawing, of which the celebrated traveller has been kind enough to send us a copy, seems to show that the skull was that of a whale, which, though certainly much more nearly related to the Greenland whale than to the common South-sea right-whales found in the Pacific, yet might perhaps be different from the former, at least if the drawing be correct.

Now, whether this south-ice fish of the ancient Dutch whalers was different from the west-ice fish or not, it is certain that the whale, quite at the beginning of the whale-fishery near Spitzbergen, four years after the second discovery of this island by Hudson, was as closely attached to the ice of the Polar Sea there as on the coast of Greenland, and that in that region also it changes its place according to the seasons. The physical condition of the district would not very well permit the whale-fishery to begin until the end of April or the beginning of May, but when the whalers reached the place at that time they found plenty of whales, which continued to stay there until the month of July, when they disappeared, and that frequently almost at once; no doubt because the enormous masses of ice that had been covering the sea at that time began to break, so that the way northwards and north-westwards became by that means opened to them. Even the ancient whalers knew very well that they could not hope to find the whale except in very high latitudes. Accordingly, they did not begin to distribute the crews to the different whalers' boats until they had reached the Polar circle; there they began to adjust the harpoons and the harpoon lines, to distribute lances, blubber-knives, and the rest of the fishing apparatus; in short, to make the ship ready for the commencement of the fishing;¹ besides, Zorgdrager not only repeatedly points out the fact that the ice-whales (for such is the significant name he gives to them) never leave the sea that is filled with ice, but at the same time he attempts to give a minute account of the reason of this peculiarity forming part of the nature of these whales, in opposition to another whale, "the Northcaper," which shuns the ice as much as the former seeks it. The coasts and bays of Spitzbergen and Jan Mayen were, as is generally known, the places where the fishing was first put in train; and later, when it was removed into the Arctic Sea itself, it was only carried on in the high latitudes, between 70° and 80°. Even Bäreneiland or Cherie Island, situated only a short distance southward of Spitzbergen, does not seem to have been visited by whales, at least not at the season when the whale-fishery took place. For Stephen Bennet and Jonas Poole, from 1603 to 1609, had undertaken seven voyages to this island to kill walruses, without ever thinking of attempting to fish whales; nay, whales are not even mentioned in the accounts of six of these voyages,² preserved in Purchas's work; while, on the other hand, the same Jonas Poole, on his Polar expedition in 1610, had no sooner visited Spitzbergen, and brought home the news of the great numbers of whales seen there, than the whale-fishery was commenced there the

¹ Martens, F., 'Spitzbergische Reise Beschreibung gathan im Jahr, 1671' (Hamburg, 1675), p. 2. Zorgdrager, C. G., 'Alte und neue Grönlandische Fischerei und Wallfischfang' (Leipzig, 1723), p. 411.

² 'Pilgrimes,' part iii, pp. 556—567.

very next year, and was carried on without interruption, until it attained a high state of development. At the same time it has been proved, by K. E. v. Baer,¹ that the whale has not been seen near the coasts of Nova Zembla. Generally speaking, in these seas the Greenland whale has kept itself more towards the north than has been the case more westwards in Davis Strait and Baffin's Bay. We know that it sometimes repairs to the north coast of Iceland, that is to say, to the same degree of latitude which it commonly reaches in its migrations along the west coast of Greenland; but farther eastwards we can only mention Jan Mayen and Spitzbergen as stations formerly visited by numbers of whales. This fact, however, when examined more closely, will appear to have nothing strange in it; it is, on the contrary, rendered perfectly intelligible by the considerable curve into which the line of the ice, or the spring limit of the solid ice, is bent towards the north just in this place, so that this limit directly south of Spitzbergen is as high as about 75° north latitude. Thus, in this place, as in Davis Strait, it is not so much the degree of latitude as the limit of the ice that is found to terminate the range of the whale, which appears, therefore, under exactly the same circumstances in both regions of the ocean. Single individuals may of course, notwithstanding this our general experience, have sometimes strayed beyond the usual limits, even as far as the coast of northern Europe. It would not be surprising that a Greenland whale should occasionally be stranded on the northern shores of Europe, this having happened four or five times to the narwhal, an animal as exclusively confined to the Polar region as the former. Yet we do not know even a single well-authenticated instance of such an occurrence. It is true that Th. Bell, on the authority of Dr. T. Barclay, has stated that emaciated Greenland whales have occasionally been stranded on Zetland,² but these statements are not accompanied by any particulars, and no part of the skeletons of these stranded whales, supposed to be Greenland whales, is known to have been preserved. Even if we could be certain that the animals stranded were right-whales and not fin-whales, it is by no means proved that they were Greenland whales; for we have seen that, near the coast of North America and in the temperate Atlantic, a right-whale has existed, and does still exist, quite different from the Greenland whale. Further proofs of the existence and appearance of such a whale, in the remaining part of the Northern Atlantic, will presently be adduced, and this species is certainly more likely to have been the one stranded in the case mentioned by Barclay than the Greenland whale.³

It thus follows that, as it is an essential part of the nature of the Greenland whale only to live in the very coldest seas, never to wander very far from the ice, and never to retreat before it but where its solid continuity makes it impossible to breathe, this whale must, at all times, have been the same Polar animal as in our days, and that it must always, and in all its individuals, however numerous they may have been, have lived just in the same way as it lives at present. All suppositions as to its having been chased up into these inhospitable seas by the persecutions of man are untenable, and the statements that Greenland whales have regularly made their

¹ Wiegmann's 'Arch. für Naturgeschichte,' vol. i, p. 168.

² Bell, Th., 'British Quadrupeds,' p. 518.

³ In the 'Zoology of the Voyage of H.M.S. Erebus and Terror,' Dr. Gray ("Mammalia," p. 47) states that a "Greenland whale" was stranded in the Bay of Caernarvon on the 4th of May, 1846, and towed into Liverpool. But, as subsequently shown by Dr. Gray, the animal proved, on closer examination, to be a fin-whale, *Physalus (Rorqualus) Boops*, Gray, Cat. Cetacea, Brit. Mus. 1850.

appearance in the iceless temperate Atlantic must be derived from confused or erroneous information. We cannot but suppose that the Greenland whale has lived in times of yore as well as now, summer and winter, close to the Polar ice, and that those right-whales said to have formerly repaired every winter to the Bay of Biscay, and afterwards caught in numbers in the sea south of Iceland, and between that island and Northern Norway, were not Greenland whales. The gradual disappearance of right-whales in all the northern iceless Atlantic cannot be accounted for by supposing that these animals have been pursued up into the Arctic Sea; it cannot even be explained by supposing a local extirpation of the individuals of the Greenland whale living most southwards, but it is only to be accounted for by an extirpation, more or less complete, of a Cetacean animal different from the Greenland whale.

In this case, the Greenland whale must, even as late as in the sixteenth century, have been perfectly unknown to all European nations, with the exception of the Norwegian settlers in Iceland, the most northerly coast of which is frequently reached by Polar ice, and in Greenland, where, though the whale can scarcely be supposed to have come down to that part of the east and west coast, in which they founded their settlements, the old Norwegians, at all events, had an opportunity of being acquainted with it on their frequent voyages in the summer, on which they reached the most northerly part of Baffin's Bay, and where they even visited the whaling stations, Lancaster Sound, and Barrow Strait, so celebrated in our days, which at least are supposed to have been meant by the name of *Krokksfjardarheidi*,¹ found in the old sagas. Thus, it is not in the authors of classic antiquity, nor in those of the Middle Ages, but rather in the old Icelandic writers, that we ought to search the most ancient information about the Greenland whale, and an abundance of information we may find in one of the most remarkable of these works, the celebrated "*Kongespeil*" (*Mirror of Royalty*) of the 12th century. It is true that the same authenticity, so willingly conceded to the rest of this interesting composition, has not generally been awarded to the description of the strange animals from the sea near Iceland, inserted into the '*Mirror*,' but it is quite an error to condemn this description as destitute of all worth and importance; and it is hardly too much to say that it is only from the present state of development attained by science that it can be justly appreciated.

The list of Cetaceans enumerated in the '*Mirror*' has been thought to be absurdly long, and accordingly exceptionable, and, most probably, some species are really to be found there under different denominations, and some of the creatures mentioned must unquestionably be considered merely as myths. But as this composition contains fewer traces of superstition than any similar writing of the same time, so it is, generally speaking, easy to distinguish the fabulous animals from those of which the description is founded on real observation. And herein consists the peculiar worth of the '*Mirror*,' that it is the first writing after Aristotle, and the only one of the middle ages, in which Cetaceans have been described from personal observation. That the '*Mirror*,' in its list of Cetaceans belonging to the most northerly seas, could enumerate many more species than are to be found either in the old classics or in authors belonging to the five or six centuries following, was partially the natural consequence of the fact that the authors really knew a much greater number of species than the others could be acquainted with. For, of the Cetaceans mentioned in the list of the '*Mirror*,' the Greenland whale is not the only one that continued an unknown animal to zoologists during several centuries; the same observation will hold good

¹ Rafn, '*Antiquitates Americanæ*,' p. 270 and 415—418.

even in speaking of such peculiar creatures as the Narwhal and the Bottle-head (*Hyperoodon*), the former of which was unknown to zoologists in the seventeenth century, and the latter until the end of the eighteenth century; the same is also the case with the Pike-whale (*Balenoptera rostrata*, Fab.), the Ca'ing-whale (*Globiocephalus melas*, Tr.), and several other dolphins which only in our days have been admitted into the zoological system.

In the 'Mirror' one of the Cetaceans is described in the following manner:¹

"En Art af Hvale er endnu den, som hedder *Nordhval*, og er den Fisk stor; den er 80 Alne lang eller 90, de som blive de største, og ligesaa tyk, som den er lang; thi et Reeb, som trækkes lige langt med den, naaer netop omkring den, hvor den er tykkest; den haver og saa stort et Hoved, at det udgjör næsten den tredie Deel af ham. Ellers lever denne Fisk reenlig, thi man siger om den, at den nyder ingen anden Føde, end Taage og Regn og det som falder af Luften ned paa Söen, og skjönt den bliver fanget, og dens Indvolde aabnes, da findes intet Ureent i dens Mave, som i andre Fiskes, der nyde Føde, thi dens Mave er reen og tom. Sin Mund kan den ikke vel aabne; thi de Barder, der sidde i dens Mund, reise sig tvert for Munden, naar den lukker den höit op, saa at den ofte faaer sin Död deraf, at den ikke kan lukke sin Mund igjen. Den er ellers ikke grum mod Skibe, haver ingen Tænder, og er en feed Fisk, og meget vel spiselig for Mennesker."

(Another species of whales is the one called *North Whale*, and that is a large fish; it is eighty ells long, or ninety, those which grow biggest, and as thick as it is long; for a rope drawn to its full length can only just encompass its body where it is thickest; it has also so large a head that it makes almost the third part of him. Otherwise this fish is very cleanly in its manner of living, for it is said not to take any other food than the fog and the rain, and what falls from the air on the surface of the sea; and though it is caught and its bowels are opened, yet nothing unclean can be found in its stomach as in those of other fishes that take food, for its stomach is clean and empty. Its mouth it cannot well open, for the whalebones sitting in its mouth are raised across the mouth when it is wide open, so that it often dies because it cannot shut its mouth again. Otherwise it is not fierce against vessels, has no teeth, and is a fat fish that may very well be eaten by mankind.)

At the time when the 'Mirror' was written, and even a long time afterwards, this description could only be read by the learned with many doubts of its veracity; for not a word was to be found in Aristotle or Pliny about an animal eighty or ninety ells long, and as big in circumference as it was long, whose head made a third of its whole length, that only subsisted on fog and rain, and by its long whalebone was prevented from opening its mouth wide; and such a description would really seem to be quite fabulous to any one that, as yet, had no idea of a North or Greenland whale. This animal, however, is, after all, according to the pictures of it given by Martens and Zorgdrager, in direct diameter a third of its length, which would thus exactly equal the circumference, and it is by no means certain that the proportion is incorrectly shown in these pictures.² The head is really, as we now know, a third part of the whole length of the animal, nay, in the males even somewhat larger. It is true that the Greenland whale does not subsist on fog and rain; but this statement may be considered as nothing more than a not very

¹ Einersen's Translation, p. 134.

² We must confess that, as to this proportion, we confide more in these drawings, rude as they are, than in Scoresby's, which certainly represents the Greenland whale as more slender than it really is.

successful explanation of the fact, most accurately observed, that the stomach of the North whale does not contain those remains of larger animals, more or less digested, which they found in the stomachs of other Cetaceans; and thus it shows us that they had perfectly well observed the difference between the food of the right-whales and that of the other Cetaceans. And even if the Greenland whale can open its mouth very wide, it scarcely ever opens it more than just to make an entrance to the cavity of the mouth in front, while at the sides the exceedingly long whalebone will scarcely ever be laid bare down to the very points, but will always, even when the whale is gaping widest, be partially concealed by the enormous underlip. Should the whalebone accidentally be laid bare, it is by no means unlikely that the animal will be exposed to the danger of being unable again to bring the points of the whalebone in their proper position inside the underlip, and of being in this manner deprived of the sifting instrument, without which it cannot procure food. On the other hand, the old author cannot be acquitted of having very much exaggerated the size of his North whale; for by the measurements of Scoresby it must be considered to be beyond doubt that the Greenland whale seldom reaches more than sixty, and perhaps never more than seventy feet long; now, it is in the highest degree improbable that it formerly grew considerably larger than now, and besides, we have a statement of the old whaler Mr. Edge, that sixty-five feet was in his time, also, the usual limit of the growth of the whale.¹ We might, indeed, be almost tempted to suppose that the author of the 'Mirror' did not even in this point deserve our blame, when we look over the lengths given by him of the other whales which he mentions; for these, too, seem to have been made twice as large as they really are;² the measures will not be tolerably correct indeed unless we put feet instead of ells; it might, therefore, easily be supposed that the old Icelandic "alná," which Einersen translates "ulna" and "alen" (ell), was not more than one foot of our present measure. The learned Icelander, the late member of the Society, Finn Magnussen, whom one of the authors, Eschricht, once consulted on the question, has, however, stated, that the old Icelandic ell was certainly somewhat shorter than the present, but not so much by far.³ Thus, it seems that we are forced to admit that the statement given in the 'Mirror' of the dimensions of the North whale is greatly and palpably exaggerated; but even if this be the case, yet this ancient description is in a very high degree characteristic, so that no doubt can be entertained as to which whale is meant by it. It is true that the 'Mirror' does not state anything about the particulars of its appearance near the coasts of Iceland; but in this respect its name appears to give the information required, for by "North whale" the old Icelanders must have understood a whale that, more than any other,

¹ "The Whale is a Fish or Sea-beast of a huge bignesse, about sextie-fue foot long," Purchas III, p. 470.

² Thus, we are told in the 'Mirror' that the "Hnidingerne" (the cai'ng whale) "are about ten or twenty ells long;" the little "Nise" (the common porpoise) "not longer than five ells," and "the Leipter," perhaps the northern Bottle-noses (*Lagenorhynchus*), "not longer than seven," the "Andhval" (*Hyperoodon*) "not longer than twenty-five ells," the Narwhal "twenty ells;" measurements which give to all the Cetaceans referred to about twice the size they really have.

³ He says in a letter to Eschricht, that it is proved in the first part of Pál Jónsson Víðalín's explanations of obsolete words in the Icelandic law-book (published in 1846, in Reykiavíg, at the expense of the *Literary Society of Iceland*) that the old Icelandic ell, formerly used in all Scandinavia, but now superseded by the Hamburg ell, was a seventh part shorter than the latter.

belonged to the highest north, that came to the coasts of their island from the north, and returned again from them to the north.

But as the Greenland whale cannot be supposed ever to have strayed down into the more temperate waters of the Northern Atlantic, it remains to consider the question, what whale it can have been which through centuries has been pursued as eagerly in this sea, as the former in the Arctic Sea. The question will not be difficult to answer. It was the "Sarpe" of the Basques, the "Nordkaper" of the old Dutch and North-German whalers, and most, probably the same species as the right-whale, already mentioned, of the Anglo-Americans, from the coasts of Nantucket and New England. Such a "Sarpe" or "Nordkaper" has at all times, by whalers of all the different nations, been distinguished from the Greenland whale; they knew very well that it was to be found in quite different parts of the sea from the latter; and the various accounts of it, however deficient they may be in other respects, agree in what is most essential, and leave no doubt of its being an animal quite different from the North whale. Finally, it had its place in the zoological system, until it was thrown out of it by the criticism of Cuvier,¹ which in this instance was too severe. It had, indeed, been introduced into the system by Klein, under the very ill-chosen and perplexing name of *Balena glacialis*, which might much rather have been given to the Greenland whale, and when introduced nobody had as yet clearly pointed out the difference between its range and that of the latter.

We do not know whether any Basque books, or manuscripts, of the early middle ages have come down to us which contain such statements relating to this whale as to enable us to form an idea about it. But in the same old Icelandic composition, that contained the earliest description of the North whale, we find it mentioned in the following words:

"Videre kaldes endnu een Hvale-Art Sletbage; og er ingen Finde paa dens Ryg; den er næsten saa stor af Væxt, som hine, hvilke vi sidst taledes om. Men de Folk, som fare paa Söen, frygte den meget, thi dens Natur er at spöge meget med Skibe."

(Further, another species of whale is called "Sletbag" [a whale without back fin], and no fin is on its back; it is almost as big in body as those last mentioned by us [namely, "Bardhvale" or Cachalots, whose length is put down at thirty or forty ells], "but those who travel on the sea fear it much, for its nature is to play much with vessels."²)

What here is stated about this "Sletbag" is certainly very little; but the want of back fin renders it at any rate probable that it is a right-whale which is introduced by this name, and not only the great difference in size, but also the difference in temper and natural disposition, prove that it was different from the Greenland whale; the latter being expressly described as peaceable, while, on the contrary, the "Sletbag" was much feared. It must, however, be admitted that, if only confined to the statement of the 'Mirror,' we should find it rather doubtful what animal was meant by this "Sletbag," but all uncertainty is removed when we compare with the above description the statements found in a list of Icelandic whales written in the seventeenth century, and sent by an Icelandic clergyman to Ole Worm, and which Th. Bartholin has printed in his fourth Centuria.³ It is true that this list is essentially a sort of im-

¹ Recherches sur les ossemens fossiles. 4me Ed. T. VIII, p. 256. Annales des Sc. natur. T. II, p. 27: Sur la détermination des diverses espèces de balciues vivantes. Par M. Cuvier.

² Kongespeil, Einersen's translation, p. 128.

³ Th. Bartholini histor. anatom. rar. Centuria IV, p. 272—289.

proved edition of that in the 'Mirror,' but several notes are added, and thus we find the "Sletbag" spoken of in the following words:¹

"Decimum tertium *Hoddunefur*, ab incurvo rostro, seu *Slettebackur* minor XXXV ulnas longus, omnium sæpissime captus et inventus. Hujus generis, ut et reliquos Sletbakos, qui esui apti sunt, venantur Hispani et Galli. Ipsorum lardum incorruptum asservari non potest. Quamprimum enim in frustra dissecatur, sive suspendatur sive in solo collocetur, in oleum resolvitur. Unde fit, ut hujusmodi carnis frustulum, quod pondo islandicum majus pendet, 24 tantum aut circiter solidis veneat. Hic 500 in rostro corneas laminas habet, omnes tenues, quinque cubitos longas, sed leviter velut glutine cohærentes, quibus sartores nostri utuntur in vestibus consuendis."

We learn by this description not only that this "Sletbag" of the old Icelanders was really a whalebone-whale (and therefore as a whalebone-whale with a finless back, a right-whale), but we learn also, on the unequivocal authority of contemporary persons, on the one hand, that this was the whale at that time most commonly caught near the coast of Iceland, especially by French and Spanish whalers, who in the seventeenth century and still long afterwards every summer used to carry on a lucrative whale-fishery in the Icelandic sea, and on the other hand, that this "Sletbag" was an animal very different from the North or Greenland whale. Worm's correspondent has retained the 'Mirror's' statements about the size of the North whale; he, too, says that, it is "LXXX ulnas longus totidemque crassus;" but he adds (what is not to be found in the 'Mirror'), "corneas laminas 13 ulnarum longas habet." Now, it is true that all these figures are much exaggerated, but however much exception may be taken to them absolutely, the great difference in the statements of the size of the North whale and the Sletbag must always be very important, and when the whalebone of the former is put down at 13 ells (ulnæ), that of the latter, on the contrary, is stated to be five "cubitos" long (by which appellation, perhaps, even another measure may be meant than by "ulna"), this, too, seems to show that a considerable difference existed between these two whales. Bartholin tells us² that the statements of the Icelandic clergyman were illustrated by drawings of all the different Cetaceans. These drawings seem to have been lost. But an Icelandic manuscript (No. 12), with Danish translation, inscribed "Om det islandske Hvalfiske Kjøn," and illustrated by outlines of all the Cetaceans enumerated in it, is preserved in the Library of the Veterinary and Agricultural Academy at Copenhagen. Judging from the appearance of the manuscript, we should suppose it to have been written in the middle of the eighteenth century; but, properly speaking, it is, like the statement sent to Worm, only another reproduction of the old list of the 'Mirror,' with several additions. Although the outlines are exceedingly bad and contain the most obvious errors, most of the different species may be recognised, and accordingly it is worthy of note that the picture of the "Sletbag" (which, perhaps, is only a copy of the older one of the Icelandic clergyman) looks as different from that of the North whale as it ought to do according to the descriptions, and it is especially distinguished from the latter by the greater slenderness of the body, and the much inferior proportions of the head, and especially the mouth. As it seems to us that none of these Icelandic statements about the two species of whales, to which reference is made, ought to be omitted, we give here the description of them as it is found in the last-mentioned manuscript:

¹ L. c., p. 278, 279.

² L. c., p. 272.

“Den 20de Art er Nord-Hval. Denne er den længste af alle de Hvalfisksorter man kjender, da den er 80 Alen lang, nogle sige at den kommer meget sjelden til Island ; den siges ikke at opholde sig af andet end Regn og Snevand, eller halvtörknet Sne. Dens Mund har en lille Aabning og Bardterne sidde tvers over hans Hals eller Strube, hvorfor den og ofte döer deraf, at den kan ikke lukke Munden, i særdeleshed da den er tyrstig. Denne Fisk er meget feed og den störste Deel af den er Hovedet, og den er ligesaa tyk, som den er lang ; Barderne ere 18 Alen lange og ere derfor meget fordeelagtige, naar den driver paa Landet.”

“Den 17de Hvalfiske-Art er Sletbak eller Sletbag. Den er 25 Alen lang, naar den er længst, den er og meget feed, hvorfor og dens Mængde formindskes meget ved Hval-fangere, der ligge og krydse meget efter dens Fangst omkring Landet.”

(The twentieth species is the North whale. This is the longest of all the Cetaceans we know, being eighty ells long ; some say that it very seldom comes to Iceland ; it is said to subsist on nothing but rain- and snow-water, or half-frozen snow. Its mouth has a small aperture, and the whalebone is placed across its throat, by which means it often dies, because it cannot shut its mouth, especially as it is thirsty. This fish is very fat, and the greater part of it is the head, and it is as thick as it is long, the whalebone is eighteen ells long, and therefore it gives great profit when such an animal is driven ashore.

The seventeenth species of Cetaceans is the Sletbak or Sletbag. It is twenty-five ells long when it is longest, it is also very fat, wherefore its numbers are considerably diminished by whalers who are continually beating near the country in order to catch it.)

From this description, as well as from the one preserved by Bartholin, we see that the Icelanders' knowledge of the Cetaceans made, generally speaking, no progress from the twelfth till the eighteenth century ; but at the same time it will be observed that even then it was the “Sletbag” that was caught by the whalers near Iceland. Nor is it quite unimportant for us to learn that the North whale was, also then, a rare visitor near Iceland ; nor is the statement of its food being water filled with snow or half-frozen snow totally destitute of interest ; for by that our supposition is confirmed that, near the coasts of Iceland, also, it only lived in the water when it was filled with ice, and in winter. At all events, so much seems finally proved by these statements of ancient and more modern dates, that the Icelanders have at all times agreed in regarding the “Sletbag” as an animal quite different from the North whale, or the Greenland whale, being, in fact, a right-whale of inferior size, and with much shorter whalebone ; and, at the same time, it is proved beyond all possibility of doubt, that this “Sletbag” of the Icelanders was the very one that was hunted by the Basques in the summer, in the sea near Iceland, during the long period of at least two centuries.

If we now turn to other sources in order to obtain further information about such a right-whale, smaller and more active than the North whale, and belonging to the Northern Atlantic, we have already stated that we do not know any description of the “Sarde” of the Basques that in antiquity can be compared with that of the “Sletbag” of the Icelanders found in the “Kongespeil.” For although the whale-fishery in the Bay of Biscay is of rather remote antiquity, and various regulations concerning it in the thirteenth and seventeenth century are still preserved, the appearance of the whale is never described in any of these. On the other hand, we find very important information about the “Sarde” in the instructions already mentioned, which the English Muscovy Company gave to Mr. Edge, for his use on his first whaling

expedition to Spitzbergen in the year 1611,¹ and in the account of this and some subsequent voyages, which Mr. Edge wrote himself.² It is true that this information does not come down to us immediately from the Basques, but yet it may be traced back to them, for the whale-fishery of the time was almost exclusively in their hands; and just as the English Company was obliged to fetch all the six harpooners necessary to the expedition from St. Jean de Luz, it cannot be doubted but that the description of the different Cetaceans procured by the company for Mr. Edge's information had originally been given by Basques. This is also proved by the names of the whales,³ even though they may have been somewhat modified by having been written in English; and the circumstance that Mr. Edge afterwards, although on his voyages he had so much opportunity of procuring additional information from his Basquean harpooners, only repeats the former list that had been communicated to him, with one or two slight alterations, seems to show that it really did state correctly the whole amount of the knowledge of whales of which the whalers were in possession at that time.

In the instructions given to Mr. Edge, in 1611, the "Sarde" is mentioned in the following manner: "The second sort of whale is called Sarda, of the same colour and fashion as the former [namely, the Bearded whale or Greenland whale], but somewhat lesser and the finnes not above one fathom long, and yeeldeth in oyle, according to his bignesse, sometimes eightie, sometimes a hundred hogsheads."⁴ In Mr. Edge's account of the different sorts of whales⁵ written about ten years later, this description is repeated with several alterations, and is to the following effect:—"The second sort of whale is called Sarda, of the same colour as the former, but somewhat lesser, and the finnes likewise lesser, and yeelds in oyle according to his bignesse, sometimes seventie hogsheads or eightie hogsheads. This whale has naturally growing upon his backe white things like unto barnacles." These two descriptions, taken together, are very interesting. For at that time the "Sarde" was fully as well-known to the whalers as the Greenland whale; it had, indeed, hitherto been the principal object of their persecutions in the Northern Atlantic; on a point so important to them as the length of the whalebone their evidence must certainly be considered to be perfectly trustworthy. Thus, when the length of the whalebone of the Sarde is stated to be only six feet, we have not only an additional proof of the difference of species between this whale and the Greenland whale, and a more exact confirmation of the statements of the Icelanders (less to be depended upon in that particular), but it also becomes very probable that the Sarde, or, as the Icelanders called it, Sletbag, was the very same species as the right-whale, which, at Dudley's time and long afterwards, was caught near the coast of New England. No less important is Mr. Edge's statement that the "Sarde" "had growing upon his backe white things like unto barnacles," or, in other words, was overgrown with Cirripeds. Thus, it was already a well-known fact that this whale is much troubled by these animals, and on account of the importance which, as one of the authors proved many years ago, must be ascribed to these parasites in a zodiagnostical point of

¹ 'Purchas, his Pilgrimes,' part iii. London, 1625, p. 709, 710.

² l. c. p. 462—472.

³ Their names are: 1. The Bearded Whale; 2. Sarda; 3. Trumpa; 4. Otta Sotta; 5. Gibarta; 6. Sedena; 7. Sedena negro; 8. Sewria.

⁴ 'Purchas,' l. c. p. 710.

⁵ 'Purchas,' l. c. p. 471.

view,¹ we shall not hesitate to express our opinion that the fact of the "Sarde's" being, in opposition to the Greenland whale, infested by Cirripeds, proves it to constitute an independent species. This peculiarity of the "Sarde" has since been confirmed by Anderson, who in his 'Nachrichten von Island' (p. 219, § 40) mentions this whale by its Dutch name of "Nordkaper."

Perhaps Anderson obtained his information from Hamburg whalers; but by the list of whales written by the Icelandic clergyman we perceive that the Icelanders themselves also, at all events, in the seventeenth century, knew very well this peculiarity in their Sletbag, although it is not mentioned in the 'Mirror.' In the description of another whale, also much infested by cirripeds, called "Skjeljunger," perhaps the northern Humpback (*Megaptera longimana* or *boops*), we read the following passage:—"Asperis testis non secus ac rosis aut stellis exterius ornatus est et depictus, *velut reliqua Sletbakorum, qui pinna in dorso carent, genera, quæ vulgo Ceti aquatici nuncupantur, sed minus proprie, excepto Nordhval, qui solo rore victitat;*" and if we venture to refer the words "excepto Nordhval" to "velut reliqua," &c., we have here a proof that the Icelanders had not only observed the existence of these semi-parasitic animals on the "Sletbag," but also their non-existence on the North whale.²

Neither Anderson nor Edge adds anything to enable us to determine to what species these barnacles belong. About this, however, we have information from a different source. In the years 1778 and 1779 two vessels were sent from Copenhagen to catch cachalots and whales in the Southern Atlantic. They had orders to seek these animals as far as 50° south latitude, and afterwards, on their return home, if it were in a favorable season, to try the "Nordkaper and Whale-fishery," near Iceland and Norway;³ and one of the vessels, called the "Christianshavn," did really succeed, on one of the voyages (we suppose on that of 1779), in catching a "Nordkaper" between Newfoundland and Iceland, the head of which was infested with such a multitude of Cirripeds that it would have been easy, according to the statement of the captain, to gather a whole sackful of these "white patches," as he called them. On the return of the vessel to Copenhagen, Chemnitz, the distinguished conchologist, obtained a few specimens which the captain had brought with him, and recognised in them the *Balanus polythalamius complanatus*, described by Walch, the type of the genus *Coronula*, Lam.⁴ As this animal exists only on right-whales, namely, on the collective species *Balæna antarctica*, we cannot be surprised that the Cirriped of the "Sarde" or the "Nordkaper", is also a *Coronula*; nay, we may even find in the fact that such

¹ Eschricht, 'Om Undersøgelsen af de nordiske Hvaldyr,' Forhandlingar ved de Skandinaviske Naturforskarnes tredje Möte i Stockholm, 1842, p. 203. Ejusd. Zoologisch-anatomische Untersuchungen über die nordischen Wallthiere, p. 95. Brandt and Ratzeburg had, however, already pointed out the existence of balaniform animals on the right-whale of the Pacific, and their non-existence on the Greenland whale, as a weighty reason for supposing these two right-whales to be different species, *vide* 'Medizinische Zoologie,' erster Band (Berlin, 1829), p. 126, note 3.

² While the Greenland whale is never infested by Cirripeds, it is a very well-known fact that it is by a species of *Cyamus*; and although this has been denied by Professor Kroyer, in a short notice "Om *Cyamus ceti*" ('Naturhist Tidsskr,' 4th vol. p. 474), we are the more surprised at his doing so, as he says himself, that zoologists owe their first information of *Cyamus ceti* to Martens, who, nevertheless, expressly states that he found his "Wallfischlaus" on this whale.

³ Pontoppidan, C. Hval- og Robbefangst udi Strat Davis, p. 79—81.

⁴ Schriffter der Berliner Gesellsch. naturf. Freunde, 5th vol. p. 463.

were the animals found on the whale caught, as we have just mentioned, between Newfoundland and Iceland, a proof that this whale did really belong to the species to which it was assigned.¹

Some information about the "Sarde," of a more recent date, is to be found in the celebrated work: 'Traité general des Pêches,' by Duhamel de Monceau. It is true we cannot here find out such positive and sharp characteristics for this right-whale as from the two important statements printed by Purchas, yet the work has its own value, and we shall, therefore, quote the author's own words:

"Comme les pêcheurs qui vont chercher ces poissons vers le nord seroient fréquemment exposés à des dangers considérables, à cause des glaces qui rendent la pêche pénible et incertaine, comme nous l'avons représenté (Pl. VIII, fig. 1), ceux qui pratiquent leur métier dans ces parages ne font communément la pêche que dans le moi de Mai, Juin, et Juillet, saison où l'on n'a point à craindre les gelées; même aujourd'hui (1769) on va communément chercher les Baleines dans des parages moins froids, quoique celles qu'on y trouve, qu'on nomme *Sardes* et qui, par la description qu'on donnent les auteurs, ne paroissent être le poisson qu'on a appelé *Nordkaper*, soient moins grosses, moins chargées de graisse, et beaucoup plus vives et plus fuyardes que les grosses qu'on prend dans le Nord." And further we read:—"Nous avons dit que nos pêcheurs distinguent principalement deux espèces de vraies et franches Baleines: Les premières sont les grosses du Nord; celles de la seconde espèce, qui sont connues en quelques endroits sous le nom de *Sarde* ou *Nordkaper*, sont beaucoup plus petites, puisque les plus grosses ne produisent, au plus, trente barrils d'huile; et comme elles sont vives et farouches, elles sont bien difficiles à attraper; néanmoins, quand la pêche des grosses Baleines n'a pas réussi, les pêcheurs

¹ Darwin, who, in his great work upon the Cirripeds, is as unwilling as his predecessors to admit the existence of more than a single species of flat *Coronula*, viz. the *C. balænaris* (Gm), is inclined to confine its range to the Southern Hemisphere, and believes that, at any rate, it is only in the Pacific that it may have found its way also to the Northern Hemisphere (A Monograph on the sub-class Cirripedia. The Balanidæ, London, 1854, p. 417). As he, nevertheless, refers the "Nordkaper coronula" of Chemnitz to this species, and quotes the description and illustrations of this conchologist (Syst. Conch. Cab. 8th vol. p. 325, fig. 845, 846), relative to *C. balænaris*; he must have overlooked the fact that Chemnitz got his specimens from the Northern Atlantic, and that the species must be cosmopolitan, at least if the synonymy given is correct. But this seems to be doubtful. The figures given by Chemnitz of the "Nordkaper coronula" are scarcely sufficient to prove its identity with the species found on the right-whales of the Pacific, and until the question has been settled by a direct comparison of the shells themselves, we may be permitted to doubt that animals living in seas so widely separated, and on whales of different species, are really of the same kind. Fortunately all uncertainty on this head may, most probably, still be removed, as one of the identical *Coronulas* before mentioned was presented by Chemnitz to Spengler the conchologist, and this most important original specimen is still to be found (if we are not mistaken) with the rest of his collection, in the Royal Museum of Copenhagen.

Whether, in the case that the *Coronula balænaris*, Auct, should prove to be a collective species, the "Nordkaper-coronula" of Chemnitz is really the same animal as the *Balanus polythalamius complanatus* described by Walch, or whether the latter might have been taken from one of the right-whales of the Pacific, and in that case most likely from the Cape whale, cannot well be decided, unless the original specimen, described by Walch, still exists, and can be again examined.

essaient de s'en dédommager, en allant pêcher les Sardes ou petites Baleines dont nous venons de parler."¹

The Dutch and German whalers do not seem to have hunted the "Sarde," or, as they used to call it, the "Nordkaper," so eagerly as the Basques; it was not until the whale-fishery near Spitzbergen was in operation that they began regularly to send out whalers, and therefore the Greenland whale was, if not exclusively, yet most commonly hunted by them. Accordingly, it would scarcely seem strange if no particular information were to be obtained from them about the right-whale which was less important to them. Nevertheless it is mentioned both by Martens and Zorgdrager, and by both as a species different from the Greenland whale, and an object of hunting. The latter author has a whole chapter in which, in his peculiar prolix style of writing, he informs us about the range of the "Nordkaper," stating that he is fully convinced that neither does this whale ever appear within the range of the Greenland whale in the northernmost seas; nor does, on the other hand, the Greenland whale appear within the more southerly range of the "Nordkaper;" at all events, he adds, he has neither himself seen such an instance, nor has he heard it mentioned by others.² It is, however, very doubtful whether he ever had an opportunity of being acquainted with the "Nordkaper" from personal examination. The doubt he expresses whether the whalebone in this Cetacean grows as far back in the throat as it does in the Greenland whale renders it improbable that he can himself have seen it caught and killed; nor does he, with the exception of the statement that it yields only twenty or forty "cordelen" of blubber (scarcely half of what the Greenland whale is said by him to yield), and that the blubber is more compact than that of the latter, tell us anything about its other characteristics. We find it, however, stated by him that the "Nordkaper" is said to live on fish; and he even thinks himself enabled by that circumstance to explain why this whale is found especially in the sea near the coasts of Iceland and most northerly part of Norway. Now, although the "Nordkaper," if such were the case, would unquestionably form an exception to the rest of the right-whales, yet we should hardly think it right if for this reason alone we rejected the possibility of its being a fish-eating animal; but Zorgdrager only supposes it to be so, and he is evidently led into this supposition chiefly by a statement which he quotes from Martens, that a "Nordkaper, caught near Hetland, had more than one cask of herrings in it."³ It is, therefore, properly speaking, Martens that is responsible for this statement, and as he says expressly that he has it only from others,⁴ we have no sufficient surety as to its authenticity, nor any certainty that the word "Nordkaper" may not in this case be misapplied to the whale caught near Hetland. As for the rest of Martens's account of the "Nordkaper," it is much to the same effect as Zorgdrager's statements; he evidently considers it as a proved fact that it is different from the Greenland whale; and it is clear that on this head he only repeats the statement most current among the whalers of his time. He alludes to its inferior size, smaller quantity of blubber, and fierce temper which renders it more dangerous to hunt than the Greenland whale; but all his statements seem to be only at second hand. He tells us, to be sure, that on his return he witnessed, in a storm near Hetland, a violent struggle between a "Nordkaper" and some killers ("schwerdfische"); but even if in this case it were a

¹ l. c. Sec. Partie. T. iv (1769), Sect. X, p. 10.

² Zorgdrager, the German translation. Leipzig, 1723, p. 141.

³ l. c.

⁴ Martens, Fr. Spitzbergische oder Groenländische Reise-Beschreibung gethan im Jahr, 1671, Hamburg, 1675, p. 107.

“Nordkaper” that he saw, such a sight can hardly have rendered his judgment about it more certain. Those who have often observed whales tumbling about in a tempestuous sea from the deck of a fast-sailing ship will know that the idea of their appearance, obtained in that way, is rather imperfect; and how little Martens was in this case enabled to make accurate observations will be best seen when we find that he has committed the error, certainly very common both then and afterwards, of confounding the “schwertfisch” (*Delphinus orca*) with the sawfish (*Pristis*)¹, so that he fancies that it was the latter he saw struggling with the “Nordkaper” off Hetland!

¹ [By the name “Schwertfisch,” the Germans mean both the fish *Xiphias gladius*, L., and the cetaceous animal, the “Killer,” or “Grampus,” *Delphinus orca*, L. The corresponding Dutch word, “Zwaardvisch,” as well as the Danish and Swedish word “Sværdfisk,” have also these two significations.

Now, the double signification of these words has often caused misunderstanding and confusion, and, in my opinion, it cannot be doubted but that Martens, in the case mentioned above, has allowed himself to be led astray by it. He has most probably been told by some of the crew of the whaler, to which he was surgeon, that the battle witnessed by them in the tempestuous sea was fought between a “Nordkaper” and a “sword-fish,” but by this name the sailors did not mean the “*Xiphias*,” but the “killer.” This is the more probable, as Martens adds, that he was also told by them that, when in their whaling expeditions, they fell in with many sword-fishes struggling with a whale, they took care not to disturb them in fighting, but waited till the whale had succumbed to its enemies, after which they would take possession of its dead body, of which the sword-fishes only devour the tongue. Now this whole story, in all its details, exactly resembles those which are commonly told about the killers (*D. orca*); but it cannot be applied to *Xiphias gladius*, which, even if it really ever attacks the whale, is not a gregarious fish; besides, it would not be able to pull out the tongue of the whale, nor is it found commonly, and in great numbers, so far northwards as in the sea where the whale-fishery is carried on.

When Martens was arranging the notes he had written during his voyage for publication, four years after his return home, he not only transferred what he had been told about the killers to the *Xiphias*, but, at the same time, he considered the latter to be identical with the sawfish (*Pristis*), which accordingly he introduces as having been engaged in the combat described, although it was certainly even more unlikely to have done so than the sword-fish.

The narrative of Captain Crow, quoted by Yarrell in his ‘History of British Fishes,’ vol. i, p. 144, about a struggle in the sea near the Hebrides, between some “Thrashers or Fox-Sharks” (*Carcharias vulpes*) and some sword-fishes on one side and an enormous whale on the other, may perhaps be founded on a similar misunderstanding. It is true that in this narrative the thrashers and the sword-fishes are distinctly mentioned as two different species. Nevertheless, I do not consider it at all unlikely that the whale, in this case, was only attacked by enemies of one kind, and these neither the *Xiphias*, nor the *Carcharias*, but killers. For the narrative itself suffers very much from extensive improbabilities. Thus, there is very little probability that animals so different as sharks and sword-fishes should peaceably join each other in an attack on a whale. Then it is a case of so rare occurrence that the *Xiphias gladius*, to say nothing of the *Carcharias (Alopias) vulpes*, is found straying so far northwards as to the sea round the Hebrides, that it would be very strange indeed that a great number of these fishes should be found there at the same time; besides, the *Alopias vulpes* is far from having a particularly powerful set of teeth, and accordingly it can, still less than any other shark, be supposed to be willing to venture an attack on a living whale; finally, it must be remembered, that

Much as we could wish, on reviewing the above-mentioned statements derived from very different authors, that the historical evidences about the whale mentioned by the name of "Sletbag," "Sarde," or "Nordkaper," had contained a more complete description of it, yet it must be admitted that they are sufficient to prove our former assertion, that the ancient Icelanders as well as the whalers of different nations really used to distinguish between this whale and the Greenland whale, and that this distinction was in all respects well founded. As certain characteristics of the "Sletbag," we are already enabled to point out the following :

1. That it was much more active than the Greenland whale, much quicker, and more violent in its movements, and accordingly both more difficult and more dangerous to catch.
2. That it was smaller (it being, however, impossible to give an exact statement of its length), and had much less blubber.
3. That its head was shorter, and that its whalebone was, comparatively speaking, much thicker, but scarcely more than half as long as that of the Greenland whale, being however still much longer than that of even the very largest fin-whale, although the "Sletbag" itself probably scarcely attained to half the length of the last-named.
4. That it was regularly infested with a cirriped belonging to the genus *Coronula*, and that it belonged to the temperate Northern Atlantic as exclusively as the Greenland whale belonged to the icy Polar sea, so that it must be considered as equally exceptional when either of these species strayed into the range of the other, and, moreover, that in its native sea it was to be found farthest towards south in the winter (namely, in the Bay of Biscay and near the coast of North America, down to Cape Cod), while in the summer it roved about in the sea round Iceland, and between this island and the most northerly part of Norway.

The existence of such a North Atlantic right-whale may be said to be so certain, that it is much more surprising that it ever should have been omitted in the zoological system than that it has now, as we hope, regained its former place in it. The reasons why Scoresby, and afterwards Cuvier, would not acknowledge it as a separate species,¹ were, besides an insufficient knowledge of the historical evidence relating to it, partly the fact of the former's not having seen anything of it on his many whaling expeditions, and partly the great resemblance to the Greenland whale,

neither the *Alopias vulpes*, nor any other shark, can spring several yards above the water, as Captain Crow tells us his "thrashers" did.

Now, when we call to mind that the name "Thrasher" not only denotes the shark just mentioned, but that it is a common appellation among sailors for the Orcas, it does not seem unlikely that, while conversing on board Captain Crow's ship about the interesting spectacle which they had witnessed, some of the company may have used the word "Thrasher," others the word "Sword-fish," about the animals which had been fighting with the whale, and that it was not until afterwards when he had sought information in scientific works about the animals spoken of by these names, that Captain Crow was induced to write down his account, having been led into the belief that really two kinds of fishes had been fighting with the whale.—J. R. 1864.]

¹ In the first edition of the "Regne Animal," (1817), Cuvier still believed in the existence of the "Nordkaper" (*Balæna glacialis* Kl.) (l. c. vol. i, p. 286). It was not till in the "Recherches sur les ossemens fossiles," and in the essay : "Sur la détermination des diverses espèces de Baleines vivantes" (in 'Ann. d. Sc. nat.' T. ii, 1824), that it was abandoned, and it is easily to be seen that this alteration in Cuvier's opinions was, to a great extent, occasioned by the statements of Scoresby.

so evidently seen in the only picture given of the "Nordkaper." Neither of these reasons will, however, on a closer consideration, seem particularly weighty. It is a matter of course that any whale so unremittingly persecuted as the "Nordkaper" has been, must gradually be brought near to complete extermination: the time will come when it will be a rarity, even in the seas where it formerly was found in the greatest numbers. And besides, when we remember that where Scoresby was beating for weeks and months in search of the Greenland whale, between Spitzbergen and Greenland, he could not have met with the "Nordkaper," but that only on his comparatively short voyages between England and the Arctic Sea could this possibly have happened, we should, perhaps, in spite of the number of his voyages, rather feel inclined to call it a remarkable coincidence if he had met with it; at all events, it cannot be a matter of surprise that he did not see it. We may also say that the drawings of the "Nordkaper,"¹ which, as we have mentioned, are published by Lacépède, have been thought far too much of, when they have been called the only evidence of any authenticity of the existence of this whale,² and when it has been inferred, from the circumstance of their exhibiting scarcely any difference from the genuine Greenland whale,³ that the "Nordkaper" must be identical with this animal. In order to make such an inference we ought to have ascertained beforehand whether these drawings do really represent the "Nordkaper" properly so called, and whether this name, so frequently misused, has not been misapplied in this instance too; but here we have no means of arriving at a certain conclusion. Lacépède tells us that he obtained the drawings from Sir Joseph Banks three months before the publication of the 'Histoire Naturelle des Cétacés' (1804), with the information that they were drawn in Greenland by Bachstrom in the year 1779.⁴ But in Baffin's Bay the "Nordkaper" is as rare as in the sea near Spitzbergen. According to what we have stated above, only single individuals, at many years' intervals, have strayed thither, and it is not very probable that Mr. Bachstrom really had an opportunity of seeing one.⁵

Now, Scoresby, knowing by many years' experience the nature and habits of the Greenland whale too well to believe that this whale, made for seas filled with ice, should ever have appeared regularly far down in the Atlantic along the coasts of France and Spain, attempted to explain the old statements of the whale-fishery of the Basques by the supposition that the whales that were then caught and killed in the Bay of Biscay and the adjoining Atlantic were fin-whales;⁶ and in support of this he appealed to the work published by De Yong, Kobel, and Salîette, about whale-fishing.

¹ Lacépède Hist. nat. des Cétacés, pl. 3.

² "Le seul document muni de quelque authenticité que l'on ait cru pouvoir y rapporter." Cuvier, 'Recherches sur l. oss. foss.' 4me. Ed. T. viii, p. 256.

³ Scoresby, Acc. vol. i, p. 448, note. Cuvier, l. c. p. 257.

⁴ 'Hist. nat. d. Cétacés,' p. 108. "Ce Cétacé (le Nordcaper) vit dans la partie de l'Océan atlantique septentrional située entre le Spitzberg, la Norvège et l'Islande. Il habite aussi dans les mers du Groenland, où un individu de cette espèce a été dessiné, en 1779, par Mr. Bachstrom, dont le travail, remis dans le temps à Sir Joseph Banks, m'a été envoyé, il y a trois mois, pas cet illustre, &c."

⁵ Lacépède does not say who Mr. Bachstrom was; nor have we been able to find any other traces of such a person. He can scarcely have had any appointment in the Danish factories, and in the list of the missionaries of the brethren in Greenland, given by Crantz, the name of Bachstrom is not found. He was most probably on board a whaling ship, as the words of Lacépède would seem to imply.

⁶ 'Acc. of the Arc. Reg.,' vol. ii, pp. 16, 162, 164.

In this compilation, otherwise very meritorious, this opinion is stated without the slightest attempt to enforce it by reasons,¹ nor are we told how the authors were led to it. Perhaps it may be only a repetition of a similar remark of Zorgdrager, which again (incredible as it may seem) is only founded on the fact that Martens, on some of his voyages, had met with fin-whales in the Bay of Biscay and in the Strait of Gibraltar.² But however that may be, it is certain that the historical facts do not admit of our supposing that the whale-fishery of the Basques was a fin-whale-fishery. Cuvier was well aware of this, and accordingly did not fall into Scoresby's error, but, following his authority in supposing the "Nordkaper" and the "Greenland whale" to be the same animal, he was led into the mistake of rejecting what was right in Scoresby's reasoning, and of setting forth the older theory that the whale has been gradually driven up into the Arctic Sea, in all its crudity.³

As the "Nordkaper" must be a different animal from the Greenland whale, the question arises, to which of the known species of right-whales it is most closely allied by its entire structure?

It is a well-known fact that since the right-whale indigenous in the Southern Atlantic and more especially near the shores of the Cape of Good Hope, was proved by the researches of Cuvier to be a species totally different from the North whale, almost all authors have agreed in referring to this species (*Balæna australis* or *antarctica* as it was also called) all the right-whales of the Pacific, both south and north of the Equator; and thus one species has been supposed to range from the Cape to Australia, New Zealand, and the west coast of South America, and from Japan to North America.⁴ This statement can scarcely be correct. Such an immense geographical range of a single species would, considered by itself, be a remarkable exception to the general laws of nature, and it is still less probable, as right-whales are no more found in the tropical part of the Pacific than in the corresponding part of the Atlantic, so that the right-whales of the South Pacific are separated from those indigenous in the northern part of the same sea by a broad and

¹ De Walvischvangst met veele Byzonderheden daartoe betrekelyk, Amsterdam, 1784, pp. 1 and 27.

² Zorgdrager, German translation, Leipzig, 1723, pp. 142 and 152.

³ 'Recherches sur les Oss. Foss.,' 4^{me} ed. T. viii, p. 252. "La plus célèbre des baleines proprement dites, celle qui attire le plus les pêcheurs, est la grande baleine des mers du Nord, qui venait autrefois jusque dans le golfe de Gascogne, où les Basques ont appris à la poursuivre et que l'on est obligé aujourd'hui d'aller chercher jusque sur les côtes du Groënland, de l'Islande et du Spitzberg." Again, in "Histoire des Sciences naturelles depuis leur origine jusqu'à nos jours chez tous les peuples connus professée au college de France," par G. Cuvier, publiée p. M. Magdeleine de Saint Agy. T. i (Paris, 1841), p. 269: "Ou voit, que de son (Plinius) temps ces animaux venaient dans le golfe de Gascogne et que les Basques paraissent être les premiers qui se soient livrés à leur pêche. Lorsque les baleines tourmentées par l'homme, se réfugient vers le nord, ce fut encore le même peuple qui les y suivit; et les environs de Terre-Neuve portent presque tous les noms qui sont ceux de différentes localités du pays de Basques, notamment des environs de Bayonne. L'histoire de la science permet au reste de suivre de siècle en siècle les baleines fuyant devant les attaques des pêcheurs."

⁴ Schlegel, Abhandl. a. d. Gebiete d. Zoologie u. vergleich Anatomie, part i, p. 37.—Schreber, J. C. D. v. die Säugthiere in Abbild. nach der Natur mit Beschreib. Fortgesetzt von Dr. J. A. Wagner, 7ter Theil (Erlangen, 1846), p. 195.—V. d. Hoeven, Handbuch der Zoologie, 2nd pt., p. 660.—Giebel, die Säugthiere, &c., p. 81.

impenetrable belt. We ought, besides, to be the more cautious in such a supposition, having already been warned by Cuvier, who states expressly that even in the sea near the south coast of Africa, besides *Balæna australis*, another right-whale was found, which he did not hesitate to pronounce to be a different species, although the parts of the skeleton in his possession were insufficient to give a characteristic description of it.¹ Dr. J. E. Gray has, therefore, attempted to distinguish between several species of right-whales from different parts of the South Sea and the Pacific, founding his opinion especially on differences in the size and quality of the whalebone;² and even though these species are far from being clearly made out, as a characteristic description of them is still wanting, it is probable that future observation will more or less completely confirm the results of his researches, and unquestionably the merit is due to him of having contributed to point out to us what little validity there is in the belief of a single "South Sea whale," as it is called, as the whalebone brought home by whalers from different parts of these seas is widely different, although, according to the supposition most current among zoologists, it ought to belong to the same species of whale. But even though the *Balæna australis* or *antarctica* of modern systematists is to be understood in a collective sense, yet the different species hitherto comprehended by this name are more closely related to each other than any one of them is to the Greenland whale, and they form a little group by themselves, to a certain degree opposed to this whale by their having shorter and somewhat differently shaped heads and whalebone essentially different.³ The most distinguishing point in the shape of the head is the appearance

¹ Rech. s. l. Oss. Foss., 4^{me} Ed. T. viii, pp. 268 and 292.

² The Zoology of the Voyage of H.M.S. Erebus and Terror, Mammalia, by J. E. Gray, Parts iii, iv, v, London, 1846, p. 47.—Catalogue of the specimens of Mammalia in the collection of the British Museum. Part i, Cetacea, London, 1850.

³ By this we do not mean to give it as our opinion that no other right-whales than those belonging to the Cape right-whale groups may be found in the temperate oceans. On the contrary, the whalebone on which Dr. Gray founded his species *B. marginata*, seems really to belong to a species different from the collective species *B. australis*, and, at least as far as the whalebone goes, more closely connected with *B. mysticetus*, although it may, when better known, turn out to form a third type of right-whale. It is, on the whole, not unlikely that forms of right-whales may be discovered, especially in the Pacific, that have hitherto been totally unknown to naturalists. On his circumnavigation round the globe, one of the authors (Reinhardt), while staying in the harbour of Honolulu, in the Sandwich Islands, in October, 1846, had an opportunity of speaking with not a few whale-fishers who at that time frequented this place. It was a common opinion among these practical connoisseurs, that several species of whales were to be found in the northern part of the Pacific, differing from each other partly in the length of the head, partly in the manner of "blowing," and partly in their movements and habits. Some of them were especially pointed out; they were called "Scrags," and said to have whalebone only four feet long, though they were real right-whales, without fins or humps on their backs; it was also stated that, like the true right-whales, they did not appear beneath or near the Equator, but that they were frequent off the coast of California. That the so called "Humpbacks" (*Megaptera*) were taken by them for this species is by no means likely; these animals are very well known to whalers; one of those to whom we are indebted for the above statement about the "Scrags" had even himself caught seven humpbacks near the Bonin Islands, and yet declared most positively that the former were quite different, and genuine right-whales. We might rather suppose that these "Scrags" were cubs of the common South Sea whales; for, according to Dieffenbach, the cubs, when two years old, and still accompanying the mother-animal, are

presented by the opening of the mouth, which does not, as in the Greenland whale, form an arch evenly curved before and behind, but is, just in front of the eyes, turned very abruptly downwards and outwards. This characteristic, first, if we are not mistaken, pointed out by Professor H. Schlegel, is so striking, that its representation will scarcely be omitted in any illustration of the exterior of these whales, however indifferently in other respects they may happen to be executed; and it is, indeed, very easily to be distinguished, even in one of the well-known drawings given by Chamisso of the wooden models made by the Aleutians, so that by this character alone the "kuliomoch" of these islanders may be recognised as a species of whale belonging to this group. No less important are the distinguishing marks afforded by the whalebone, and in a practical point of view they are even preferable to the character already mentioned; for while it is extremely uncommon for the zoologist to obtain either a drawing of the whale, or characteristic portions of its skeleton, the whalebone, on the contrary, is continually brought home, as it forms an important part of the merchandise obtained by whalers. In the Greenland whale the anterior and far greater part of the plates of every set of whalebone are curved in the form of a sabre; their thickness is, comparatively speaking, not considerable, scarcely exceeding ten millimeters, even in pieces of ten or eleven feet in length; but, on the other hand, the thickness is not much less at the point than at the root; then the hair-like fibres along the inner edge of the whalebone are extremely smooth and soft and flexible; the surface of the whalebone, when rubbed a little with a cloth, or even with the finger, very readily assumes a fine polish; and, finally, the horny substance itself is very tough and flexible. The whalebone of the South Sea whales is, on the contrary, almost straight, and this is not only the case with those of which the whalebone is shorter than that of the Greenland whale, but even the north-west whalebone, as it is called, obtained from the whales caught on the fishing-grounds along the north-western coast of North America, which even exceeds in length the Greenland whalebone, is nearly straight. Their whalebone is, moreover, less flexible, and much more brittle than that of the Greenland whale, so that sticks cut off it may easily be broken, especially in frosty weather; then, again, it is much thicker at the root (the north-west whalebone almost twice as thick), but it tapers much towards the point. The fibres are much coarser and rougher,¹

called by that name by New Zealand whalers; the persons, however, to whom we owe the information mentioned above did not speak of cubs accompanying full-grown whales, and the identity of the name can scarcely settle the question, as Scrag and Scrag-whale have been common appellations during at least 150 years, and, like the name of right-whale itself, have at different times, and in different places been applied to cetaceans quite different from one another.

¹ In Gray's above-mentioned catalogue of the Cetaceans in the British Museum, *Balæna australis* is indeed mentioned in the group characterised by thick whalebone and coarse whalebone hairs, but in the description of its whalebone, the whalebone hairs are nevertheless stated to be much finer than in the former species, this being *B. marginata*, which is admitted into the same group as *B. mysticetus*, and accordingly distinguished by thin and tough whalebone with few very slender whalebone hairs. This contradiction, however, is only caused by the description of the whalebone of the Cape whale being verbally copied from a former essay, by the same author, in the Zoology of the voyage of the Erebus and Terror, in which *B. australis* is not mentioned (as in the catalogue), just after *B. marginata*, but, on the contrary, immediately after *B. japonica* (with which it is therefore compared), and when the series of the species was altered the passage referred to was not altered in accordance with the new context.

and all the pieces of whalebone have, as it were, a dirty, grayish, dim-looking covering, or a dull, gray, and uneven crust, which cannot be scraped off without some of the inner portion coming off with it, nor can the surface be made smooth and shining by friction alone. With these differences in the exterior is also combined a difference in the internal structure of the whalebone. When any piece of this substance is cut through, an external, more condensed, and more uniform layer, which may be called by a term often used in an analogous manner in histology, the cortical substance, can easily be distinguished from an internal and more fibrous part, the medullary substance, consisting of very fine tubes, being in reality nothing but a part of the whalebone hairs hidden by the external covering. In the Greenland whale the cortical layer is comparatively thick, being considerably thicker than the internal medulla, which consists of fibres running parallel with each other. In whalebone coming from the South Sea, on the other hand, the cortical layer is relatively much thinner, and the great thickness of this whalebone is chiefly owing to the hidden part composed of numerous and coarse whalebone hairs occupying about a third of the whole diameter; moreover, the single fibres of the medulla are not arranged regularly parallel with one another, as in the Greenland whale, but more or less intertwined, and accordingly it is much more difficult to split the South Sea whalebone than that of the Greenland whale into long strips of uniform thickness. Finally, there is one mark by which the South Sea whalebone may be easily distinguished, for a certain wave-like inflexion is always found in it, repeated six or seven times in its whole length, which may be seen most distinctly in those long and thin quadrangular strips into which the whalebone is cut up by machinery. It is difficult, even by strong pressure, to smooth down these inflexions, and this inconvenience, added to its brittleness and the difficulty of splitting it, would render the South Sea whalebone considerably inferior as an article of commerce to the Greenland whalebone, even if it had the same length as the latter. How far a common characteristic distinguishing all the South Sea whales from the Greenland whale may also be found in their skeletons cannot be decided with certainty at present, for the Cape whale is still the only South Sea whale whose skeleton has been subjected to close examination;¹ of the right-whales from the Northern Pacific no skeleton, nor even any part of it, seems ever to have reached Europe; and although a skeleton of the New Zealand whale has for some years been in the Paris Museum,² it has not yet been accurately examined and described. The drawings, however, that we have of the right-whale from the sea near Japan, and of that indigenous in the sea near the coasts of New Zealand, make it at least very probable that these whales must share with the Cape whale the peculiarities of the cranium, by which the latter differs so much from the Greenland whale; we may, therefore, venture to presume that they will also be found to possess the most essential of the other osteological peculiarities, by which, as we shall show hereafter, their near relation is distinguished from the whales of the Arctic seas, especially a well-developed thumb provided with two joints, and a shoulder-blade without the least trace of any coracoid process.

Now to return to the "Nordkaper." Should this whale, a native of the Northern Atlantic, be referred most appropriately to the group of South Sea whales, or was its structure more like that of the Greenland whale? The former of these suppositions appears the most probable, for it is supported by those very few statements which we have about its appearance and by its habitat in a

¹ By Cuvier, in 'Recherches sur les Oss. Fossiles' (4^{me} ed. T. 8, p. 278, seq.).

² Catalogue of the specimens of Mamm. in the coll. of the Brit. Museum. Part i, Cetacea, p. 18.

temperate sea; but what especially speaks in its favour, and renders it most probable, is the very well-authenticated fact of the Nordkaper being infested by coronulas. For while the whalers of all times agree in declaring that no semi-parasite whatever of the order of Cirripeds is to be found on the Greenland whale, it is an indisputable fact that the species just mentioned is peculiar to the South Sea whales, and inseparable from them, wherever they live, near the Cape as well as near New Zealand and the coasts of Japan, exactly in the same manner as the cirriped genus *Diadema* is confined to the humpbacks (*Megaptera*), and found on these whales in Davis Strait and Baffin's Bay, as well as in the Pacific. That the "Nordkaper" is to be placed in the same group as the South Sea whales is, however, all that can be said, as long as we have only historical evidence to go by. It is scarcely possible by this alone to say what place it ought to occupy among them. It is not likely to be identical with any of them, not even with the Cape whale; but when we consider it to be different from the latter, it is more on account of the common laws affecting the geographical distribution of animals than because the scanty information we have about the Nordkaper contains anything that positively contradicts the contrary supposition.

We are not, however, confined to these historical statements alone, for although a few years ago they were the only ones accessible, the case is now different.

Since the close of the last century nothing had been heard of the Nordkaper; but it then was still, if not very numerous, yet not unfrequent in the Northern Atlantic. It was, as we know, regularly caught near the coasts of Nantucket; we have also seen that one of two Danish whale-ships which, in the years 1778 and 1779, were sent out on a whaling expedition into the Southern Atlantic, on its return caught a Nordkaper between Newfoundland and Iceland. The fact that the captains in their instructions were ordered, certain events taking place, to seek the Nordkaper in these northerly seas, shows that the capture of this individual cannot be considered as a peculiarly remarkable case,¹ in proof of which assertion it may be mentioned that even American vessels, as late as between 1770 and 1780, occasionally caught Nordkapers in Brede Fiord and Faxe Bay, in Iceland.² Now, when we add that the fitting out of whale ships requires so much capital that a very considerable diminution of the number of whales must render the fishing too bad a speculation to be continued for any length of time, and that therefore, though some species of whales may indeed even in a short time be almost destroyed, but can hardly be totally extirpated by the whale-fishery, we might hope, with a certain degree of probability, that an opportunity might be given to us of becoming better acquainted with the Nordkaper, and such an opportunity has really presented itself.

On the 17th of January, 1854, a right-whale, accompanied by its young one, appeared in the Bay of Biscay, outside the harbour of San Sebastian. On being chased, the mother escaped, but the cub was caught, and its skeleton was brought to Pampeluna. The excellent scholar, Professor Geffroy, whose interest in our country, we Danes have so much occasion to acknowledge with gratitude, was kind enough to inform one of the authors of this remarkable event, and at the same time to send him a lithographed sketch of the cub that had been caught and killed, and proved to be twenty-six Spanish feet long. The lithograph had been executed from a drawing taken on the spot under the superintendence of Dr. Monedero. As might have

¹ Pontoppidan, C. Hval-og Robbefangst udi Strat-Davis, p. 81.

² l. c. p. 76—78.

been expected, this picture represents an animal very different from the Greenland whale; its head is comparatively very small, not much more than a fifth of the whole length of the animal, and it has also the inflexion in the hind part of the outline of the under-lip so characteristic of the South Sea whales. Thus, if no other right-whales different from the Greenland whale should live in the Northern Atlantic (and at present we have no sufficient reason to believe that such is the case), we may venture to suppose that in the cub caught near San Sebastian we have really the Nordkaper or the Sarde of the ancient Basques before us; and in this case its picture confirms completely the opinion about it to which we had arrived by other means.

In order to profit fully by the opportunity of studying the Nordkaper that thus most fortunately had been procured, one of the authors, Eschricht, went to Pampeluna in the year 1858. The special results of his examination of the young skeleton will be given in another essay, which he intends to publish; here it may be sufficient to state, that he has succeeded in establishing the fact, that the Nordkaper, though belonging to the group of South Sea whales, is really, as we had supposed, an independent species perfectly different from the Cape whale.

We may be considered, perhaps, to have proved sufficiently by the preceding examination, that the Greenland whale was not in former times, any more than at present, found in the Bay of Biscay; that it has never been indigenous in the iceless European seas, but that it has been confounded with another right-whale, the "Sarde" or the "Nordkaper," supposed to have been found in these seas.

We have still to examine whether it also appears on the opposite Eastern side of the globe, and in that case to attempt to determine the limits of its range there, and especially to show if it comes down regularly into Behring's Straits and the Behring Sea. The question, however, can scarcely be settled in a perfectly satisfactory way by means of the facts hitherto ascertained, and as the little information we have been able to obtain ourselves is insufficient for the purpose, we shall here only briefly touch upon it.

It is a well-known fact, that several instances have been mentioned of whales having been found in the Pacific,¹ in which European harpoons were still sticking, a very long time before any European whaler had visited that sea, which harpoons necessarily have been put into them in the Arctic Seas on the opposite Western side of the globe. The earliest intelligence of such incidents we owe to the crew of a Dutch vessel, which was wrecked on the island of Quelpaert in the year 1653, after which they were kept in captivity for a long time in the Corea. In the description of this country which was published after his return by one of the shipwrecked men, Hendrik Hamel van Gorkum, he tells us that in the sea north-east of Corea, a great many whales were found every year, some of which had still French and Dutch harpoons sticking in them;² and a more minute account of this may be found in Nikol. Witsen, who, in order to

¹ The first attempt to send whalers into the Pacific took place in the year 1768, when a ship-owner in London, Mr. Enderby, sent out the *Amelia* round Cape Horn on a cachalot fishing expedition.

² *Recueil de voyages au nord* T. 4^m. (Amsterdam, 1718), p. 52. "Il (Corée) n'est borné du côté du Nord-Est que par une vaste mer, où on trouve tous les ans une grande quantité de Balaines, dont une partie porte encore les Crocs et les Harpons des François et des Hollandois, qui vont ordinairement à cette pêche aux extrémités de l'Europe, vers le Nord-Est."

obtain certain information about a matter at that time of essential importance in a geographical point of view, found out one of the sailors returned from the Corean captivity, one Benedictus Klerk, of Rotterdam, and was informed verbally by him, that he had himself once been present when such a whale, in which a Dutch harpoon was sticking, was thrown up on the coast of Corea.¹ A similar instance is mentioned by Zorgdrager, who, according to the statement of persons whose names he mentions, informs us that in the "Tartar Sea" (most likely near the coast of Japan), a whale had been found in the back of which a harpoon was sticking, marked with the letters W. B., which by this means could be ascertained to have belonged to a Dutch vessel on a whaling expedition to Spitzbergen, commanded by one Wilhelm Bastianse.² Finally, we have an instance of a whale, with an European harpoon sticking in it, having stranded on the coast of Kamtschatka. For when the Siberian traveller, the Academician C. F. Müller, stayed at Jakutzk, in the year 1736, he met with a Dutch sailor whose name was Henrich Busch, who had joined the expedition which the Russians had undertaken in the year 1714 in order to find a way from Okhotsk to Kamtschatka, and who told him that, in the year 1716, during the stay of the expedition near the mouth of the River Kompakova (on the west coast of the peninsula, about 50° N. lat.), a whale had been thrown ashore having a harpoon sticking in it of European workmanship, and marked with Roman letters.³ It is true that Müller adds that Busch could neither read nor write, and as the Kossacks, whom he accompanied, were in the same predicament, it is possible that his account is not to be understood according to the letter; but, on the whole, this circumstance can scarcely diminish the trustworthiness of his

¹ Noord en Oost Tartarye, Ed. 2, Amsterdam, 1705, vol. i, p. 43. "De Hollanders, die in, t Jaer 1653 op Korea gevangen zijn geweest, oordeelden uit de harponen, die zy in de gevange Walvisschen aldaer vonden, dat dezelve door de Weigats derwaerts waren komen zwemmen. En tot bevestiging, dat de Hollandsche Harpoenen op Korea in de Walvisch zijn gevonden, zoo hebbe ik met Benedictus Klerk van Rotterdam, welke op Korea gevangen geweest is den tijd van dertien Jaren, over deze Harpoenen gesproken, die dan verzoekert, wel toe te hebben gezien, wanneer in ziju tegenwoordigheid uit het lichaem van een Walvisch op Korea, een Hollandsche Harpoen wierde gehaelt, en zegt uitdrukkelijk zulks aen het maekzels gezien te heppen. Hy gaf reden van kennis, dat hy en andere zijner makkers, in hun jengt uit Holland op de Groenlandsche Visschery hadde gevaeren, en vervolgens de Harpoenen wel kenden." Again, page 44: "Een Hollandsche Harpoen vonden de Nederlanders in een Walvisch steecken, die daer te Lande tegen de wal dood aenquam drijven, hy was zeer klaer te onderscheiden van een Koresche of Japansche Harpoen, om da de Hollandsche Harpoenen qualijk het derde van de groote der Koresche of Japansche Harpoenen hebben. De Inlanders zeiden dat zy mede meermalen diergelijke Harpoenen outdekten in Walvissen, welke zy bequamen, door aenstranding op hare Kusten."

² Zorgdrager, German translation (Leipsig, 1723), p. 187. "Hiernechst dienet noch zur Versicherung und Bestättigung dieser Gedanken, was Peter Jansz. Vischer mir erzehlet hat, nemlich, dass ein in Ost-Indien gewesener Fiscal, Namens Zemann, ihm selbst berichtet habe, was masen in der Tartarischen See ein Wallfisch ist gefangen worden, in dessen Rücken eine Holländische Harpun stuck, so mit dem Buchstaben W. B. gezeichnet war, und einem Grönlandsfahrer vom Admiral Wilhelm Bastianse gehört: selbige wird allda in der Kayserl. Kunst-Cammer zur Rarität aufgehoben wie der Ost-Indische Schiffer Jacob Col von Sardam bezeuget, welcher auch mehr als einmal in Grönland gewesen ist, daher ihm sothane Harpun bekannt war."

³ Müller, G. F., Sammlung Russischer Geschichte. Des 3^{ter} Bandes, 1^{stes}, 2^{tes} u. 3^{tes} Stück. St. Petersburg, 1753, p. 104.

narrative. Judging by his former occupation, we should think that Busch might be perfectly able to recognise the European origin of the harpoon, and by the account of the Roman letters he may, perhaps, have only meant to say that he had found on it one of the common marks which the European whalers regularly use to stamp their harpoons.

But interesting as these cases are, they cannot be made to prove anything but that whales hunted by whalers near Spitzbergen may be found roving through Behring's Straits as far southwards as the coasts of Korea and Japan. That the Greenland whale regularly repairs to these regions is not proved by them; and as the whalers, to judge by the whalebone which they bring home from the fishing grounds round Japan, do not in our days meet with any other whale there, but one of the species comprehended by the collective appellation of *Balæna australis*, we are inclined to suppose that, at least in those cases where these whales wounded by European harpoons have been found as far towards south as near the coasts of Japan and Korea, they have only accidentally strayed to these places. It is a different question whether the Greenland whale is a regular visitor farther northwards in Behring's Straits and in the sea round Kamtschatka, and many circumstances seem in a certain measure favorable to such a supposition. For when the South Sea whalers, in the beginning of the year 1840, or about that time, began to extend their expeditions to these northern regions, they found a species of whale different from the common South Sea right-whale, and which they called "Bowheads," on account of their much larger heads and much greater curve of their upper jaws. Even in this short description of these Bowheads we recognise without difficulty those features by which the Greenland whale is distinguished, and their resemblance with the latter is rendered still more certain by the appearance of the whalebone, commonly sold by the name of Okhotsk or Polar whalebone, which comes to us from those very regions in which the Bowheads are caught, and which we have not been able to distinguish from genuine Greenland whalebone by any certain character. We can, therefore, hardly doubt but that in the sea near Kamtschatka a whale exists which, to judge by the shape of its head and the quality of its whalebone, must at least belong to the same group as the Greenland whale; but whether it is exactly of the same species can hardly be ascertained as long as small quantities of its whalebone are the only parts of it that have come to Europe. We have already mentioned that Zorgdrager believed that among the whales appearing near Spitzbergen, two species were distinguishable, a West-ice fish and a South-ice fish, and we have hardly at present a right to reject the possibility of the Greenland whale being a collective species like the South Sea whale, and that the Bowheads of the American and English whalers, in that case, might be identical with the South-ice fish of the old Dutchmen. But however that may be, whether the Bowheads may in time be proved to be genuine Greenland whales, or to constitute a different species, at all events we are already in a position to assert that our statements about the geographical distribution of the two groups of right-whales are not incorrect. The sea on both sides of Kamtschatka seems to be the southernmost limits of the range of these Bowheads which we have mentioned so often. Mr. Södring, the captain of a Danish whaler, who, on his third voyage to the Pacific in the "Neptun," caught two such in the Behring Sea, just off Petropavlovsk, has been kind enough to inform us that it was not till he arrived in this place that he found them, and that in the somewhat more southerly fishing place, where he had been fishing before, he had only seen the common South Sea right-whales. The two specimens which Mr. Södring succeeded in obtaining were caught in the months of June and July; there was no ice at the time where he was beating between Petropavlovsk, Behring's

Island, and the most westerly of the Aleutians, but a little northwards of Behring's Island, according to his statement, it still remains in some places to this late period of the season. Bowheads were then mingled with common South Sea right-whales on the fishing-ground, and thus he had an opportunity of convincing himself by direct comparison of the essential difference in the appearance of these two right-whales. It must, however, be left to future researches to find out whether the Bowheads, when the summer is farther advanced, follow a northward course through Behring's Straits, and whether, perhaps, they meet with the South Sea right-whales only for a limited portion of the year in the sea near the south point of Kamtschatka, as it were in the confines of the ranges peculiar to the two species, while during the remainder of the year they may be widely separated from each other, and living in altogether different parts of the ocean.

II.

THE EXTERNAL AND INTERNAL CHARACTERS OF THE GREENLAND WHALE.

By the preceding inquiries we have been taught—(1) that not only in the southern, but also in the northern hemisphere, and in the Atlantic as well as in the Pacific, different species of right-whales are to be found; (2) that all these species may be arranged into two different groups, one of which may be said to have the Cape whale and the other the Greenland whale as its representative; and (3) that the one of these two groups, represented by the Cape whale, is so far from being limited to the seas south of the Equator, that it always has been, and is still indigenous in all the iceless seas of the northern hemisphere, both west and east, while the other group keeps more closely to the North Pole, and more especially (as is the case with the Greenland whale) to the immediate neighbourhood of the ice.

Now, the next problem of our science would be to find out distinguishing marks sufficiently characteristic, both in their external form and in their skeleton generally as well as in individual bones, at least for those two species which have been chosen as types of the two groups, which we will briefly denominate the groups of North whales and South whales.

As far as the type of the latter group is concerned, this problem may be said to have been solved by Cuvier's classical examinations of two skeletons of this species, the one that of a full-grown animal, the other of a young one, both of them sent from the Cape to the Paris Museum by the French naturalist Delalande. But no skeleton of the Greenland whale had been sent to Cuvier, or to any other European naturalist. However much it was to be desired that this interesting animal, of which several thousands have been annually caught during the last two centuries, should be more minutely examined, no such examination has ever hitherto been made.

Singular as this may seem at first sight, the reason will be obvious on further consideration. While carrying on the whale fishery, formerly so profitable in the northern Polar seas, several

whalemen with a more scientific education, especially Captain W. Scoresby, had an extremely favorable opportunity for making observations as to its manner of living at the season at which the fishing took place, and also as to its external characters; but circumstances did not permit of more minute examinations of the internal organs being undertaken, nor of any large parts of the animal being preserved and brought home. If we except the whalebone prepared for trade, all the European museums taken together have gained nothing out of the many thousand individuals killed but about four or five small fetuses, three or four crania, more or less incomplete, and various separate bones, especially lower jaw-bones and loose tympanic bones.* Of the fetuses, one (a male) has been made use of by Jan Arnold Bennet;¹ another (a female) by Peter Camper,² to give an outline of the relative position of the principal internal parts, and two by G. Sandifort,³ for the examination of the larynx. Of the skulls, one of a new-born animal, has been described and figured by Camper;⁴ one of an older individual, in the Berlin Museum, has been briefly described, and delineated, partly by Pander and D'Alton senior,⁵ partly by Brandt and Ratzeburg;⁶ finally, a skull, in a rather damaged condition, preserved in the British Museum, and belonging to a full-grown individual, and several other single bones, have been described and figured by Cuvier.⁷ A young cranium in the Hamburg Museum has not, as far as we know, been described.⁸ From materials so incomplete only separate fragments of the anatomy and the osteology of the animal could be given.

The want of a more accurate account of the characters of the Greenland whale was, perhaps, as far as its skeleton is concerned, less to be regretted, as long as only two species of right-whales were supposed to exist, and the skeleton of the one of these was so well known through the examination of Cuvier. Every bone of a right-whale that did not show the characters of the corresponding bone of the Cape whale would then be set down as belonging to the Greenland whale. Now the case is quite altered, as the researches communicated in the preceding part of our essay have shown. As we have already said (page 44), we may, indeed, presume that all species belonging to either of the groups possess those marks of distinction that characterise the type of the group; but then it will be of the greatest importance to have a complete knowledge of the characters of both. Thus, a more accurate description of the anatomy of the Greenland whale in general, and more particularly of its osteology, so far from having lost its interest now, when Cuvier's examinations of the Cape whale are in everybody's hands, may, on the contrary, be said, from a scientific point of view, to be more requisite at present than at any previous time. To this we must add the following remarks. In Cuvier's examination of the skeleton of the Cape whale

¹ 'Natuurkundige Verhandelingen van de Koninklijke Maatschappij der Wetenschappen te Haarlem,' 5 D., 1 Stuk. Amsterdam, 1809.

² 'Observations anatomiques sur la structure intérieure et le squelette de plusieurs espèces de cétacés.' Paris, 1820 (opus posthumum).

³ 'Nieuwe Verhandelingen der eerste Klasse van het Koninklijk-Nederlandsche Instituut van Wetenschappen te Amsterdam,' Derden Deels, eerste Stuk. Amsterdam, 1831.

⁴ Loc. cit.

⁵ 'Skelette der Cctaceen,' 1827.

⁶ 'Medicinische Zoologie,' i Bd., 1829.

⁷ 'Recherches sur les ossemens fossiles,' tome v.

⁸ [A very large, but not quite perfect skull, formed part of the Hunterian Collection now in the Museum of the Royal College of Surgeons of England.—W.H.F.]

we have not only a satisfactory proof of its being a different species from the Greenland whale, but, at the same time, the first complete description of the skeleton of any right-whale; accordingly this skeleton has been considered as the best type of that of the right-whales in general. We, however, venture to assert that the skeleton of the Greenland whale is better adapted to this purpose than that of the Cape whale, especially as compared with the osteology of the plaited-bellied whales or Rorquals (Humpbacks and Finners), because the first result of any comparison between the Cape whale and the Greenland whale must always be that the latter forms a more complete contrast to the Rorquals than the former, as it is in this species that the whalebone, the enormous development of which is the most peculiar character of the right-whales, reaches its greatest length, and all those most important peculiarities of organization concurrent with this extraordinary development of the whalebone must follow step by step with it.

But we have still another reason to use the Greenland whale instead of the South whale from the Cape as a type of the genus of right-whales (*Balæna*), a reason, too, which, after what has been stated before, may seem surprising, namely, that, troublesome and expensive as it always must be to procure the skeletons and viscera of such colossal animals as the right-whales, yet this trouble and expense will generally be found to be much less considerable in the case of the Greenland whale than in any other species, as long as it is only with its regular coast fishing-places in Greenland, and not with those of the South whales (on the coasts of Africa and New Zealand), that the European museums have any communication; and to this we must add the readiness to serve our purpose, for which we cannot be sufficiently thankful, that has always been shown to Danish museums and men of letters by the Royal Direction of the Greenland Trade, and by the functionaries appointed in the northern and southern inspectorate, formerly more especially Major Fasting and the lamented Captain Holböll, and more lately Dr. Rink and Mr. Ohik.

For it is not, as we have been taught by experience, from the whalers, but from the regular fishing-places on the coasts, that we may hope to obtain the materials necessary to the study of the right-whales. How successful we have been in this respect will be proved by the list of the materials at our disposal for these researches.

1. The skeleton of an individual about forty-seven and a half Danish feet (forty-eight feet ten and a half inches English) long, stated to have been a male. It was given, in the year 1846, for a comparatively small sum to repay expenses, by the late Captain Holböll to the keeper of the Zootomical and Physiological Museum of the University of Copenhagen (Eschricht), and by the latter to the museum, in which it was exhibited until the winter of 1860-61;¹ and it is especially from this that all the figures, with one exception, have been taken on the second, the fourth, and the fifth plates illustrating our memoir. But though in other respects complete, it had this defect, that all the foremost caudal vertebræ were totally disfigured by large exostoses; and as its pelvis consisted of only two bones on either side, the third, which we consider to be the most interesting, being absent, its place has now been conceded to the one we shall mention next, which, with all the good qualities of the former, had neither of these essential defects.

2. The complete skeleton of a full-grown male, forty-four and a half feet long, caught in the

¹ It is now in the Museum at Brussels.

winter of 1859-60, near Holsteinsborg, and most carefully prepared at that place under the superintendence of Mr. Elberg, the administrator of the factory. Late in the autumn of 1860, after this essay had been laid before the Society, it was forwarded to the keeper of the same museum. With the skeleton followed several other parts of the same individual, all preserved in salt, namely, the foremost and hindmost parts of each series of the whalebone, the penis, the eyes, those parts of the skin in which the blow-holes and the external openings of the ears are situated, and, finally, the entire larynx.

3. The equally complete skeleton of a young individual of the female sex, twenty-two feet four inches long. It was sent to the Royal Museum of Natural History in the autumn of 1857 by Mr. Olrik. The whole of the whalebone was still attached to the palatal surface, and the pelvic bones, as also the larynx with the trachea, followed.

4. A new-born cub of the female sex, which had been harpooned on the 6th of May, 1843, by an English whale-fisher, near Godhavn, while it was accompanying the mother animal, and which the captain of the whaler, when he visited this harbour, twelve days afterwards, presented to Major Fasting, who again, as stated in our preface, presented it to the Royal Museum. When it arrived at Copenhagen, in brine, in the autumn of the same year, its length was thirteen feet, of which the head occupied four feet, or between two sevenths and one third of the whole length. The skin has been stuffed, and is exhibited in the museum, as is also the skeleton, which, in its present state, after having been dried, is only eleven feet nine inches long, of which the head occupies three feet nine inches, accordingly almost one third. The viscera were transferred by the administration of the Royal Museum at the time being to the Zootomical-Physiological Museum.

5. The head of an almost full-grown foetus of nearly the same size as the last named, viz., three feet eight inches long. It was sent in brine by Captain Holböll in the year 1854, and the greater part of it is now preserved in spirit in the Zootomical-Physiological Museum.

6. A female foetus eight and a half feet long, the head two feet ten and a half inches long, also sent down in brine by Captain Holböll, and now preserved, in portions, in spirit, in the same museum.

These materials for the study of the external and internal structure of the Greenland whale are, comparatively speaking, extraordinarily rich, considering the fact that hitherto not even a single complete skeleton of this remarkable animal has been at the disposal of naturalists. As to the outward form, our observations have been almost entirely confined to the new-born specimen preserved in brine; and as to the viscera, our information is still deficient in more than one respect; but this cannot be said to be the case as regards the more solid parts, especially the skeleton.

It is a peculiarly favorable circumstance in this store of materials that it is composed of individuals most different as to age and development—two skeletons of nearly full-grown individuals, one of a half-grown one, a new-born individual, and a foetus in the last half of uterine gestation.

It is still to be added that, through the kindness of Professor Sundevall, one of us was permitted, in the summer of 1842, to examine and ascertain the dimensions of a foetus sixteen and a half inches long which is preserved in spirit in the Museum at Stockholm, so that we shall hardly say too much when we declare that the differences of age peculiar to this species have, in almost all respects been made perfectly clear to us. As to the differences of sex, we

have been less fortunate, the two oldest individuals having both been males, the younger ones, on the contrary, females.

As extremely advantageous to our purpose we must finally point out the fact that we have been able to preserve in spirit the fetus at the middle of its uterine life, and the head of the full-grown fetus, after they had been divided into several pieces. That we cannot do without specimens with all the parts in their natural connection, not even in the examination of the skeleton, if it is to be comparatively complete and accurate, will not be less true as to the Cetaceans than as to any other family of animals. Without being able to examine such specimens, we can neither form a correct idea as to the natural position of the pectoral limbs, or the juncture of the ribs with the vertebral column and the sternum, or the relation of the pelvic bones to the rest of the body. Nay, even when the bones have been subjected to the influence either of drying or putrefaction, we cannot in all cases in full-grown individuals, and scarcely ever when younger ones are concerned, obtain a correct idea of the form of single bones. The ossification proceeds very slowly, especially in the large whalebone-whales; in several bones it is not completed until very late; in some, as in the carpus and the phalanges of the five fingers, most probably never; but as long as a bone is still partially cartilaginous, especially on its surface or on its most prominent parts, generally speaking it will lose about as much of its natural shape whether the cartilaginous parts have shrunk from having been dried or have fallen off from putrefaction.

We have made use of our rich materials with the best of our ability in order to give in this essay a description as complete as possible of the external form of the Greenland whale, the cavity of its mouth and its whalebone, its skeleton, and its separate bones. Convinced, as we are, that the peculiarities of the right-whale family are most distinctly visible in the Greenland whale, as contrasted to the rorquals, we have, in describing it, continually compared it with the latter species; but supposing, at the same time that the Greenland whale and the Cape whale are each representatives of a special group of the family of right-whales, we have not less continually had our attention fixed on the Cape whale, at least as far as it could be done through Cuvier's description and figures.

The Greenland whale must, no doubt, be considered one of the most colossal of all animated beings. The much greater length of the large fin-whales is compensated for in it by a far more considerable thickness. The humpbacks sometimes exceed it in length, but then they are not so thick; the South whales, at least the greater part of them, are inferior to it both in length and in thickness; and among the toothed-whales only one animal is found which may, perhaps, in both respects, equal the North whale, *i. e.* the male cachalot.

In order to answer the question as to the size the full-grown Greenland whale may attain, we shall here give a few statements. The extraordinarily experienced and trustworthy whale-fisher Scoresby has, as is well known, stated, that the largest he ever saw were about sixty English feet or about fifty-eight Danish feet long; at the same time he is not sure but that they may exceed that length. From this statement, certainly, no one would infer that every Greenland whale which has not attained a length of fifty-eight feet or more is not full grown; it is a matter of course that among them, as among animals in general, larger and smaller individuals may be found. But the materials in our possession seem to prove that the individual differences in this respect may possibly be more considerable than might have been imagined.

We know that the bodies of the vertebræ are ossified in the same manner as the long bones, that is, first in the middle portion, then in each of the epiphyses, here in the shape of circular bony plates, after which the growth in length is still continued in the part not yet in a state of ossification, between the centre-piece and the epiphyses. When at length this part also is ossified, so that the three portions form one single continuous piece of bone, then the growth in length is quite finished. But when all the individual vertebræ cease to grow, the growth of the whole vertebral column must have stopped; and that the jaw-bones should still continue increasing in length is, at any rate, most improbable. We must, then, be guided by the well-known fact that the ankylosis of the vertebral bodies with the epiphyses forming their extremities is a certain sign that the skeleton has belonged to a full-grown animal.

Now, this sign is really to be found in one of the skeletons that we have been able to examine, but, strange enough, it is not in the largest of them, which is forty-seven and a half feet long, the head being eighteen and a half feet long, but it is in the one mentioned as No. 2, which is only forty-four and a half feet long, its head being seventeen feet seven inches long. In the larger skeleton the union of the vertebral bodies with the epiphyses is, indeed, nowhere so loose as to have rendered it necessary to nail them on in fitting up the skeleton, yet it was not, particularly in the thoracic vertebræ, of greater firmness but that they might have been separated by a small amount of force. The vertebral bodies and the epiphyses do not yet form one solid mass of bone, and as long as that is not the case a growth in length is still possible.

It must, then, be considered as a matter of fact that some Greenland whales are full grown though their heads are at least one foot, and the whole body at least three feet, shorter than in other individuals of the same species. We do not deny that the figures given as the results of our measurements of the smaller individual may be found to be somewhat too small; but this is certainly not the case in the head at all events, and can only be so in very small degree in the vertebral column, especially for the following reasons. No vertebra is wanted, not even in the end of the tail; for, in conformity with the general care taken in the whole preparation, the last eleven vertebræ were still found united by the concentric ligamentous intervertebral substance, and the very last was still united with the skin of the notch between the two expansions of the tail. It cannot be denied but that the intervertebral substance may have shrunk a little, but by this means the total length of the vertebral column can hardly have been shortened by more than an entire foot; for the intervertebral substance was by no means dried up, and, like the last caudal vertebræ, the remaining vertebræ, too, were still united in pairs in natural coalescence, in consequence of which it was easy to place them all at the proper distance from each other. The eleven caudal vertebræ that were still united measured just after we had received them, in the middle of September, 1860, three feet five inches, the interposed ligamentous substance being still very soft; two months afterwards, the same substance having become dry, no alteration was yet distinguishable in the length of the piece; but by the middle of April, 1861, or seven months afterwards, it had shrunk to the length of three feet two inches.

We therefore suppose that we are right in stating that some Greenland whales, at least, do not attain a greater length than forty-four and a half feet, or perhaps forty-five feet (forty-six English feet, or 14.12 metres), although it seems that others may grow longer, even by as much as a third. But another point must be here considered. It is a matter of fact that the small yet

full-grown individual just mentioned was a male. To make this perfectly sure, its penis followed in brine, and there was no possibility of its having been mistaken for another individual, as it was the only one that had been caught near the factory for two years past. Our other large skeleton was not full grown, yet very nearly so, and, though three feet longer than the former, yet it would, as full grown, always have been reckoned as a whale of inferior size; and of this specimen too it was expressly stated that it was the skeleton of a male. Few as these facts are, yet they may, perhaps, serve to give some strength to the opinion that in the Greenland whale, as in cetaceous animals in general (the Cachalots, and perhaps the Hyperoodons, alone excepted, forming in this respect quite a group by themselves), the males are inferior in size to the females, and that accordingly all statements about the greatest length of this whale will only be true in the case of the latter sex.¹

Of reliable measurements, we have only the six given by Scoresby,² and of the individuals measured the sex of only four is stated; two were males, and two females. The longest individual (fifty-eight English feet in length), was among those the sex of which is not stated. We may, perhaps, be permitted to presume that it was a female. The largest but one was a male, fifty-two English feet (fifty and a half feet Danish) long. Even if the measuring of Scoresby be supposed to have been made with the strict accuracy of our proceeding, and not along the curved line of the surface, but in a straight line from the foremost point of the mouth to the notch between the expansions of the tail, there is still no certain authority that the male of the North whale has ever attained a greater length than fifty and a half Danish feet, and a difference in size in such colossal animals of between forty-five and fifty and a half feet is scarcely more considerable, comparatively speaking, than that which may usually be found in individuals of the same species.

In order to determine the usual length of the Greenland whale at birth, we believe we are right in referring to the specimen mentioned in our list as No. 4, and figured in Plate I. It is true that it was already swimming freely about at the side of the mother animal when harpooned, but part of the umbilical cord was still attached. It has already been mentioned that at its arrival at Copenhagen, preserved in brine, it measured thirteen feet in a straight line. That the North whale at its birth is thirteen or fourteen feet long, or perhaps a little above that size, corresponds both with the usual statements and with the general rule that the greater Cetaceans at their birth measure between a third and a fourth of the full length of the adult animals—more exactly speaking, a fourth; while the smaller species, when newborn, already measure one third. Our individual was a female. That the males at their birth are smaller than the females, or less than thirteen or fourteen feet long, is at any rate improbable.

Most of the right-whales in the temperate oceans scarcely attain the size of the largest Greenland whales, though their females may sometimes become larger than the full-grown males of this species. Of those that live in the Southern Atlantic we know especially, by the measurements of Cuvier, that the skeleton of the Cape right-whale exhibited in the Paris Museum is 14m. 55 (= forty-six feet one third Danish) long. In the Museum of Bordeaux is a model in papier mâché of a right-whale fœtus, which was taken in 1831 by Roussel de Vauzème, in the neighbourhood of Tristan d'Acunha, and measured two feet eight inches long (French measure), which equals 0m. 866. On its label it is mentioned that the mother animal was

¹ See Appendix.

² 'Account,' i, p. 464.

twenty-one times as long, *i. e.* forty-three and one sixth French feet or fourteen metres, equal to forty-four feet and a half Danish. In the yard of the Museum of Paris a skeleton of a South Sea right-whale (a pregnant female) is exhibited, from the Bay of Acaroa, in New Zealand, which (according to the statement which M. Gratiolet, the distinguished naturalist at the Museum, was kind enough to give us) was measured at the fishing-place by Lieutenant Méryon, and found to be 15m. 9 long, that is, forty-nine feet two thirds Danish; and the female whale which Dieffenbach measured in Jackson's Bay, of the same island, and of which he brought home a drawing, upon which Dr. Gray founded his *Balæna antipodarum*, was sixty feet English, or fifty-eight and a quarter feet Danish, long; it was, however, considered to be an unusually large specimen.¹

Now, as to the right-whales at present nearly extirpated from the Atlantic north of the Equator, the more ancient whale fishers agree in stating them to be considerably smaller than the Greenland whale, not only in the circumference of the body, but also in length. Those right-whales, on the contrary, that live in the Northern Pacific seem, if not to exceed, yet to be quite equal in size to the Greenland whale. It is true that we do not know of any measurements of these whales made by professional naturalists; but, according to the information obtained by one of the authors (Reinhardt) during his stay in the Sandwich Islands, it seems, indeed, that they may attain a length of seventy feet. Thus he was told by the mate of the whaler, "Die Elbe," that this vessel, in the fishing season of 1846, somewhat to the south of Mount Kronotsky caught a right-whale, which was measured on account of its size, and was found to be seventy-one feet long, and forty-eight feet in circumference, its longest blades of whalebone measuring thirteen and a half feet.

Accordingly the length of a right-whale cannot by itself, except in rare cases, be of use in determining to what species it belongs.

As one of the most essential characteristics of the Greenland whale we must mention the disproportionate size of its head as compared with the rest of its body. In this respect, all the right-whales are superior to the rorquals, but among the right-whales themselves the first place must be assigned to the Greenland whale. This observation is not, however, equally true of all individuals of the species; nay, it is even stated by Captain Scoresby,² so well experienced in these matters, that the difference is so great, that it might almost lead to the supposition of there being several sub-species or varieties among them. Thus, in some individuals, he found the head to be four tenths of the whole length of the animal, in others scarcely three tenths; he also found in some, the circumference of the body to be upwards of seven tenths of the length; in others less than six tenths, or even little more than one half.

We have also found in our skeletons dissimilarities of the same kind, but so far from supposing sub-species or varieties to exist, we believe that they will be found to indicate a regular difference of sex and age. Our measurements gave the following proportions:

¹ Dieffenbach, E., 'Travels in New Zealand,' vol. i, p. 44.

² 'Account,' i, p. 469.

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In the skeleton of the largest male	$\frac{\text{The head } 18\frac{1}{2} \text{ ft.}}{\text{The total length } 47\frac{1}{2} \text{ ft.}}$	$= \frac{37}{95} = 0,3895$
„ „ smaller male	$\frac{\text{The head } 17 \text{ ft. } 7 \text{ in.}}{\text{The total length } 44 \text{ ft. } 5 \text{ in.}}$	$= \frac{211}{533} = 0,3959$
„ „ young female	$\frac{\text{The head } 7 \text{ ft. } 7 \text{ in.}}{\text{The total length } 22 \text{ ft. } 4 \text{ in.}}$	$= \frac{91}{268} = 0,3396$
In the new-born female	$\frac{\text{The head } 4 \text{ ft.}}{\text{The length } 13 \text{ ft.}}$	$= \frac{4}{13} = 0,3077$
„ female foetus preserved in spirit	$\frac{\text{The head } 2 \text{ ft. } 10\frac{1}{2} \text{ in.}}{\text{The length } 8 \text{ ft. } 8 \text{ in.}}$	$= \frac{69}{208} = 0,3317$
„ very small female foetus (at Stockholm)	$\frac{\text{The head } 5\frac{3}{4} \text{ in.}}{\text{The length } 1 \text{ ft. } 4\frac{1}{2} \text{ in.}}$	$= \frac{23}{66} = 0,3485$

Here, indeed, we have also the proportionate size of the head sometimes nearly four tenths, sometimes even under three tenths (two sevenths); but it can hardly be supposed to be accidental, that both the large-headed individuals were full grown males, and all the small-headed ones young females. The only thing doubtful might perhaps be, whether the difference is rather a character of age or of sex. But such a doubt appears already to have been removed by Scoreby's statements. Numerous as the whales caught by this excellent whale-fisher were, he only measured them in very rare cases, limited, apparently, to the six before mentioned. At all events he has not informed us of the results of other measurements, so these are the only ones available. These six measurements¹ showed the following results:

Sex.	Length.	Length of the Head.	Ratio.
Female	17 ft. Engl.	5 ft. Engl.	0.2941
Male	28 „	8 $\frac{1}{2}$ „	0.30356
Female	50 „	15 $\frac{1}{2}$ „	0.3100
Not stated	51 „	16 „	0.3137
Male	52 „	20 „	0.3846
Not stated	58 „	19 „	0.3276

It will be seen that, in the four of these cases in which the sex is stated, the ratio is in the large male 0.3846, almost exactly as in our two large males, in the small male (twenty-eight feet) only 0.30356, even smaller, therefore, than in the female (twenty-two and a half feet long) measured by us. We have, then, some reason to suppose that the extraordinary size of the head is only developed as the animal advances in years; but by the measurements of the two females

¹ 'Account,' i, p. 464.

it is also shown that the head of the large individual (fifty feet long) was only 0·31 of the whole length; the surpassing size of the head will accordingly appear to be peculiar to the older male alone. This inference would become far more certain if we dare presume that the two individuals measured by Scoresby, whose sex he has not stated, both of them large ones (fifty-eight and fifty-one feet), and both with a comparatively small head (0·3276 and 0·3137), were females.

To express this result in few words:—The head of the Greenland whale at the time of its birth must be supposed to be between two sevenths and one third of the whole length of the body, in living specimens most likely nearer two sevenths, in those preserved in brine or spirit (on account of the shrinking of the vertebral column), nearer one third; it continues in the female throughout its life to be one third or somewhat less; but in the male, during its growth, the head will ultimately come to exceed one third; nay, even become as large as two fifths. Thus the male, though somewhat smaller than the female will, nevertheless, be found to have a much larger head, even absolutely speaking.¹

In comparing our measurements with those of Scoresby it will easily be observed that the relative size of the head is, on the whole, stated somewhat higher by us than by him; and his measurements having been taken from fresh individuals, ours from skeletons or specimens that have been kept for a shorter or longer time in brine or spirit, one might perhaps feel inclined to think his more trustworthy than ours. Nor can it be denied that we never can be perfectly sure, when speaking of a skeleton, that the vertebræ are placed at the right distance from each other; nor that, when speaking of the specimens preserved in brine or spirit of wine, we can with certainty make due allowance for the shrinking of the intervertebral ligaments. But before we should absolutely prefer the measurements of Scoresby to ours, it would be necessary to know, not only whether the measures are taken in a line parallel with the axis of the body, (which, perhaps, we ought to consider as a matter of course) but also, where he fixed the limit between the head and the body. In the skeleton we can hardly hesitate in setting it in the articulation between the occipital bone and the atlas. Above this point we find, externally, both the auditory orifices and the anterior angle between the breast fins and the body. But these orifices are extremely difficult to find, and it may be doubted whether Scoresby has considered everything placed before the fins as forming parts of the head. If he has taken the limits between the head and the body to be somewhat in front the point in question, he must have rated the comparative size of the former too low.

We might be tempted to believe that in the South whale group some species may be found with heads proportionately as large as those of the North whales, when we consider the fact that their whalebone may attain to even the greatest length of the whalebone of the Greenland whale (fifteen feet). Nevertheless, it is a fact, that in those few skeletons of this group which have hitherto been measured, the head has always proved to be under a third of the total length. According to Cuvier's measurements, the great Cape whale was 14m. 55 long ('Ossem. Foss.,' vol. v, p. 384), its head (*ibid.*, p. 377) 4m. 30, or only $\frac{80}{291}$ instead of $\frac{97}{291}$ —one third.² The head of the young one is stated in the same work at p. 368 to be only two feet long, but

² See Appendix.

¹ The ratio will, indeed, be made higher—even above one third—if we follow his statement of the size of the head of the same skeleton nine pages before (p. 368), namely, 15 pieds; for this would make 4 m. 87.

at p. 377, 1m. 2, that is three feet nine inches; the total length of the skeleton is not mentioned. While at Paris one of us (Eschricht) measured this skeleton, and found it to be 4m. 05, the head 1m. 05, accordingly $\frac{21}{31}$, or only little more than one fourth.

According to the above-mentioned statement of M. Gratiolet, the whale caught in Acaroa Bay measured, just after it had been killed, 15m. 90 (fifty feet and two thirds), the head, 4m. 22 (scarcely thirteen feet and a half), very little more, therefore, than a fourth (0.2654) of its total length. The head of a fœtus thirty-one inches long, taken out of a whale caught near Kamschatka, and belonging to the same group, was only nine inches long, therefore $\frac{9}{31}$ instead of one third. Finally, that the Nordkaper had a comparatively still shorter head, is clearly proved by what has been stated of this species in the preceding part of our essay.

EXTERNAL CONFORMATION.

Our observations upon the external characters of the Greenland whale are almost totally limited to those we have been able to make on the newborn individual presented to the museum by Major Fasting. Besides this, we have only had for this part of our researches the following materials: 1. The head of a full grown fœtus. 2. The fœtus, eight and a half feet long; and finally, 3. Some few disconnected portions that followed the skeleton forty four and a half feet long.

At the first glance at the young Greenland whale, the length of which was, as we have mentioned, thirteen feet (Plate I, fig. 1), we were struck by the plumpness and robustness of the shape of its body, and its considerable thickness, very much out of proportion to its length, (peculiarities by which the right-whales in general, but more particularly the Greenland whale, are distinguished from all the rorquals,) although, as yet, only a very inconsiderable layer of blubber had been formed under the skin.¹ The body has its greatest circumference at a point almost midway between the fins and the vent; the vertical diameter is in this place one fifth or one fourth of the total length of the body (Plate I, fig. 1), so that the circumferences of the body may here be reckoned to be three fourths of its total length.

From the rounded point of the snout the upper contour of the head rises gently towards the blow-holes, situated on the top of a small elevation. This elevation and the occiput form the highest points of the entire body. Behind the blow-holes the outline is at first a little lowered, but then again it gradually rises to a slightly arched elevation indicating the situation of the cerebral cavity, evidently a remnant of the fœtal form. The shape of the head when seen from above (Plate I, fig. 2), will be found to differ much from that of the rorquals. It is broadest between the eyes; immediately before these it is suddenly contracted into three fifths of this breadth, and it continues to taper until it ends in the roundish outline of the muzzle, so that the upper jaw, properly so called, resembles most a beak with an arched surface above and abruptly sloping sides, especially towards the point. The lower edge of the upper jaw (see fig. 1), was already in the fœtus, and still more in the newborn cub, curved in the direction

¹ In a young whale, about nineteen feet long, Scoresby found already a layer of blubber five inches thick. See W. Scoresby, 'Journal of a Voyage to the Northern Whale-fishery,' Edinb., 1823, p. 149.

of its length, although only slightly, when compared with that of older individuals. Along its anterior half a narrow but thick upper lip extended, broadest before, but getting narrower though thicker behind, and at last disappearing at a distance of one foot and two thirds from the point of the snout.

The outline of the lower lip, as seen from the side is sigmoid, so that the angle of the mouth is situated a little lower than the symphysis of the under jaw. The angle of the mouth is just beneath the eye, but its fissure may be traced on the surface of the skin a little farther backwards. The lower jaw was already in this newborn individual considerably broader than the upper jaw. Its two rami meeting in front under the muzzle, were curved so much outwards as to extend about their middle, much beyond the upper jaw. For the purpose of covering this interval, an under lip of considerable thickness below, but having a sharp upper edge, ascends from the uppermost part of the lower jaw in an oblique and inward direction. It has its greatest height (thirteen inches) about midway between the foremost point of the snout and the angle of the mouth, though somewhat nearer to the latter. Posteriorly it gradually diminishes; towards the front, at a distance of about seven inches from the symphysis, it sinks abruptly downwards, so as to produce a roundish hollow into which the somewhat prominent point of the snout fits while the mouth is shut. At the same time, the lateral edges of the under lip are placed along the upper jaw, completely hiding the comparatively small upper lip.

The external nostrils, the so-called blow holes, are situated as already mentioned, on the top of an obtuse elevation, called by whalers "the crown."¹ Their distance from the point of the snout was, in the newborn specimen, two feet five inches. We have had an opportunity of examining them, not only on this individual and the two fetuses, but also in the full-grown, forty-four feet and a half long specimen. They have the form of two arcs of a circle (three inches long in the young, and eight inches in the full-grown one), with their convexities turned towards each other (Plate I, figs. 2 and 3), but so that their distance from each other is much less before (in the young seven lines, in the full grown one two inches) than behind (in the young two inches seven lines, in the full-grown one seven inches and a quarter). The inclination of their foremost corners in a contrary direction, or towards each other, was only very slightly indicated in all the specimens, both old, young, and foetal, certainly not so much by far, as in Scoresby's figure.² The more ancient statements about the blow holes being sigmoid, or having the shape of the holes of a violin, must therefore be considered as wrong, or at least very much exaggerated.

On the inner side, the nostrils are limited by the cartilaginous septum of the nose, and have a sharp and unyielding edge. Outwardly, on the contrary, they are bounded by a thick tumid

¹ The Spitzbergen and Davis' Straits whalers, at least, call this elevation by that name (Scoresby, 'Acc. of the Arctic Reg.,' ii, p. 219, note); but the Southern whalers understand, according to the verbal communication of some of them, and the statement of Jules-Lecomte ('Pratique de la pêche de la baleine dans les mers du Sud,' Paris, 1833, p. 71), by the name of "the crown," an elevation a little in front of the one just mentioned (see Schlegel's figure of the Japan Right-whale in 'Fauna Japonica'), which in all the right-whales living in the more temperate seas, is regularly covered by coronulas and tubicinellas, as well as by dense crowds of cyami, thus acquiring a snowy colour, and serving as a mark to the whalers.

² 'Journal,' &c., p. 152.

fold of the skin representing the exterior wall of the nostril, that may be so contracted by muscular fibres, that either nostril is transformed into a circular opening, just as with the single nostrils of the toothed whales, when the tumid anterior lip, corresponding with the exterior walls of the two nostrils coalesced, is in a state of contraction.

The eyes are placed very low in the Greenland whale; in the newborn animal only two inches above the angle of the mouth, on the top of a small elevation, one foot and three quarters farther back than the blow holes. The fissure between the eyelids was in the newborn specimen only three quarters of an inch long, in the full grown individual two inches and a quarter; but before and behind it was prolonged by a sulcus on the surface of the skin, by which means its length became five inches and a half. The eyelids themselves were, in the full-grown specimens, six inches broad, and both taken together five inches high, of a yellowish-white colour, with small black spots like gunpowder marks; this colour contrasted very much with the jet-black colour of the skin around. In the young animal they were only moveable to a very small extent; in the full grown specimen they had, in consequence of having been preserved in brine, become as hard as wood; no eyelashes were found. The eyeball itself was very small, in the full grown animal two inches (that of the humpback being two inches and three quarters), when measured from the foremost to the hindmost point; its transverse diameter was two inches and three quarters (that of *Megaptera* being three inches and a half); the transversely placed pupil was seven lines long.

The external orifices of the ear were found in the newborn whale, to be nine inches and six lines behind, and one inch seven lines below the eyes; they were almost circular, and about two lines in diameter.¹ But in the relative position of these organs considerable deviations seem to occur; for in the fœtus that was eight feet and a half long, the orifices of the ear were found to be only three inches behind the eyes, and one inch higher than a horizontal line supposed to be drawn from the fissure between the eyelids in a backward direction. We have also had an opportunity of examining the orifices of the ear of the full-grown whale, of which besides the complete skeleton, we received several softer parts. They were so small that only a very fine probe could be introduced through them.

It is stated by Martens,² and still more positively by Scoresby,³ that several hairs are to be found on the lips of the Greenland whale, as in those of most other Cetaceous animals, especially when young. In the newborn whale, as well as in the two fœtuses, these had indeed fallen

¹ Scoresby's statements about this point of the structure of the whale, to be found in the two works in which he mentions the Greenland whale, seem to be somewhat inconsistent with each other. For this excellent, and generally accurate author, says, in his 'Journal of a Voyage,' &c., p. 154, "That he has found the external openings of the ear to be one sixth of an inch in diameter in a nineteen feet long sucker;" but in his 'Account of the Arctic Regions,' vol. i, p. 456, it is on the contrary stated, "The whale has no external ear; nor can any orifice for the admission of sound be discovered until the skin is removed." Fr. Cuvier has only followed the statement in the latter place when, in his book, 'De l'Histoire naturelle des Cétacés,' p. 367, he tells us that Scoresby has seen no auditory orifice in the Greenland whale.

² 'Spitzbergische oder Groenlandische Reise Beschreibung,' Hamburg, 1675, p. 98: "fornen an den Lefftszen unten und oben sitzen kurtze Haar."

³ 'Account of the Arctic Regions,' vol. i, p. 458.

out in consequence of the commencing decomposition, but the thick and soft epidermis (the "Mattak" of the Greenlanders) having been removed, all the holes in which they had been situated, resembling those made by a needle, were discovered. Each of these holes was found on the top of a small knob of the skin, about one line broad, being thus the more easily distinguishable (see Plate I, figs. 4 and 5). Judging by the number of these knobs, we should say that the Greenland whale has more hairs than hitherto have been found in any other Cetacean, though certainly the far greater part of them are collected on the anterior extremity of both jaws, while none are to be found along the upper lip, which is in other cases the place where they occur in the greatest numbers (in the toothed whales indeed they are not found anywhere else). On the muzzle sixty-six holes were counted in the newborn animal; in the fetus about fifty. Without being arranged in any precise order, they were gathered somewhat in the form of a crescent, the convexity of which was turned forwards and downwards (Plate I, fig. 5). On the lower jaw their position was quite different. On its foremost part on the symphysis, a space two inches broad was found without these hair knobs; but outside this space we found several, pretty regularly arranged in four or five rows (Plate I, fig. 4). Gradually, however, these disappeared in an outward and backward direction, except one row, which (Plate I, fig. 1) was continued along the base of the under lip, formed by six or seven holes at a continually increasing distance from each other, the last at a distance of about two feet from the middle of the lower jaw. On the right side of the lower jaw we counted forty-eight holes in the newborn specimen presented to the Museum by Major Fasting; on the left side there were fifty-five holes, by which it will be seen that the number of the hairs is not so constant in this as in many other Cetaceans. Around the blow holes, where both the Vaagehval (*Balenoptera rostrata*) and the Greenland humpback (*Megaptera longimana*) have several hairs growing, we did not find in this newborn North whale the least trace of any hair knobs, or opening in which hairs might have been growing. In the fetus, on the other hand, eight or nine hair knobs were distinctly visible encircling the hindermost corner of either blow hole. We might, therefore, feel inclined to suppose that these hairs fall out during the uterine life of the fetus; but on that piece of the skin that remained with the blow holes of the full-grown whale, we still found near the place in which the skin had been cut through, a single hair standing on a level with the hinder extremities of the blow holes. It was only ten lines long, about one third of a line thick, of a yellow colour, very stiff and solid, without the least trace of any infection.

Behind the slight elevation which indicates the position of the occiput, the outline of the back was a very little sunk in the newborn specimen, so that the foremost part of the back was somewhat hollow; but then, again, it arose in a very slightly curved line up to about the same height as that of the occipital prominence. Its most elevated point was almost directly above the umbilicus.

The outline of the belly was sinuous. Just before the fins it was bent a little inwards, which caused the body to appear in this place slightly constricted; then it ran towards the vent in a uniformly curved line of which the greatest curvature was placed somewhat nearer to the inflection before the fins, than to the vent.

The body was almost circular in the foremost part; towards the vent it became somewhat compressed at the sides, especially, in a downward direction, so that a section of the body in this place would be oval. In giving this description of the shape of the body we must not, however, forget to call the attention of our readers to the fact that the abdomen had been opened,

and the intestines removed, so that the shape of the living animal is likely to be somewhat different.

Near the vent the body imperceptibly passes into the tail. The length of the latter measured to the notch between the lobes of the caudal fin, was $\frac{11}{30}$ ths of the total length. A section through it is, just behind or close before the vent, of an oval form, but while tapering towards the fin it is at the same time compressed so that it gets an obtuse keel both above and beneath, which is still continued in the caudal fin where it is gradually lost at some distance from the notch between the lobes.

The caudal fin (Plate I, fig. 6), had almost the form of a Turkish crescent, if we except the roundish incision of the depth of about two inches between its two lobes. The distance between the points of these lobes was in the newborn specimen four feet two inches, so that the breadth of the caudal fin was four thirteenths of the length of the animal.

The vent was situated in the newborn sucker four feet in front of the notch in the caudal fin. It was, as is generally the case in the whales, angular with thick and wrinkled edges, the point turned forwards, while behind it had a breadth of six lines.

At a small distance before the vent (in the newborn animal two inches nine lines) we found the opening of the pudendum of the female, in the shape of a longitudinal fissure five inches and ten lines long, with thick edges. In the anterior end of the opening the clitoris was seen. It was rather thick at its root, then very much compressed, almost flat. It was so unsymmetrically attached to the vestibulum, by means of its two lateral parts that its point was turned very much to the left side. Its length might be reckoned at about two inches. Close behind the clitoris the outlet of the urethra was situated, at the foremost edge of which we found a conical wart, about three lines long, which may probably serve as a valve.

On either side of the pudendum of the female, and somewhat nearer its posterior than to its anterior end, is a lengthened fissure (in the newborn whale about one inch long), at the bottom of which the nipple is to be found.

The umbilicus was, in the newborn female, two feet three inches in front of the pudendum rather nearer to the foremost point of the head than to the incision of the caudal fin. In a section through the cord the two umbilical arteries and the two veins were seen, and in the middle the urachus.

The fins or swimming paws are placed very low and close to the back of the head; in the newborn individual only five inches behind the angle of the mouth, so that their anterior edge begins almost immediately beneath the opening of the ear. Their length in this specimen was two feet one inch, therefore one sixth or one seventh of that of the entire body; their breadth in the middle, where they are broadest, about half as much.¹ Close to the root they are slightly constricted; their anterior edge is only slightly curved, their posterior edge more strongly so; their extremities are very obtuse.

Of the most external, very thin, and horny layer of the epidermis no traces remained in any

¹ These measurements, compared with those of Scoresby ('Acc.,' i, p. 464), will show that the fins of the newborn Greenland whale are, comparatively speaking, somewhat longer, but narrower than those of the older animals, in which their length is always under one seventh, but their breadth nearly three fifths of the whole length. (Compare the description given afterwards of the skeleton.)

of the individuals examined by us, and even of the next layer beneath, consisting of flat epidermic cells, the foetus alone had still some portions left in several places. That layer of the epidermis, on the contrary, which is perforated by the long papillæ of the corium, and which, generally known by the name of *Mattak*, is highly valued in Greenland for the nourishment it affords, was found nearly everywhere, either still firmly attached to, or lying loose on the skin where the papillæ of the corium had been decomposed and torn. The thickness of the layer of the mattak, which in the Cetaceans always chiefly determines that of the epidermis, varied much in different parts of the body. It has its greatest thickness (one inch) on the back of the head and on the neck; near the blow-holes it was about seven lines, behind and beneath the eye only four lines. On the throat and the anterior part of the belly it was eight lines thick; on the fins and the lobes of the tail generally rather thin, especially towards their posterior sharp edge, where it was only one line thick. Finally, it appears to be equally thin near all the natural openings, where it is continued into the mucous membrane.¹

The colour, as far as it may be ascertained by that of the mattak, was still very well marked on the newborn specimen. On the entire upper part of the body it was bluish-black, towards the lower parts it gradually became lighter, and on the under side it was on the whole greyish; the throat however and the lower jaw had a chalky white colour, except the hindmost third of the underlip, which had the same bluish-black colour as the back. A small circular bluish-grey spot about four lines in diameter was found round each of the six or seven hairs affixed to the inferior edge of the underlip. Whether the same was the case with the far more densely growing hairs of the anterior part of the underlip could not be ascertained, as the mattak had come off in this place. The thick anterior edge of the fins was white from the root towards the outer corner, where the colour gradually became bluish-grey. Beneath the place where the fins issued from the body we found a whitish-grey spot, and finally the bluish-black colour of the back was continued directly from the vent over the whole tail.

CAVITY OF THE MOUTH.¹

From the examination of the exterior of the North whale we will now pass to the description of the cavity of its mouth, especially as far as the whalebone is concerned, founding our observations, as before, on the condition it presented in the newborn individual.

The tongue, extraordinarily large, is firmly fixed almost as far as its obtusely rounded point; its thickness (height) is greater than its breadth; it is broadest (seven inches) in the

¹ In a sucker nineteen feet long, Scoresby asserts that he found the epidermis one inch nine lines (English) thick; but, strange enough, when speaking of the full-grown animal, he states that its epidermis has only half the thickness of the newborn sucker ('Journal,' &c., p. 149). In some detached portions of the skin, which were sent us with the forty-four and a half feet long skeleton, and which had been taken near the openings of the ears and the blow-holes, we, however, found the thickness to be six or seven lines, or just as thick (especially in one of these places) as in the newborn sucker; and indeed it is not very probable that the epidermis should decrease in thickness during the growth of the animal.

posterior part of its anterior half. Its upper free surface is slightly arched behind, but becomes flattened in the fore part, and even a little hollow towards the point. This superior surface meets the lateral surfaces in an edge which becomes sharper and more distinct towards the point; the lateral surfaces are slightly furrowed longitudinally. The tongue was of a very light liver colour, and at the bottom of the furrows of the lateral surfaces it became almost white. According to the statement of Major Fasting, its colour was exactly the same in the fresh-killed animal before it was placed in salt. The epidermis had come off almost everywhere, and in those very few and small spots where it still remained it could be very easily pulled off. When this was done it appeared very distinctly that the skin beneath is provided with a multitude of short extremely fine papillæ, which, as on the entire surface of the body, are hidden beneath the smooth surface of the horny layer of the epidermis.

The roof of the mouth or the palate is formed, as in whalebone whales in general, by two sides converging obliquely downwards and meeting in a sharp edge, only that these sides in conformity with the peculiar form of the upper jaw are far more narrow than in the fin-whales and humpbacks, and that they, except in the posterior part towards the pharynx, descend far more abruptly towards the mesial line of the palate, so that the edge in which they meet is situated very much lower than the upper lip, which certainly is in itself of very small dimensions.

What particularly attracts our attention in any description of the cavity of the mouth of a whalebone whale, must, of course, be the whalebone system so characteristic of this family. Everybody knows that this consists of several hundred horny blades placed transversely on either side, hanging down from the converging sides of the palate, so that only the mesial line of the palatal surface is left bare. As all horny parts are produced in the form of a sheath on the skin beneath, which serves them as a germ or pulp, the form and position of the whalebone-blades alone will show that they are produced on as many transverse folds of the skin of the palate, and we may get an almost exact idea of the outlines of the soft pulps of the whalebone by examining the horny whalebone-blade. We say "almost exact," for the horny part, produced in the form of a sheath round its pulp, may, as it is very well known, grow more or less freely in an outward direction without a corresponding increase of the pulp. Each blade of whalebone (all those pieces included into which it may appear to be divided or split, not only the large external plate or the baleen, properly so called, but also all its internal narrow plates or subsidiary plates as we call them) has the shape of a lengthened triangle, the shortest side of which is fixed to the palate, while the remaining two sides are free; one of these is turned outwards and is smooth, the other is turned inwards and downwards, and fringed by more or less flexible hairs or bristles. The consequence of this must be that the corresponding pulp of a whalebone-blade (that of the external baleen and all its subsidiary laminæ taken together) must also be triangular and more especially have its superior edge fixed, while its exterior is free and smooth, and the interior one is turned downwards and provided with the hair pulps corresponding to the hairs; but it cannot be determined beforehand how far this cutaneous pulp enters into the horny blade, nor how far the hair-pulps or the filaments on the interior and inferior edge of its blade-like part enter into the hairs or bristles.

Several naturalists have already had opportunities of observing the baleen-matrix of stranded whales in its whole extent on the sides of the palate, the horny parts having fallen off in consequence of commencing decomposition. Such observations have been made by Rosenthal on a

fin-whale stranded on the island of Rugen in 1825;¹ by Ravin on a fin-whale stranded on the northern coast of France in 1829;² and by one of us (Eschricht) on the great fin-whale that was driven ashore in 1841 on the north-western point of Zealand.³ We had an equally favorable opportunity of observing these parts in the newborn Greenland whale sent down in 1843, on which we may still found our description. In this, too, the horny blades had fallen off, owing to imperfect preservation in the brine; but their blade-like pulps were still uninjured on the sides of the palate, affording us some valuable information about the whalebone in this species as well as, most probably, in the right whales in general. In the foetus the horny part of the whalebone blades was still fixed, but only as a very thin and fine layer on the lateral surfaces of the pulp. On the mesial parts of the palate, which is not provided with whalebone nor, of course, with any baleen-pulps, the skin was found to form a longitudinal ridge, which extended in the shape of a lip a little over the part occupied by the baleen-pulps; this elevation or ridge gradually disappears behind, but in its foremost part it is widened rather suddenly toward the point where it meets and joins the upper lip. (See Plate I, fig. 7.)

On first observing this peculiarity in the newborn Greenland whale which arrived at Copenhagen in the autumn of 1843, one of us (Reinhardt) immediately saw its great importance, especially as in itself it seemed to prove that the two sets of whalebone cannot meet in front in the Greenland whale, although the supposition of their joining each other across the anterior part of the palate had hitherto seemed to be well founded.

It is true that Rosenthal has stated that the two sets of whalebone were separated from each other before as well as behind in the fin-whale stranded on the coast of Rugen in 1825; but it had been pointed out by Prof. Krøyer already in 1839,⁴ that in the "Vaagehval"⁵ they are perfectly joined in front, in an obtusely pointed end, and leave only a small interval between each other behind, and we have not only found this statement perfectly confirmed, as far as this species is concerned, but also in the case of the common great Northern fin-whale (*Balenoptera musculus*), especially in the one stranded on the north-western point of Zealand, and also in a younger individual, the anterior part of whose palate was sent by Captain Holböll, preserved in alcohol.

Now, as to the humpbacks (*Megaptera*), it has indeed been expressly stated of them also, especially of the Greenland species (the "Kreporkak"), that an interval was left in front between their sets of baleen,⁶ but a preparation of the anterior part of the palate of a "Kreporkak," which was sent by Captain Holböll for a more accurate examination of this very part, and is preserved in the Zootomical-physiological Museum in spirit, together with the two similar preparations of the great fin-whale, will make it perfectly clear that this statement is erroneous, and that the humpbacks in this respect do not differ in the least from the fin-whales.

¹ "Ueber die Barten des Schnabel-Walfisches," in the Transactions of the Berlin Academy for 1829, p. 127.

² 'Annales des Sciences Naturelles,' 2me Série, t. v, p. 266.

³ 'Kong. Danske Vidensk. Selskabs Naturvid. og Mathem. Afhandlinger,' 12te Deel, 1846, p. 358.

⁴ 'Naturhistorisk Tidsskrift, udg. af H. Krøyer,' 2d vol. (1838-39), p. 633. As far as this whale is concerned, the same fact had even previously been mentioned by Hunter, 'Philosoph. Transactions,' vol. lxxvii, t. ii, p. 402.

⁵ The Lesser Fin-Whale, *Balenoptera rostrata*, (Fabr.) *Pterobalena minor*, Esch.

⁶ O. Fabricius 'Fauna Groenlandica,' p. 37: "interstitium tamen anticum sine lamellis."

Thus, as we may venture to state that in all rorquals, humpbacks as well as fin-whales, the two sets of whalebone meet in the mesial line on the anterior tip of the palate, we might feel the more inclined to suppose that the same was the case with the baleen of the right-whales, and especially with that of the Greenland whale, as Zörgdrager has even given a special illustration to show the position of the baleen in this species,¹ in which the two sets are quite distinctly seen to meet in front, and neither Captain Scoresby nor any other person of authority on the subject has made any objection to the correctness of this illustration.

Nevertheless, the condition of the skin of the palate in the newborn Greenland whale showed distinctly enough that the two sets of whalebone, far from meeting each other at the tip of the jaw, on the contrary receded from each other, each of them terminating in a point (Plate I, fig. 7). In the individual twenty-two feet long, the whalebone of which was still attached to the palate, we also found this observation completely confirmed, and having finally, in 1860, received with the full-sized skeleton the foremost and hindmost parts of both sets of whalebone of the same individual still adhering to the gum or matrix, and finding our observations confirmed in this case also, it must be considered a matter of fact that the two sets of whalebone of the Greenland whale are completely separated in front, contrary to what has been stated by the experienced whalefisher Zörgdrager. That this character is not peculiar to the North whale alone, but to the right-whales in general in opposition to the rorquals, is quite probable in itself, but is further corroborated by its having been as it seems indicated in Cuvier's small figure of the newborn Cape-whale in his "Ossemens Fossiles," though he makes no mention of the fact in his text.

As to the relative position of the two sets of whalebone at their posterior ends just before the gullet, it can, as far as the rorquals are concerned, be proved with the same certainty that they here remain separated from each other, as that they meet at the tip of the jaw.² That the same is the case in the Greenland whales, that even here no connection exists between the posterior ends of the two sets of whalebone, has been most clearly proved to us by the complete sets of whalebone of the twenty-two feet long individual, as well as by the extremities of those of the full-grown animal.

The foremost enlarged part of the naked skin of the palate, especially as far as it is situated in front of the anterior ends of both sets of whalebone, evidently corresponds to that part of the palate which in the rorquals is situated before the coalesced sets of baleen; and indeed, we see in the newborn whale two blind pits like those described in a former essay,³ and supposed according to our interpretation of them to be traces of the Stenonian ducts, only that they have a different form, being narrow transverse fissures on either side with their concavity turned forwards.

Passing to the consideration of the pulps of the whalebone, and comparing them with those of the rorquals, we shall, in this respect too, discover rather an interesting difference.

In every whalebone whale the mucous membrane of the palate, as far as it is clothed by an

¹ 'Bloeyende Opkomst der Aloude en Hedendaagsche Groenlandsche Visschery,' &c., Amsterdam, 1720, p. 81. In the German translation printed in Leipsic, 1723, p. 129.

² Ravn's figure, l. c., shows the two sets of whalebone of the fin-whale, examined by him, meeting both before and behind. By this latter erroneous statement the importance of the former correct one is, no doubt, not a little diminished.

³ 'Kong. Dansk. Videnskab. Selskab. Nat. og Math. Afh.' 12te Deel, p. 360.

uninterrupted series of baleen, must also be considered as one entire matrix of whalebone. This is limited inwardly by the lip-shaped border before mentioned, running along the middle of the palate, outwardly by a similar but much higher fold of the membrane in close connection with the exterior surface of the whalebone plates. These two folds form together the "*Krandsbaand*" (wreath-band), as it is called.

The Greenland whale has two matrices, one on either side; in the rorquals the matrices coalesce in front into one. In both of these matrices we must distinguish between those parts which project in the shape of blades or filaments, which we shall denote by the name of pulps, or pulp-blades, and the intervals between them where the membrane of the palate is smoothly extended over the bone. In the former as well as in the latter parts of the surface of the matrix, epidermic cells are continually forming, but the cells of the pulp-blades and those of the smooth intervals are essentially different from each other, the former hardening into a horn-like substance, the latter not. The horny whalebone-blades are formed separately each on its own pulp-blade, and are only kept together (besides by the fold encircling the whole set of whalebone) nearest to the palate by the soft cells on its smooth intervals. But these cells always form here a layer several inches thick, so that in the newborn specimens scarcely more than the hairy bristles of the whalebone-blades projected beyond it. The cells, of course, are perfectly homologous with epidermic cells in general. It can only be considered as a simple consequence of the influence of the surrounding water, that instead of drying up in the form of scales, like epidermic cells in general, they form in this place a soft white substance, most analogous to the mucus of the mucous membrane. As it is principally situated between the blades of whalebone, we shall often in the following part of our memoir simply denominate it by the name of the "intermediate substance" (called the "gum," by Scoresby).

By the name of a blade or lamina of whalebone we have hitherto understood not only the chief blade, but, at the same time, all the subsidiary blades inside the chief blade. The chief blade, however, is in all right-whales, and especially in the Greenland whale, so disproportionately large, particularly in point of length, that its subsidiary blades are most commonly not noticed at all, and the name of "a blade or lamina of whalebone" means generally only the exterior chief blade. The length of the adjoining and therefore largest subsidiary blade may always be ascertained simply by measuring the interior edge of the chief blade, which is parallel with, but a great deal shorter than, the exterior edge.

In the horny whalebone, in the chief blade as well as in each of its subsidiary blades, we must distinguish between the exterior solid layer, the cortical layer, or the "enamel" as it has been called, and the interior medullary part consisting entirely of horny fibres. In the natural position of the blade the medullary part issues from that edge of the pulp, which is turned downwards and inwards, whereas the enamel is prolonged in the form of a sheath over the whole surface of the pulp, until it ends in a free margin quite up at the place where the pulp rises from the common matrix. This part of the enamel, which, instead of enclosing the medullary tissue, sheathes the pulp-blade itself becomes thinner the nearer it approaches to the fixed edge of the latter; near the free margin which encircles the entrance of the cavity of the blade into which the pulp fits, it is so extremely thin that the margin itself is scarcely ever to be seen in its natural sharp outline. When the blade is pulled with due caution off the pulp, we may easily be convinced that where nearest to the mucous membrane of the palate, it imperceptibly loses itself in a layer of the soft white substance. In other words, the limit between the horny cells of the pulp-blade and

the soft cells of the smooth intervals is not so sharp, but that the nearest approaching cells of the latter may also become somewhat horny.

We have stated before that the formation of the cells on the whole surface of the pulp takes place continually. But in this continuous formation of cells certain periodical changes can very easily be traced, especially by those small transverse elevated lines which are seen more or less distinctly on the two lateral surfaces of each blade of whalebone at pretty regular distances from each other. John Hunter pointed out¹ that these transverse rings are imperceptibly lost in the extremely fine membranes that divide the layers of the soft intermediate substance (gums) from each other, though, it is true, only rather indistinctly. Besides this, he observed in each transverse ring an immediate connection between one of the extremely fine membranes of the soft intermediate substance and the most external layer of the cortical tissue beneath the ring. But in his supposition that he might conclude from this that the cortical tissue of the whalebone-blades is formed out of the soft intermediate substance, we by no means agree. To explain the connection between the two we need only, in addition to the description we have just given of the cells that are, and those that are not, converted into horn, think that the periodical changes in the formation of both are contemporaneous, and then it will easily be seen that the relation between them must be exactly as Hunter has already described it to be. All the layers of the cortical part can only be supposed to be formed from the surface of the pulp-blade. The more rapidly the blade grows, especially when the animal is young, the fewer layers will be added *from within* to those layers of the enamel that already have become horny, and the thinner this enamel will be found to be; but the more slowly the growth of the blade takes place, as in a more advanced time of life, the thicker the enamel will be. In the subsidiary blades of the twenty-two feet long individual there is a peculiarity which leads us to suppose that the formation of the cortical tissue may even be quite suspended for a time. For throughout the whole length of the set of whalebone, except a small portion anteriorly, these small ribbon-like blades want all the cortical covering in the middle third of that length, by which they project from the soft and white intermediate substance, and in this part they appear like mere fasciculi of bristles, completely resembling those on the free edge of the blade, whereas the cortical layer is formed perfectly normally, not only above but also beneath the place mentioned.

The rings of the whalebone-blades with the fine membranes often attached, even in dried specimens, and having always their free margins turned towards the palate, prove as we have said a periodical change in the formation of the cortical part. But we are not yet in possession of the necessary data for ascertaining the length of these periods. We are able, however, to state that they do not correspond to the revolutions of the years. For in the blades of our twenty-two feet long skeleton we find already many such rings, and yet it is certain that, considering the rapid growth of these animals, the Greenland whale, which at its birth is about thirteen feet long, must be supposed to have attained a size of twenty-two feet by the end of the two ensuing years. We should be far more inclined to explain the interruption of the cortical tissue in the subsidiary blades of the same individual just mentioned as evidence of a periodical change in the cortical formation corresponding to the change of the seasons of year, as it would denote an age of two years, just the age which this half-grown animal may be supposed to have attained, judging by its size.

¹ 'Philosophical Transactions,' vol. lxxvii (1787), p. 404.

As the cortical layer of the whalebone-blades is formed from the surface of the pulp, the medullary tissue must be supposed to be formed from its free edge turned downwards and inwards. The medullary part consists chiefly of horny tubes, the same that on the inner edge of the blade project freely in the shape of bristles, as the cortical layer disappears in this place or is at least partly worn off; and as the pulps of these bristles we have already indicated those soft filaments found on the inner and lower edge of the pulp-blade. These filaments are so numerous that the entire pulp-blade may here be truly said to be quite fringed out in them. In the fin-whales especially we have seen most distinctly that these fibres formed at least three longitudinal rows on the whole extent of the free edge. We have already reminded our readers of the fact that it can never be ascertained beforehand how far a hair-pulp extends into the interior of a hair or bristle; neither are we in like manner able to state how far these soft filaments extend into the fibres composing the medullary tissue of the whalebone-blades. In the rorquals they pass very far into them. In the fin-whale stranded in 1841 on the North point of Zealand the pulp-blades laid bare by the coming off of the horny baleen were seen; about 400 of them were found on either side, the largest more than two inches high, provided with fibres more than three inches long, floating in the clear water of the sea and presenting a remarkably fine sight.¹ Nor is it less instructive when, in a macerated piece of the whalebone of a large fin-whale or of a humpback, the entire pulp can be successfully extracted out of its horny blade without tearing these filaments. We have in this manner found them to be so long in a Greenland humpback that they probably extended halfway into the whalebone blades, which are comparatively speaking very short. As for the rest, it is very easy to see in any given blade of whalebone how far the pulp-blade has extended into it, for it must of course be just so far as the horny baleen-blade is seen to be hollow internally. The same may even be said about the filamentous pulps of the hairs, only that it is necessary for this purpose to lay open the interior of the blade with a knife.²

Now to return to the more particular consideration of the whalebone laminae of the right-whales, and especially those of the Greenland whale. We shall first examine the relation between their horny parts and their pulps, and must direct the attention of our readers to the interesting fact that whereas their horny blades are so greatly superior in length to those of the rorquals, no such corresponding difference is to be found in the length of the pulp-blades, which are, indeed, comparatively speaking, even much shorter. In order to satisfy ourselves on this point we need only examine the whalebone blades of commerce, which even if they are ten, twelve, or more feet long, are only hollow to a depth of about three and a half inches nearest to their broadest end. Now, if we ask how far the hair-pulps are introduced into the blades, and try to answer this question only by examining preparations of dried whalebone, we shall feel inclined to suppose that these soft vascular filaments only penetrate a very short space, especially in the Greenland whale, in the whalebone of which the horny fibres are very fine, and seem only to be hollow to a very short distance from their origin.

Our rich materials have provided us with very satisfactory information on this question. Yet it is only on the anterior and posterior parts of sides of whalebone belonging to the forty-four feet and a half long skeleton that we have had an opportunity of making the experiment of loosening

¹ 'Kong. Danske. Vidensk. Selskab. Natur. og Math. Afhand,' 12te Deel, p. 358.

² A beautiful figure of such a preparation from a fin-whale has been given by Rosenthal on the third Plate of his above-mentioned memoir.

the whalebone blades from their pulps, and only in the newborn individual that we were able to obtain a view of the matrix of the entire set of whalebone on either side. On the cranium of the twenty-two feet long skeleton both sides of whalebone were still attached to the palate, even to the whole extent, but they were much too far advanced in decomposition to allow of successful loosening of the horny baleen. It was on both occasions quite evident that the pulp-blades of the whalebone of the Greenland whale, no less than those of the rorquals, are provided with filamentous hair-pulps on their inner and lower edge, only that these soft filaments in conformity with the hairs themselves are a great deal finer both on the free margin and in the interior of the baleen-blades. Besides this, they also appeared to us to be much shorter, in the newborn specimen only six lines, in the full-grown animal (judging by the foremost and hindmost blades of the whalebone sets) hardly much longer, but it is no doubt extremely probable that the filaments may have been torn by the artificial loosening of the whalebone blades of the full-grown individual as well as by the loosening brought about by putrefaction in the newborn one.

The result of these observations as to the relation between the horny blades and their pulps in the Greenland whale is this, that though, as might be expected, it is in all essential points similar to that which obtains among the rorquals, yet there are some very remarkable deviations, all corresponding with the disproportionately finer and more compact inner structure of the whalebone blades of the former.

We shall now give some observations illustrative of the differences of age in the whalebone of the Greenland whale.

It seems to be an invariable rule that the whalebone does not appear until about the beginning of the latter half of uterine life. In our eight feet and a half long foetus no traces of it were as yet to be discovered. In its earliest condition we have observed it in the head sent down in brine by Captain Holböll, which was three feet eight inches long, or only four inches shorter than that of the newborn individual. This was most certainly the head of an unborn animal, though as a foetus almost full-grown; and by comparing it with that of the newborn specimen we may obtain a very clear conception of the state of the baleen at the time of its birth.

In the foetus the soft "gum" was so disproportionately large that the whalebone blades, though the longest of them had already a length of three inches when measured by their exterior smooth edge, were nevertheless almost totally hidden by it, and only the bristles projected freely. The subsidiary blades were so entirely enveloped in it that they looked like narrow and diminutive stripes, or thick fibres of a white colour, though on a more minute examination they were found to consist each of a fasciculus of hairs agglutinated by the "gum." A special cortical tissue was not yet distinguishable in any of these delicate subsidiary blades, and this might perhaps serve as a sufficient proof that the hairs are the primitive formation of every baleen-blade if this were not evident by the general rule, that in the development of corneous substances the extremity is always the part first formed. The chief blades were already provided with a cortical layer, though only in the shape of a very thin horny covering; they consisted chiefly of a soft but tough medullary tissue, which could easily be split into horny fibres, all of them perfectly straight.

With the just-described laminæ of the whalebone of the foetus those of the newborn sucker perfectly agreed, at least as far as we might judge from the chief blades still remaining, and the pulps on the palate of the latter perfectly corresponded with those of the former, not only as to

number and position, but also to a certain degree as to form and size. As to form, as far as the pulp of each of the blades, like the blades themselves, had, besides a fixed upper edge, an outer smooth and an inner and depending filamentous edge, and moreover they were separated by fissures from one another throughout their entire length into a chief lamina and a row of subsidiary laminæ; and as to size, as far as the length of these transversely placed parts was not only quite the same, but the height of the pulps as well as that of the horny blades was also greatest outwardly, gradually diminishing in an inward direction. Of course the pulps were here, as everywhere else, much smaller than the blades, absolutely speaking, though not nearly in the same proportion as in older individuals. In the chief-blade, four inches long, the pulp was nine lines long or only four times shorter than its horny baleen, whereas no pulp higher than three or four inches can find room in the hollow part of a ten or eleven feet long whalebone-blade of a Greenland whale. Thus, while the pulps are growing from nine lines to four inches, or in other words have increased to four times their original length, the horny blades grow from three inches to eleven or twelve feet, or forty-eight times that length; the pulp must accordingly, as compared with the horny blade, be ten times longer in the newborn individual than in the full-grown animal.

It must be mentioned, as something peculiar in the pulps of the newborn whale, that, in many of those of the chief laminæ, fissures were found on the filamentous edge, that could only be distinguished from those by which the baleen was divided into a chief-blade and several subsidiary blades by their not penetrating entirely to the fixed base of the pulp-blade. Now, as it can scarcely be doubted but that every pulp-blade, as happens with the pulps of all other horny parts, has grown out gradually on the smooth surface of the skin, and especially that the most prominent part of it is the one that has appeared first, it must necessarily be supposed that every such imperfect fissure in a pulp-blade has, in an earlier period, divided it into two pieces, from which we may infer that the pulp of the chief lamina of whalebone, and with this also its horny baleen, grows in breadth by gradually uniting into itself the nearest subsidiary lamina. This supposition is also corroborated by the fact that the younger the whalebone-blade is, the greater is the extent of its subsidiary blades in proportion to its chief-blade, thus in the newborn whale this extent is half the length of the lamina measured from the exterior to the interior encircling ligament; in the half-grown one, on the other hand, only about one-third (two inches of six). On the other hand, it might seem to be refuted by the remarkable fact that the number of subsidiary blades according to our researches is by no means diminished by age. In the fœtus we could not count more than twenty subsidiary blades for each lamina; and in the half-grown individual the number was the same as far as we could judge. This observation, however, will lose all its weight as an objection to our supposition, when we add another observation certainly not less authentic, namely, that the gradual appearance of the pulps of the subsidiary blades is by no means concluded with uterine life but continues during the first years after birth, for so long and in the same proportion as the larger subsidiary blades continue to unite with the chief lamina.

Presuming, as we do, that the most prominent part of every blade of whalebone is the one that has appeared earliest, we must suppose that the longest blades, those of the middle of the series, appear first of all. It seems, however, as if all the blades of either set grow forth very quickly one after another. For whereas not any laminæ of baleen seem to be found in the fœtus at the middle of uterine gestation, they seem already to be present in their full number, in the full-grown fœtus. We say seem, for it is always difficult, not to say impossible, to state the exact

number of the blades in a set of whalebone, especially because anteriorly and posteriorly they become so small and so irregularly placed, that we cannot strictly distinguish between chief-blades and subsidiary blades, or make out how many of them belong to one and the same transverse row. In the newborn specimen, however, we could distinguish in the external row of the pulps of each set of whalebone 308 regularly placed cross-folds or pulps, to which must be added an approximation to the number of those irregularly placed, at least 11 behind and 4 or 5 before, so that the whole number must be rated at 324, which also seems to be the number of the laminæ in full-grown individuals. In the whalebone sets of the twenty-two feet long individual, we could only count 310 distinct blades, and the indistinct cross rows in the anterior and posterior parts could not be estimated at more than about 14 in all. As the number of the laminæ are thus not larger in the half-grown whale than in the newborn one, it is certainly very improbable that it should be increased afterwards, nor do we know of any observation tending to favour such a supposition. The whalers most commonly bring home from the large North whales 500 laminæ in all, or 250 from each side, but the most posterior and anterior they leave disregarded. Some estimate of the number of the laminæ of whalebone found in the whale captured in 1859, near Holsteinsborg, is rendered possible, as its discarded small laminæ came into our hands. To the Greenland Commercial Company 518 laminæ in all were sent, 100 of which were set down as under-size, and in our four extremities of the two sets we could count 86 in all, which would make 604, or 302 in the exterior row of either side. It can hardly be doubted but that several were lost between the under-sized laminæ and the largest of those which were still kept together by the gums; but that they were many more than 22 in either set, seemed to be refuted by a direct comparison of the size of those left in the palate with the smallest of those taken out.

As to the gradual growth of the baleen-blades in point of length and breadth we must first direct the attention of our readers to the fact that as their number is really the same in the newborn as in the full-grown individual, the foremost and hindmost laminæ of both sets must grow very slowly; for not only in the twenty-two feet long female, but even in the forty-four feet long quite full-grown male these laminæ were very short, the smallest blades being only about two inches long.

The same may be said respecting the growth of the subsidiary blades as related to that of the chief-blades; for whereas the latter grow from three inches to a length of eleven feet, it is certain that the largest subsidiary blades never become much longer than one foot, as a glance at the inner edge of the chief-blade will be sufficient to show.

How fast, on the contrary, the middle laminæ of the Greenland whale grow after its birth has already been partially shown in what we have said above. In the newborn animal they were (along the outer edge) four inches four lines long (measured to the points of the hairs), one inch nine lines broad, about two thirds of a line thick, and their distance from each other was about one line.

In the twenty-two feet long female the longest baleen was thirty-six inches and a half long, four inches and a half broad, where it was affixed to the palate, and about one line and a half thick; in the forty-four feet long male the longest lamina was eleven feet long, eleven inches broad, and five lines thick. These measurements agree pretty well with those made by Scoresby,¹ which are as follows:

¹ 'Account,' i, page 464.

	Female.	Male.	Female.		Male.	
	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.
Total length	17	28	50	51	52	58
Length of the head	5	8 $\frac{1}{2}$	15 $\frac{1}{2}$	16	20	19
Length of the longest blade .	1	6	11 $\frac{1}{8}$	10 $\frac{3}{8}$	13 $\frac{7}{16}$	11 $\frac{1}{2}$

It will be seen from this that the length of the baleen relative to that of the entire animal has by no means the same ratio. The greatest difference in this respect evidently originates in the circumstance that during the growth of the animal the laminæ only gradually attain to their full relative size, which from one fiftieth (in the newborn animal) is at length increased to almost one fourth (in our forty-four feet and a half long individual), or even upwards of that ratio (in Scoresby's fifty-two feet long male).

Judging from the observations before us we should suppose that it is only in the males that the laminæ attain to this extraordinary length, while in the females they only grow to one fifth of the length of the body. The very largest blades, especially all those of between eleven and fifteen¹ Danish feet in length, must accordingly be supposed unconditionally to have belonged to male individuals, and their considerable difference in point of length may probably be explained by the circumstance that the laminæ still continue to grow for a long time after the body has reached its full size.

That the whalebone-blades of the Greenland whale may be distinguished not only from those of the rorquals but also from those of other right-whales, both by their form and by their internal structure, has already been stated, and the distinguishing characters have been pointed out. We are the less disposed to enter into any renewed examination of this question, as these distinguishing characters have not been given as the results of examinations of our own materials but as the results of the experiences of practical men who, either as traders or mechanics, are employed in dealing with this very common article of commerce. We have limited ourselves to making such observations only as might convince us of the trustworthiness of the assigned characters, and we have had an excellent opportunity of satisfying ourselves on this point in the immense stores of whalebone contained in the warehouse of Messrs. Schwartz and Son, who have kindly permitted us to make use of them for our purpose.

On the other hand, we have had from our own materials an opportunity of making some observations as to the relative position of these laminæ and their difference from one another in the Greenland whale. Such observations can of course be made with certainty only in complete sets of whalebone with all the laminæ in their natural position, and such we can hardly hope to find in Museums, except in unborn or newborn individuals. Nevertheless we have succeeded by the kind assistance of Mr. Olrik in obtaining these parts of a half-grown female Greenland whale for our inspection; for they were, as we have already stated, still found affixed to the twenty-two feet long skeleton, sent in 1857 to the Royal Museum of Natural History. This distinguished

¹ An instance of this extraordinary length is mentioned by Pastor Glahn, in his anonymous memoir "Annotations to the first three books of David Crantz's History of Greenland," page 140.

functionary in the service of the Royal Greenland Commercial Company, succeeded on this occasion in obtaining permission to leave the whalebone sets entire and uninjured for the benefit of science, in consequences of the circumstance, so fortunate for us, that even the longest blades were only three feet long, or shorter than the under-size laminæ current in trade.

Either of these sides or sets of whalebone forms in its entire mass an exceedingly heavy and flat body, one surface of which is formed by all the exterior smooth edges of the single laminæ covered at their uppermost extremity by the exterior part of the "wreath," the other surface is formed by their interior hairy edges, and is accordingly itself perfectly hairy. In the uppermost broad edge, that by which the set was affixed to the surface of the palate, the topmost open ends of the transversely placed laminæ and the intermediate naked parts of the skin of the palate are to be seen alternating with each other. This edge has, of course, everywhere about the same breadth as the whalebone blades, and is evenly arched in the same degree as the surface of the palate to which it is affixed. In front and behind the set has an obtuse point in which its upper and lower margins may be said to meet. The lower edge, quite hairy by the projecting hairs at the extremity of each single lamina, is, indeed, also generally speaking evenly curved like the upper one, though only when we disregard its foremost and hindmost parts, where it ascends rather suddenly towards the two ends. This characteristic arises from the essential peculiarity of the whalebone-blades of the Greenland whale, that the most anterior and most posterior of them are fully as small and insignificant as those of any of the rorquals, but in their natural order of succession they increase most rapidly in length near the extremities and then again only grow very little longer towards the longest middle laminæ, so little that the lower hairy edge in the greater part of its extent is very slightly curved, and the difference in the length of the laminæ is chiefly shown in the arched form of the upper edge.

The measurements of these sets of whalebone in the half-grown Greenland whale, after they had become quite dry, gave the following results :

The length of the whole set in a straight line between its foremost and hindmost points was five feet and a quarter, its height between the two most distant points of its upper and lower edges three feet nine lines ; the breadth of the upper edge was four inches and a quarter.

The number of the laminæ can, as is well known, never be quite accurately ascertained, as there are no distinct limits between the smallest chief-blades and the small irregular subsidiary blades, in which both sets of whalebone terminates before and behind. We were, as has already been stated, in this young individual, unable to distinguish clearly more than 310 in either set. Measured according to the order of their position the length of these 310 laminæ was found to be as follows :

The number of the lamina.		Its distance.		Its length.	The height of the "wreath."
From before.	From behind.	From before.	From behind.		
		Inches.	Inches.	Inches.	Inches.
1	307	$3\frac{3}{4}$	$59\frac{1}{4}$	$3\frac{1}{2}$	$2\frac{1}{2}$
11	297	2	58	$9\frac{1}{5}$	3
21	287	$3\frac{3}{4}$	$56\frac{1}{4}$	$15\frac{1}{2}$	$3\frac{1}{2}$
31	277	$5\frac{1}{2}$	$54\frac{1}{4}$	$19\frac{1}{2}$	$4\frac{1}{4}$
41	267	$7\frac{1}{4}$	$52\frac{3}{4}$	$22\frac{1}{2}$	$4\frac{1}{2}$
51	257	9	51	26	5
61	247	11	49	30	6
71	237	$13\frac{1}{2}$	$46\frac{3}{4}$	32	6
81	227	$15\frac{1}{2}$	$44\frac{1}{2}$	34	7
91	217	$17\frac{3}{4}$	$42\frac{1}{4}$	$34\frac{1}{2}$	$7\frac{1}{4}$
101	207	20	40	$35\frac{3}{4}$	$7\frac{1}{4}$
111	197	$22\frac{1}{2}$	$37\frac{1}{2}$	$36\frac{1}{2}$	$7\frac{1}{2}$
121	187	25	35	$36\frac{1}{2}$	$7\frac{3}{4}$
131	177	$27\frac{1}{2}$	$32\frac{1}{2}$	$36\frac{1}{2}$	$7\frac{3}{4}$
141	167	$29\frac{3}{4}$	$30\frac{1}{4}$	$36\frac{1}{2}$	8
151	157	32	28	36	$7\frac{3}{4}$
161	147	34	26	$35\frac{3}{4}$	$7\frac{3}{4}$
171	137	36	24	$35\frac{1}{2}$	$7\frac{1}{4}$
181	127	38	22	$34\frac{1}{2}$	7
191	117	40	20	34	7
201	107	42	18	$33\frac{1}{2}$	$6\frac{3}{4}$
211	97	44	16	$32\frac{1}{2}$	$6\frac{1}{4}$
221	87	46	14	$31\frac{1}{2}$	$6\frac{1}{4}$
231	77	48	12	$29\frac{3}{4}$	6
241	67	50	10	$28\frac{3}{4}$	6
251	57	52	8	26	5
261	47	54	6	$24\frac{1}{2}$	$4\frac{3}{4}$
271	37	56	4	$22\frac{1}{2}$	$4\frac{3}{4}$
281	27	57	3	$19\frac{1}{2}$	4
291	17	58	2	13	$3\frac{1}{2}$
301	7	59	1	5	2

It will be seen that the longest laminæ (thirty-six inches and a half) are the 121st to the 141st from before, the 167th to the 187th from behind, therefore not exactly the midmost in the row, nor are they placed exactly in the middle of the set, but somewhat more towards the anterior point, that is to say, thirty inches and a quarter to thirty-five inches from its posterior extremity, and only twenty-five to twenty-nine inches and three quarters from its foremost extremity. Of course, the circumstance of their being in a dried state can only so far diminish the trustworthiness of this calculation, as the foremost and hindmost parts of the set may perhaps have been unequally influenced by it.

The "wreath," it will be seen, increases in height with the increasing length of the whale-bone-blades, but not in the same ratio, for the smallest blades before and behind are almost completely, whereas the longest laminæ have only their upper fifth part, covered by it. As far as the

blades are covered by the wreath they may also be supposed to be surrounded by the intermediate substance. The hairs have not been reckoned in these measurements as their length depends on several fortuitous circumstances. The longest were four or four and a half or even five inches long and were placed on the 296th lamina. In front of these only some few were found of a similar length.

Finally, we shall, before proceeding to another part of our essay, enter on a comparison of the form of the single blades of our whalebone sets with one another, especially as we thus shall have an opportunity of showing how it may easily be determined of any given blade what place it occupied in the baleen-set.

The inner hairy lateral edge of either set of whalebone is, taken as a whole, somewhat hollow, though scarcely perceptibly in the posterior part, and in the very hindmost part, on the contrary, it is slightly convex. This form of the inner surface of the whalebone sets is caused by the circumstance that the baleen-blades of the Greenland whale are most commonly curved in the form of a sabre, and placed with the concave edge turned inwards and the convexity turned outwards, but this curve disappears gradually in the posterior parts, so that even the size-laminae behind are quite straight, and the small under-size blades are here even curved in an opposite direction, so that in these the interior hairy edge becomes convex, and the exterior smooth one becomes concave.

It is therefore always easy to know in the under-size blades whether they belong to the anterior or posterior parts of the sets, and, in the size-blades, we may at least by their greater or smaller curvature in addition to their length always be able to determine pretty nearly how far they have been situated towards the middle, or towards either of the extremities.

The exterior surface of the whalebone sets is formed by the exterior wreath and by the outer edges of all the laminae taken together. Accordingly this surface would, if the blades were placed in an exactly transverse position, appear like a railing, affording a free view through the interstices. But this, as is well known, is prevented by the circumstance that each lamina partially covers the lamina nearest behind it. This overlapping is, no doubt, partially effected by an oblique position, by which their anterior surfaces are turned somewhat in an outward direction, though more particularly, as is generally known and as has been already pointed out by Martens,¹ by the blades being generally inflected along the outer edge, so that their posterior surfaces are excavated in the shape of a groove, whereas their anterior surfaces are convex longitudinally. In the foremost half of the set this convexity is greatest, and as far as the hindmost third of the set (that is, to the 191st lamina) it is still great enough to cause the blades to cover each other, so that any view from without between the blades is perfectly obstructed. But from the beginning of the posterior third this relative position of the blades is gradually altered, and from the 240th blade the imbricate position takes place, though far less distinctly, in an opposite direction. A groove-like excavation along the exterior edge of the anterior surfaces of these laminae is, however, only very inconsiderable, the overlapping here being principally occasioned by the oblique position of the laminae.

It will be readily seen how these peculiarities of the blades, according to their different places

¹ L. c., p. 100: "Ausswendig aber hat das Fischbein eine Höle, denn es ist umgeleget wie ein Wasser-Rönne, da es auf einander lieget, wie Krebs-schilde oder Dachsteine: sonst möchte es leicht die untersten Lefftzen wund machen."

in the set, afford very distinct marks by which we are enabled to decide of any loose lamina, in what place it was formerly affixed, whether near the front or back, at the right hand side or at the left.

SKELETON.

It has been already mentioned, that no naturalist before us has had an entire skeleton of a Greenland whale for examination, and how exceedingly valuable therefore the materials must be considered, which have been at our disposal for this purpose.

The first skeleton of a whale of this species exhibited, was that of the newborn female, which was presented by Major Fasting in 1843 to the Royal Museum of Natural History. The second was that of an almost full-grown male, forty-seven feet and a half long, which Captain Holböll sent in 1846, and which has been exhibited for several years in the Zootomical-Physiological Museum of the University. From these two skeletons we had already almost finished our description of the structure of the bones of the Greenland whale, when further additions were made to our materials; first, by the foetus eight feet and a half long, of the female sex, sent down in brine by Captain Holböll, then by the skeleton, twenty-two feet one third long, also of a female individual, sent by Mr. Olrik, and finally, in the autumn of 1860, by the forty-four feet and a half long skeleton of a male, for which we are indebted to Dr. Rink and Mr. Elberg. Each of these additional specimens has afforded us new and essential information, so far complete, as to enable us to say, that the following description has become an osteography not of one or two individuals of the Greenland whale, but of the species itself, generally speaking.

The forty-seven feet and a half long skeleton of the almost full-grown male is figured at a scale reduced to one forty-eighth of its natural size, in our second plate (fig. 1). That which particularly attracts our attention at the first glance at this skeleton is undoubtedly the extraordinary size of the head in proportion to the body. Of the forty-seven and a half feet of the entire skeleton the head occupied, as we have already stated above, eighteen and a half feet, or much more than one third, viz., 0.3895. And yet it is scarcely so much on account of the length of the head, but rather on account of its thickness, that the Greenland whale may be justly designated as the most large-headed even among the right-whales. It is, perhaps, the most bulky of all animals, and even if there was some exaggeration, when in the twelfth century, the author of the 'Mirror' stated that a rope, to encompass its body, must have the entire length of the animal, yet it was not much, as the greatest circumference is, according to the measurements of Scoresby, five sevenths of its whole length. As the most peculiar feature in the shape of the Greenland whale, it deserves to be pointed out, that the head is scarcely much inferior in thickness to any other part of the body, however immense the thickness of the latter may be, so that the head, by occupying at the same time more than one third of the length, must evidently make far more than one third of the entire bulk of the animal.

As will be seen, this enormous size of the head is essentially caused by the huge dimensions of the cavity of the mouth. To what an extent this cavity may attain, will be evident at the first glance at the figure of the skeleton. Above, the upper jaw forms a high arch, at the sides, the

two branches of the lower jaw are widely separated from each other, and the space between these three, comparatively speaking, small bones, is in that way rendered so large, that the bones themselves almost dwindle into mere outlines of it.

In the description of the exterior it has already been mentioned, how the large space between the narrow upper jaw, and the rami of the lower jaw is covered on either side by the underlip. Even in the newborn individual this underlip deserved to be called extraordinarily high (Plate I, fig. 1); how large its dimensions must be in the full-grown whale, we may imagine pretty accurately by considering, that it covers the whalebone-blades, sometimes even upwards of twelve or thirteen feet long, with the exception of their lowest extremities, which are situated between the rami of the lower jaw and the tongue; but in the skeleton we have a perfectly exact, though not direct, picture of the extraordinary dimensions of the underlip, shown by this great distance between the upper and the lower jaw.

If we consider the two underlips as the side walls of the cavity of the mouth, part of this cavity is, of course, occupied by the whalebone; but the laminæ are here so narrow in proportion to their length, and besides curved in such a way, and placed one overlapping another, that they may to a certain degree themselves properly be considered as part of the side walls. An exceedingly large space is, at all events, still left between the two sets of whalebone. As long as the mouth is kept shut, this space is occupied by the tongue, which may certainly be called the most colossal of all the organs of the Greenland whale; but when the mouth is opened, and the tongue drawn back, it is filled with the water of the sea containing large quantities of crustacea and free swimming mollusca, streaming into the mouth in front, and then leaving it through the whalebone grating, when the mouth is shut again, while all these small animals are left on the hairy covering of the inner side of the baleen.

In the rorquals, the cavity of the mouth is comparatively small in conformity with the much smaller quantity of water which is admitted into it with the food. As regards the height this may be observed even in the skeleton, where the surface of the palate can scarcely be said to be arched at all from before backwards; as to breadth, on the other hand, it can only be understood by imagining the surface of the palate covered with its whalebone. The surface is, not only relatively to the length of the head, but also absolutely speaking, broader than that of the Greenland whale, and the lateral rami of the lower jaw are curved even more strongly in an outward direction from each other, but the cavity of the mouth very broad in itself, is in reality very much reduced by the whalebone. This is partly caused by the whalebone itself being, comparatively speaking, very broad, the laminæ of the humpback, for instance, only two or three feet long, being scarcely narrower than the very largest blades from the Greenland whale, but especially, by their being all curved transversely, so as to have their smooth outer edge concave, and the hairy inner side convex. In the baleen of the right-whales no such curve is found to reduce the space of the cavity of the mouth, except in the most posterior blades. We have already stated of the laminæ of the Greenland whale, that the greater part of them are, on the contrary, curved in an opposite direction, by which means the cavity of the mouth is rendered wider. Judging only by the outline of the cranium, we might suppose, that the cavity of the mouth of the rorquals, at least quite in its most posterior part, was broader than that of the Greenland whale, as the lateral parts of the cranium are much more extended in an outward direction, but in its natural connection with the lower jaw, it will be seen directly that its extension in width adds nothing to the width of the mouth, as the branches of the lower jaw, bending where

they pass beneath the occiput, are curved inwards, so as to become slightly sigmoid, and are articulated very inwardly with the lateral parts of the temporal bones.¹

Passing now to a more particular description of the osteology of the head of the Greenland whale, we shall principally be guided by, or at least begin with, the forty-seven feet and a half long skeleton, to the illustration of which in the first figure of the second plate we have already directed the attention of our readers. In this figure, the skull is seen from the side, in the second figure of the same plate, it is seen from behind (20 times diminished), in the fourth plate, the posterior part of it is shown from above and from below.

As the most characteristic feature in the skeleton of the Greenland whale is the extraordinary size of the head, so the most characteristic feature of its head is the disproportionate size of the jaws relatively to the cranium, properly so called, or rather the disproportionate size of the cavity of the mouth compared with that of the cranium. But while the former characteristic disproportion in the skeleton, considered as a whole, may be said to be prevalent in every period of age, as the head already in the newborn individual as well as in the fetus, occupies a third of the entire length of the body, the disproportionate size of the jaws, or the cavity of the mouth, only gradually develops itself during the growth of the animal.

This is evidently in perfect conformity with the fact that the brain on the one hand is one of those organs which first appears in the animal, and has already attained to the full size in the half-grown whale, while, on the other hand, the whalebone does not appear until at the beginning of the latter half of uterine life, being still only four inches long in the newborn animal, and in the half-grown one a little more than three feet; it has accordingly only attained one fourth of its full size at a time when the brain has already ceased to grow, and, as in all animals, the growth of the skull, properly so called, must necessarily correspond to that of the brain, so in the whalebone whales the growth of the jaws must conform with that of the whalebone. It is true, that the proportion is in the latter respect not quite the same; for in the small fetus of a Greenland whale, still unprovided with whalebone, the jaws already occupy a greater part of the head than the cranium; but this is only the consequence of the general rule that in the development of every organ, its future importance is indicated beforehand. That in other respects the development of the jaws correspond to that of the whalebone, cannot be doubted; for every one of their peculiarities as well as all the specialities in the structure of the entire head, can only find their proper explanation in the exceedingly great development of the whalebone.

Thus, in particular, the arched form of the palate is necessitated by the rapidly increasing length of the whalebone from the two extremities towards the middle of the palate, while the comparatively small breadth of the whalebone produces a corresponding narrowness of the sides of the palate, and of the upper jaw generally; but the great number of the whalebone-blades necessitates at the same time an extraordinary length of both the jaws, and the great distance of the lower extremities of the two rows of laminæ from each other necessitates a corresponding curve of the two lateral branches of the lower jaw in an outward direction. The immense weight

¹ The greater part of these peculiarities of the jaws of the rorquals may be seen in our third plate, figs. 2 and 3. Fig. 2 represents the skull of a forty-three feet long specimen of a hump-back. Fig. 3 the skull of a fifty-three feet and two-thirds long skeleton of a fin-whale, both from Greenland, and both exhibited in the zootomical-physiological Museum.

of the whole number of laminæ necessitates finally a corresponding strength in the structure of the bones of the narrow upper jaw, and still more in that of the occiput, to which the upper jaw is attached horizontally, and which therefore must support the whole weight of this enormous bone itself, and of both sides of baleen.

The palate becomes more and more arched during the growth of the animal, though by no means in the same proportion as the laminæ increase in length. In the newborn specimen, the longest blades of which were four inches in length, the highest part of the palate was about four inches removed from a horizontal line between its two extremities; in the half-grown individual, of which the longest laminæ were about three feet (thirty-six inches and a half) long, the height of the palate had increased to nearly two feet (twenty-three inches), and in our forty-four feet and a half long skeleton, of which the longest laminæ were eleven feet long, the height of the palate was scarcely four feet. That the height of the palate in the newborn whale is almost equal to the length of the whalebone, in the half-grown whale is only two thirds, and in the full-grown one but little more than one third thereof, may be readily explained by the fact, that the laminæ, while growing, are turned in a more outward direction, which is indicated, partly by the two sides of the palate to which they are attached gradually increasing in steepness, assuming an outward instead of a downward direction, and partly by the rami of the lower jaw deviating continually more and more from each other. Most probably it is only in the male, that the palate is so strongly arched, as in our two largest skeletons, and not in the female, the whalebone of which according to the description given above, seems to be considerably shorter, in comparison. That the convexity of the palate of the Greenland whale skull in the British Museum, described and figured by Cuvier, is so much smaller than that of our specimens, though, in other respects, it has every mark of having belonged to a full-grown individual, may be interpreted on the supposition that this individual was a female.

As the curvature of the upper jaw may already be discovered in the newborn Greenland whale, and according to Cuvier's description and figure, also in the newborn Cape whale, while it never becomes easily distinguishable in the comparatively broad upper jaw of the rorquals, it becomes in itself a sure mark of distinction of the right-whales, generally speaking; and as its height is pretty uniformly proportional with the length of the whalebone, the different degree of its development may at the same time, serve as indications of age and, as we presume, also of sex. As to the distinction of the various species of right-whales, it seems, on the contrary, that we must rather consider the different form, than the different degree of the curvature of the upper jaw.

We are here, of course, alluding to the distinguishing mark of the South whales pointed out by Cuvier and Schlegel, that the side-edges of their upper jaws, in their posterior parts, suddenly follow a downward and outward direction, while those of the Greenland whale, descend gradually downwards. This, as is well known, is caused by the peculiarity that, especially in the Cape whale, the orbital process on either side, both that of the superior maxillary bone and that of the frontal bone, instead of being directed almost completely backwards, as is the case with the Greenland whale, point rather transversely outwards, so that they almost form a right angle with the middle line of the skull. But this distinguishing mark, so sure and easily to be applied in older individuals, will not hold true when applied to the cranium of very young specimens. In the newborn Greenland whale, the orbital process, at least of the superior maxillary bone, points distinctly backwards, so that we find already the gradual descent of the lateral-

edges of the upper jaw, characteristic of the older individuals of the species, but the same form is also found in the skeleton of the very young Cape whale, described by Cuvier.

That the oblique position of the lateral parts of the cranium can gradually diminish in the Cape whale during the growth of the animal, while in the Greenland whale, on the contrary, it becomes continually more distinct, can scarcely be explained except in connection with the difference which, in these two right-whales, contemporaneously develops itself in the structure of the anterior walls of the cranial cavity, and which therefore requires from us now a little attentive consideration.

Although the right-whales, like other Cetaceans, at their birth are generally in a greatly advanced state of development, their skull, however, is at that time so little developed in its structure that the primordial cranium of the already colossal head is still preserved to a great extent. This is the case, even in the occipital bone, though in this the ossification is first completed (see Plate III, fig. 1). This strangely retarded development of the skull of the right-whales can by no means be accounted for by the supposition, that the brain itself grows more rapidly than in the mammalia generally. One glance at the space of the cerebral cavity of the full-grown animal will be sufficient to show that it is quite the reverse (Plate V, fig. 1, A), for even absolutely speaking it is scarcely larger than that of the newborn animal. The only cause of this retardation is, that in these animals the function of the skull, as a receptacle for the brain, is, as it were, only secondary to its function as a support of the upper jaw. For this purpose the anterior wall of the cranial cavity is thickened to such a degree, that a section through it in the mesial line of the Greenland whale cranium (Plate V, fig. 1), is five times as large as the diameter of the cranial cavity itself. The anterior wall of the cranial cavity does not, however, attain to this thickness by a corresponding increase of the frontal bones alone, but also by that of the ethmoid, the anterior sphenoid, and the entire squamous portion of the occipital bone, all which bones are combined to form the front wall of the cerebral cavity. That the ethmoid forms part of this wall, may also be true, in speaking of most other mammalia, as this bone, on account of the great development of the upper jaw, is quite commonly raised from a horizontal into a vertical position on the base of the skull; but the most that can be said of the occipital bone is, that its squamous portion, on account of the greater development of the upper jaw, may be placed far more forward on the superior surface of the skull, and its articular portions farther upwards on the back of the head, by which means the occipital foramen is removed farther backwards. It is peculiar to the Cetaceans for the squamous portion of the occipital bone to be so far advanced on the superior surface of the skull, that the occipital foramen itself is partially placed on this surface, and in the Greenland whales this peculiarity is still farther developed, so that the whole occipital foramen is placed on the superior surface of the head, and the squamous portion itself only covers an extremely small portion of the brain, while it partakes to a great extent in the formation of that osseous mass, into which the front wall of cerebral cavity is changed. The skull of the right-whales may accordingly be said to develop itself very rapidly after birth, not, however, accommodating itself to a continued growth of the brain, but almost entirely in relation to the increasing weight of the upper jaw. It not only grows extraordinarily thick in the front wall of the cerebral cavity, but all its different bones alter their relative positions. In this respect, the Cape whale, however, seems to be very different from the Greenland whale. For in the former, the front wall of the cranial cavity is raised very much during its growth, by which means the upper jaw gains considerably in height

in its posterior part; in the Greenland whale, on the other hand, it grows more in length, so that the upper jaw becomes longer, while the cerebral cavity seems to be removed just as far backwards. With this difference in the direction in which the front wall of the skull principally grows in the Cape whale and in the Greenland whale, the difference existing between them as to the direction of the lateral parts of the cranium, must evidently be immediately connected.

The lateral parts of the cranium consist chiefly of the outwardly directed prolongations (*processus orbitales*), of the superior maxillaries and frontals, and the articular portions of the temporals. On either side of the cranium, these three prolongations tend to meet each other, the first two mentioned in a backward, the third in a forward direction, so as almost to meet at their extremities, close behind the orbit. In the Greenland whale, however, some little space is always left between them; a very strong ligament by which this space is occupied, seems to be the means of attaching them here firmly to one another. The longer these three prolongations grow in an outward direction on either side, the broader the back of the head will, of course, be found to be; the more they, at the same time, point backwards, the farther backwards its greatest breadth will be, but how far the cavity of the mouth will thus gain in breadth, or in length, depends on whether the glenoid articulations on the lateral portions of the temporals are placed in a more outward, or in a more backward position.

Now the cranium of the full-grown Greenland whale exceeds in both respects that of all other whales; the cavity of its mouth being both broader in its posterior part, and more prolonged than that of any other; as to the breadth of its posterior part, it has already been pointed out by Cuvier, how in the Greenland whale the two glenoid articulations are placed so externally on the lateral portions of the temporals, especially as compared with their position in the Cape whale, that, notwithstanding the less transverse positions of the lateral portions themselves, the glenoid articulations are nevertheless much farther removed from each other, and as to the prolongation of the cavity of the mouth, these lateral portions are not only themselves placed rather in a backward, than in an obliquely forward direction, as in the Cape whale, but that the part of them, more especially, on which the articular cavities are placed, is situated so far backwards, that the articulation with the lower jaw in the full-grown Greenland whale is removed even considerably farther backwards than the articulation with the vertebral column.¹

Thus, while the apparent retrocession of the middle part of the occiput of the Greenland whale is only caused by the immense thickness of the front wall of the cerebral cavity in the longitudinal direction of the head, it is, on the other hand, quite certain that a retrocession is to be found in the lateral portions of the temporals, and it is by the position of these very portions, that the great dimensions of the cavity of the mouth posteriorly is effected. The last-mentioned peculiarity only develops itself gradually during growth. In the newborn Greenland whale, the articulation with the lower jaw is still placed a good deal before the occipital foramen (see Plate III, fig. 1, between *g* and *l*), in the immature animal it is about on a level with the same.² The considerable retrocession of the articulation with the lower jaw (in the full-grown Greenland whale, even entirely behind the occipital foramen), can therefore only be employed

¹ Compare especially figs. 7 and 11 of the often-mentioned plate in *Recherch. s. l. oss. foss.* (Ed. 3, tom. v, tab. xxv: in the octavo edition, tab. cxxvi.)

² See the figures of the Greenland whale cranium in the Museum of Berlin, in Pander and d'Alton, 'die Skelete der Cetaceen,' tab. iv, and in Brandt and Ratzeburg, 'Mediz. Zool.,' tab. xvi, figs. 3 and 4.

as a distinguishing mark for the adult animal. The cavity of the mouth in the newborn Greenland whale scarcely extends much farther backwards than in the rorquals (compare figs. 2 and 3 in our third plate). But as to the outward position of the glenoid articulations on the lateral portions of the temporals, this characteristic, no less important for the Greenland whale in opposition to the Cape whale, is prevalent in all stages of its development, as may be seen by a reference to our illustration of the cranium of the newborn whale compared with Cuvier's figure of the very small Cape whale. By this character, any cranium of a Greenland whale, be it young or old, may always with certainty be distinguished from that of the southern species.

The glenoid articulations of the temporals are also, in another respect, conspicuously characteristic of the Greenland whale, as compared with the Cape whale, for they are placed in a position almost perfectly horizontal (see Plate II, figs. 1 and 2 and Plate V, fig. 1), whereas in the Cape whale they are directed more forwards. This distinguishing mark derived from the direction of the glenoid articulations, may also be applied in all periods of the animal's life.

As to the articulation between the cranium and the lower jaw in the Greenland whale, it still remains for us to impart to our readers a most unexpected discovery, which we have had the opportunity of making in our two small specimens preserved in brine (the newborn one and the fœtus). According to John Hunter's statement,¹ no synovial capsules are to be found in the Cetaceans in this articulation, but only a dense mass of fibrous tissue, containing in its interstices a viscid oil. This statement has either been expressly corroborated by all succeeding observers, or, at all events, not contradicted. Nevertheless, we have found that in the Greenland whale shortly before and after its birth, between the articular cavities of the temporals and the condyles of the lower jaw, there is really a double synovial capsule of the same breadth as the corresponding articular surface, and that both the capsules are entirely without any communication with each other, in which particular they are therefore quite similar to those of the mammalia in general, except only that we have not been able to find any cartilaginous plate in the septum between them. We cannot help supposing that the synovial capsules discovered in these whales, shortly before and after birth, must also be found in older individuals of the species. How far they may also be discovered in the other right-whales, or perhaps in many other Cetaceans, must be the object of future researches.

To finish the examination of the peculiarities prevalent in the structure of the cranium of the Greenland whale, by which the cavity of the mouth is enlarged in a manner so characteristic, there still remains the form of the lower jaw. In conformity with the outward position of the glenoid cavities with which it is articulated, the lower jaw is of course also extremely broad behind, almost as broad as the whole base of the head, which is perhaps only very little narrower than the broadest part of the body. The two rami have, accordingly, their posterior extremities very much removed from each other, and, therefore, they are only very slightly curved from each other at the middle of the head, whereas in their foremost part they are strongly bent inwards to meet each other at the symphysis. In the Cape whale, it will be seen by Cuvier's figures (l. c., fig. 6), that the lower jaw has rather a different form. In opposition to that of the Greenland whale, it is on the whole not so broad by far as the back part of

¹ 'Philosoph. Transact.,' vol. 77, page 384 (1787).

the cranium; but in the middle it is much broader than behind, where the two rami approach each other very much, especially where they are placed just beneath the orbital processes of the superior maxillaries and the frontals; the rami of the lower jaw of the Cape whale therefore, though forming a much narrower cavity of the mouth, are, comparatively speaking, much more strongly curved than those of the Greenland whale.

All these differences between the Greenland whale and the Cape whale, as to the articulation of the cranium with the lower jaw, and as to the form of the latter, are particularly interesting, as they prove the former to be more different from the rorquals than the Cape whale. A glance at the two skulls of rorquals, figured in Plate III, shows immediately that the articulation between the upper and the lower jaw in both, though more especially in the hump-back (fig. 2), is placed far more inwardly and in a more anterior position relative to the foramen magnum, than in the Cape whale, and at the same time the rami of their lower jaw are seen to be still more strongly curved than those of the Cape whale.

The peculiarities described above, by which the cavity of the mouth of the Greenland whale, more than that of any other whale, is increased in height, length, and breadth, may as certainly be considered as its most essential osteological characteristics, as the extraordinary dimensions of the cavity of the mouth may justly be said to be the most characteristic feature of its whole organization. But nevertheless we must not omit to enter more minutely into the details of its remarkable composition; and though we shall not give a description of each bone by itself, we shall endeavour to describe each of the different regions of the cranium. By acting thus, we believe we shall be able to perform in the best way our task of pointing out the characteristics of the Greenland whale. For in the skull of this animal by far the greater number of the bones are completely united with one another, and to a great extent concealed in such a manner as to render it impossible to describe them singly, except in fetuses, and they will therefore scarcely ever come before the eye of the zoologist, except in larger or smaller fragments of the cranium.

In the following description we shall especially follow the large head sawn through the middle, wherefore we shall be obliged continually to refer our readers to the illustrations of it given in the plates.

This skull is, as we have already mentioned, represented (forty-eight times diminished), as seen from the side in the first figure of plate II, as seen from behind in the second figure (reduced to one twentieth) of the same plate; its posterior part is given as seen from above and from below in the first and second figure (reduced to one twentieth) of the fourth plate, and the most anterior part from below in the third figure of the same plate. In all these figures the letters have the following significations:

- a.* *Processus articularis ossis temporum.*
- b.* The parietal (*os parietale*).
- c.* The cavity of the foremost point of the primordial vomer (Plate IV, fig. 3).
- d.* The frontal (*os frontale*).
- g.* The tympanic (*os tympanicum*).
- h.* The hook of the pterygoid (*hamulus pterygoideus*).
- i.* The intermaxillary (*os intermaxillare*).
- k.* The condyle of the occipital (*condylus ossis occipitis*).
- l.* The lachrymal (*os lachrymale*).

- m.* The superior maxillary (*os maxillare superius*).
- n.* The nasal (*os nasale*).
- o.* The occipital (*os occipitale*).
- p.* The palatine (*os palatinum*).
- q.* The *processus jugularis* of the occipital.
- r.* The *processus mastoideus* of the temporal.
- t.* The temporal (*os temporale*).
- t'.* The *processus zygomaticus* of the temporal.
- u.* The pterygoid (*os pterygoideum*).
- v.* The vomer.
- w.* The petrous bone (*os petrosum*).
- z.* The zygomatic (*os zygomaticum*).
- x.* (Plate IV, fig. 1), strong ligaments.

In the skull of the Greenland whale, as in that of the other right-whales, we are immediately struck by the great difference between the short broad cranial portion, and the long and narrow maxillary portion, almost resembling a shaft issuing from it. In commencing by an examination of the latter, we may refer our readers to the facts above mentioned relative to its curve, and the inclined position of its two lateral palatine surfaces; here we shall only mention the individual bones composing it, which appear on its exterior surface.

The lower surface of this extremely long and narrow part is, in the full-grown whale, formed almost exclusively by the superior maxillaries, closely united with each other in the middle line, forming the very sharp keel of the palate, completely concealing the vomer. But they are not continued quite to the anterior point of the jaw, and close to their foremost extremity they separate from each other on the palatine surface (see Plate IV, fig. 3 *m*), so that the cartilaginous primordial vomer appears here on the skull (*c*). Such is the case in both our large skeletons, and also in the half-grown twenty-two feet long one; but in the newborn specimen the vomer makes its appearance in the middle line of the palate. This appearance of the vomer is also shown, both in Cuvier's figure of the old cranium in the British Museum, and in d'Alton's of the young one in the Museum of Berlin; but we believe that this may probably be accounted for by the circumstance that, among the numerous injuries sustained by both these specimens, the very brittle palatine keel, formed by the superior maxillaries, has been broken off. The vomer only extends as far as to the anterior third of the upper jaw (see Plate V, fig. 1 *v'*); and where it stops, the superior maxillaries meet together in the middle line even in the cranium of our newborn cub, and do not deviate from each other again until near the anterior extremity. The extreme point of the upper jaw is formed, nearest to the middle line of the palate by the cartilaginous primordial vomer on both sides, and by the intermaxillaries above. The primordial vomer, which throughout the rest of its extent is higher than broad, becomes flattened at this point, and the anterior extremities of the intermaxillaries are closely joined with its flattened point. In the palatine surface, where (Plate IV, fig. 3, *i*) the intermaxillaries look like a direct continuation of the superior maxillaries, they only enclose it at both sides, leaving it bare in the middle. So far they may be said to diverge from each other in this place; but they can hardly have done so to such an extent as the drawings of Cuvier and Brandt (not those of d'Alton of the same specimen) would seem to indicate, in which the foremost

extremities of the intermaxillaries even spread out to both sides in the shape of a pair of wings, except by a distortion, occasioned by the drying of the bones, which at this place are comparatively thin.

While the palatine surface of the upper jaw is chiefly formed by the superior maxillaries, its superior surface is, on the other hand, chiefly formed by the intermaxillaries. As these bones were seen on the palatine surface to enclose the anterior obtuse point of the primordial vomer above and on either side, they also cover in the same manner this enormous cartilaginous structure in its entire length, as far as the anterior angle of the nasal aperture, and they will be found to occupy by far the greater part of the superior surface of the whole upper jaw. Near this aperture they diverge from each other to form the greater part of its free margin, except only the most posterior part, where they are replaced by the nasal bones (*n*). Behind the opening they enclose the nasal bones; and then, as usual, they meet the frontals. The margin of the nasal opening formed by them and the nasals is so much elevated, especially behind (Plate II, fig. 2 *i—n*), that it may be compared to a tube, though certainly a very short and wide one. This tube points upwards and forwards; it inclines a little outwards to either side (Plate IV, fig. 1), by which its side walls become visible; in front, on the contrary, it is, as it were, somewhat compressed at the sides, and gradually disappears in the part of the intermaxillaries just before it.

On either side of the intermaxillaries the superior maxillaries occupy a comparatively small part of the superior surface of the upper jaw at the nasal opening, where its border is turned a little outwards; this border hides them completely in the newborn individual. Behind the opening, on the contrary, the superior maxillaries seem even to have far greater dimensions in the Greenland whale than in the rorquals, appearing here in the form of a triangular plate, the posterior edge of which meets the frontal in its whole outward extent, and the exterior part of which is continued in the orbital process already mentioned. This triangular plate is by no means wanting in the rorquals, but in them it is covered by a projecting portion of the frontal, in such a manner as to appear divided into two prolongations, one of which (Plate III, figs. 2 and 3, *m'*) extends backwards and inwards to meet the anterior edge of the frontal, the other (*m''*) is prolonged outwards as an orbital process.

The nasal bones (Plate III, fig. 1; Plate II, fig. 2; and Plate IV, fig. 1: *n*) are placed in the Greenland whale, as in the Cape whale, just behind the nasal opening in the shape of two elongated rectangular osseous plates, which, unlike to those of the rorquals, are about equally broad behind and before. Their anterior half had in our largest specimen a remarkably dark colour and a more brittle texture (Plate IV, fig. 1 *n'*), which was certainly only accidental. As has just been mentioned, though on the whole placed in a horizontal position, they are perceptibly elevated in their anterior parts, together with the adjoining part of the intermaxillaries, so that they become visible from behind (Plate II, fig. 2, *n*), whereas the frontals are hidden between them and the squamosal portion of the occipital bone.

As is usually the case in all cetaceous animals, only a small part of the frontals is left uncovered on the superior surface of the skull, yet a greater part than that left uncovered in the fin-whales. It is also remarkable, that they are by no means more, but rather less, covered by the squamous portion of the occipital bone in the full-grown individual than in the newborn one. Close to the middle line from their anterior edge a pair of narrow prolongations extend to the posterior edge of the nasal bones, and are enclosed like the latter by the posterior

extremities of the intermaxillaries. Of these prolongations, from the anterior edge of the frontals, it deserves also, perhaps, to be pointed out that they are comparatively larger in the newborn animal (Plate III, fig. 1, *f*), just as in the Cape whale they are at least distinguishable at birth, though not visible in full-grown individuals. On either side the frontals, like the superior maxillaries, are produced into their orbital processes. In the newborn specimen these lateral prolongations of the frontals are comparatively very broad, especially as compared with their still very small length (in the transverse direction of the body). In the full-grown individual, on the contrary, they are extremely narrow, arched in their upper surface, but excavated in the form of a groove on the lower one, so that they really appear like semicircular canals, destined to protect the optic nerves, and only in their most external part, where they are considerably extended in breadth, to form, as ordinarily, the roof of the orbit. It has already been mentioned that, although these long lateral prolongations of the frontals point very much in a backward direction, so that they approach very near to the lateral prolongations of the occipital bone, yet some space is left between them, in which they are, as it were, bound together by a peculiar very strong ligament (*x*). Thus, these prolongations appear especially on the superior surface of the cranium. On its inferior surface, on the contrary (as well as from the sides), the zygomatic bones (*z*) are seen inserted between them, by which means the circumference of the orbit is closed below.

Neither the zygomatic nor the lachrymal bones appear to have been seen in the Greenland whale before; both the one and the other have, at least, been wanting in all crania of this species hitherto described and figured. The zygomatic bones of the Greenland whale differ from those of the Cape whale in being less strongly curved, and having their articular surfaces which meet the superior maxillaries, much more elongated. The lachrymals are exceedingly small, much smaller, indeed, than those of the South whales. While they appear quite distinctly, not only in both the Cape whales figured by Cuvier, but also in the cranium of a South whale fœtus in our possession, which is only sixty-three inches long, and brought from the sea near Kamschatka, we have not succeeded in tracing them in any of our very small Greenland whales, and we are tolerably sure that they are not to be found in this species in a state of ossification until after birth; but in all our older skeletons we have found these bones (Plate II, fig. 1, and Plate IV, fig. 2: *l*), as usual, inserted on either side, between the superior maxillary and the frontal, just before the zygomatic, in the shape of narrow splinters of bone tapering towards the inner side.

The parietals (*ossa parietalia*), situated nearest to the frontals in the cranium itself, are not very prominent in the Greenland whale. Already, in the newborn individual, they are completely covered by the squamous portion of the occipital in the middle of the superior surface of the cranium, though in Cuvier's figures of the very young Cape whale they are seen distinctly standing out, together with the interparietal. In the temporal fossa the parietals of the Greenland whale are seen, like those of the Cape whale, to form about the whole anterior half of its lateral surface (Plate II, fig. 1, *δ*), turned directly outwards, whereas the posterior, more transversely placed half (same fig., *ε*) is formed by the temporals. The temporal fossa is further, as in the Cape whale, and contrary to that of the porquals, much higher than broad, and the fibres of the temporal muscle must point almost directly down towards the coronoid process of the lower jaw, curving round the posterior edge of the lateral part of the frontal, which serves them as a pulley, far less than in the porquals. The part of the parietal belonging to the temporal

fossa is, in conformity with the form of the entire cavity, far less broad than high. These bones, however, project in front in a downward and outward direction, so as to cover the orbital processes of the frontals, and even to enclose this prolongation near its root like a half sheath, of which, in the newborn animal at least, the upper part is visible from above (Plate III, fig. 1, *b*), though not so strongly developed as in the humpbacks. Its lower part, on the contrary, is in the Greenland whale still more distinctly prolonged in an outward direction, in a semitubular form (Plate IV, fig. 2, *b*), with its concave part turned upwards, and thus it joins the orbital process of the frontal in such a way that the optic nerve, in its inner part at least, is encased in a completely closed bony tube. The semitubular groove formed in this way by the parietal is still further strengthened by a similar, but much shorter, semitubular portion of the pterygoid (Plate IV, fig. 2, *a*).

Of the occipital bone it has already been stated that it is so imperfectly developed in the newborn Greenland whale that its part of the primordial cranium is still cartilaginous where it meets the squamous portion and the sphenoids, as well as between its own three separate ossifications, namely, the basal and the two articular portions. The articular portions, both with their lateral prolongations and with their condyles, are still at this period partially prominent on the lower surface of the cranium, and the occipital foramen is not yet advanced entirely up to its superior surface; it is therefore the more surprising that the squamous portion of the occipital is already fully as far advanced over the parietals and the frontals (see Plate III, fig. 1, *c*), as in the full-grown individual.

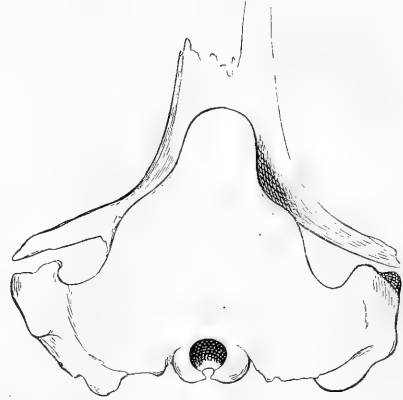
While thus the lateral portions of the occipital are still distinctly separated by a cartilaginous strip from the squamous portion, their exterior edge, which meets the temporal, has only a slight sigmoid curvature, and is quite even and uniformly smooth in its whole extent. Afterwards, when all the separate bony elements of the occipitals are firmly united with one another, these earlier relations are scarcely to be recognised any longer. The external part of the temporal fossa has grown out in the form of a strong ridge, towards which the adjoining part of the sigmoid edge on the occipital is raised. The lateral prolongation of the temporal, on the other hand, has been produced very strongly in a transverse and outward direction; the adjoining part of the articular portion of the occipital has followed it in this metamorphosis; the posterior surface is on a level with the same surface of the lateral prolongation of the temporal, and the exterior half of that sigmoid lateral edge of the occipital forms an indented suture, running in a backward and inward direction, which indicates the boundary between the respective shares of the two bones in the lateral parts of the occiput.

Instead of entering on a more detailed description of the upper surface of the occipital of the Greenland whale cranium, we think we shall do better in referring our readers to the illustrations we have given of it; but we cannot leave it without noticing the fact that, compared with other parts, it is often found uninjured in those fragments which are usually placed before the zoologist for his decision as to their species. In the first part of this memoir such a fragment of a whale, found by Middendorff's expedition on the north coast of Siberia, was mentioned, which, judging by two drawings of it, which we owe partly to Mr. Branth of the expedition, partly to the celebrated leader of the expedition itself, we should hesitate in referring to the same species that is the chief subject of our researches. One of these drawings we place before our readers in the annexed woodcut, for a closer comparison with our illustrations of the Greenland whale. It will be found that, as the narrowness of the upper jaw is in itself sufficient to exclude any thought of its

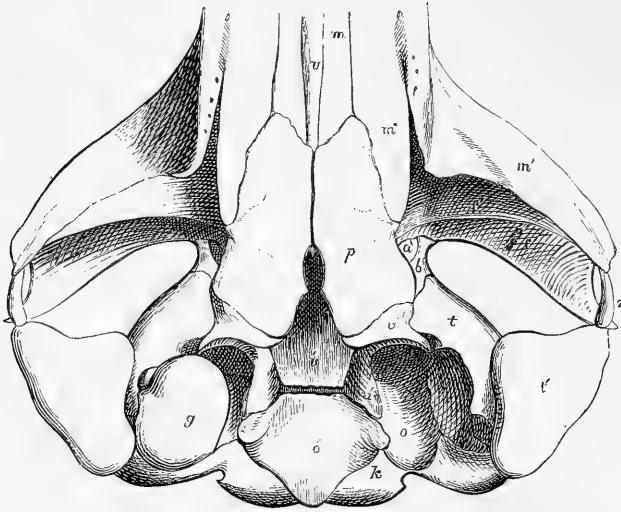
being the cranium of a rorqual, so the direction of the orbital processes of the superior maxillaries and the frontals, as well as the greatly advanced situation of the squamous portion of the occipital, are sufficient to show that the right-whale to which this fragment belonged was more closely related to the Greenland whale than to the Cape whale; but at the same time we may find sufficient reason in the narrowness of the squamous portion of the occipital, and in the greater breadth and smaller length of its lateral parts, to suppose that this fragment should be referred to a particular species belonging to the North whale group.

On the basal surface of the cranium (Plate IV, fig. 2) the superior maxillaries are seen still partially retaining their superiority in the formation of the bony palate. The limits between their lateral portions (*processus orbitales*) and the middle portion behind appear in the form of a very deep fissure in their palatine surface. This forms the entrance into a deep cavity in the interior of the bones, and the fissure is prolonged anteriorly in the form of a series of foramina for vessels and nerves. Numerous similar foramina are found close around the fissure itself. The middle portion of the palatine surface of either of the superior maxillaries is again divided behind into two narrow prolongations, of which the exterior is the longer. The cleft between them is occupied by the anterior end of the palatine bones. In the full-grown Greenland whale this end of the palatine bones is pointed, and these bones (*p*) are, generally speaking, narrow. They separate from each other behind in an acute angle, in which a small part only of the nasal septum formed by the vertical plate of the vomer is visible. To the posterior edge of the palatines, which is turned very much in an outward direction, the palatine plate of the pterygoid bones (*a*) is as usual attached, on the free edge (*b*) of which a hook, properly so called (*hamulus pterygoideus*), can scarcely be distinguished (as is the case with the rorquals). Of the pterygoids we may, besides the above, see on the lower surface of the cranium, not only the narrow prolongation before mentioned, serving as a support to the part of the parietal which enters into the formation of the tube of the optic nerve, but also a small part of their middle portion deeply wedged in between the rest of the bones.

The palate, and with it the cavity of the mouth, is in the full-grown Greenland whale so much prolonged backwards that its posterior edge, formed by the pterygoids, nearest to the middle line, will be found to be at the same time the posterior edge of the lower surface of the cranium itself. The bones corresponding to the floor of the skull and the organs of hearing have been removed so much upwards, or have become so extensively covered by the palatine bones, or have, at any rate, become so small, comparatively speaking, that they are either quite invisible, or subordinate to the bony portions belonging to the lateral prolongations of the palate and the occiput. In no other part shall we find the cranium of the newborn animal so different from that of the full-grown one as here; and as a further illustration of this point, we have given a woodcut of this region in our newborn Greenland whale, to be compared with the



corresponding figure in Plate IV. The letters *b*, *g*, *m*, *p*, *t*, *t'*, *u*, *v*, and *z*, have here the same signification as in the plate; *m* is the exterior and largest of those prolongations into which the visible portion of the palatine surface of the superior maxillary is divided behind; *m'* the orbital process of the superior maxillary, *o* the basal part of the occipital, *u* that part of the pterygoid which immediately joins the parietal, *u'* that part of the pterygoid which joins the occipital, *v* the most posterior part of the vomer.



It will be seen that here in the newborn individual a very considerable portion, composed of bones belonging more or less to the cranium, is still placed behind the free edge of the pterygoids (*u*), contrary to what is the case in the full-grown specimen. More especially, we still see here in the middle line that part of the vomer which covers the posterior sphenoid as well as the entire basilar part of the occipital (*pars basilaris ossis occipitis*, *o'*), of comparatively large dimensions, while in the full-grown individual these parts can scarcely be distinguished in their covered position between the inner edge of the palatines. Immediately to the outer side of this plate of the vomer the middle portions of the pterygoids occupy in the newborn individual a very extensive tract (*u'*); behind their palatine portions and outside and behind the basilar part of the occipital (*o*) a great part of the condyles (*k*) of this bone are still to be seen, which in the full-grown individual have been pressed upwards on to the superior surface. A little further outwards the tympanic (*g*), loosely joined with the petrous bone, is shown on one side; in the newborn animal it is large and round, in the full-grown one comparatively much smaller, and, at the same time, rather differently formed. Also the lateral portions of the articular parts of the occipital are still in the newborn specimen (*o*) very prominent on the lower surface of the cranium, while in the full-grown one, they have almost totally disappeared.

A very different relation will be perceived between the cranium of the newborn animal and that of the full-grown one, as to the lateral portions of the temporals, in conformity with what has already been stated to take place in them during their growth. In this, as

well as in the opposite surface of the cranium, we find them in the newborn specimen still only in the form of short or irregularly triangular pieces of bone (t'), in which only by the lateral position and the junction with the zygomatic (z) can we recognise those bony masses which in the full-grown animal are developed to such an extraordinary degree, especially behind and outwardly, as well as greatly removed in a backward direction.

The petrous bone in the newborn specimen is also of a much simpler form than in the full-grown one, where (w) it is exceedingly hard and rough. The junction between it and the tympanic is, as usual in the Cetaceans, effected by means of thin, but solid, osseous prolongations, one of which is the *processus anterior mallei*; these are very easily broken. The petrous bone itself, on the contrary, is exceedingly firmly wedged in between the remaining bones of the skull, especially by means of the two osseous processes already described and figured by Cuvier. We have represented this very complicated junction of the petrous bone with the adjoining bones in Plate V, fig. 4, as it appears on the left side of the head when looked at from below and from the front.

In this figure (four and a half times diminished) the letters have the following significations :

- a.* The tympanic (*bullæ tympani*).
- b.* The petrous bone.
- b'*. The thin and sharp plate of this bone, forming the anterior wall of the innermost part of the auditory meatus in which the sack-like eversion of the membrana tympani is placed.
- c.* The foremost and (towards *o'*) lower surface of the external tenon-like process of the petrous bone, of which the former, together with *x*, forms the hindmost wall of the auditory meatus.
- d.* The internal process of the petrous bone, as far as it is firm and osseous.
- d*^o. The internal process of the petrous bone, as far as it consists of a spongy mass.
- e* (and *h*). The portion of the occipital entering into the inner wall of the pterygoid cavity.
- f.* The roof of the pterygoid cavity, formed by the occipital.
- g.* The portion of the pterygoid entering into the internal wall of the pterygoid cavity.
- h* (and *e*). The portion of the occipital entering into the internal wall of the pterygoid cavity.
- o.* The occipital.
- o'*. The inferior rough surface of the lateral portion of the occipital joining the lowest surface of the external tenon-like process of the petrous bone.
- p.* The pterygoid.
- t.* The temporal.
- t'*. The inner wall of the articular portion of the temporal.
- t*^o. A spongy prolongation of the temporal joining *d*^o.
- x.* The posterior wall of the auditory meatus as far as it is formed by the temporal.
- y.* Interval between the petrous bone and the lower surface of the articular portion of the temporal, filled with a strong fibrous tissue for the attachment of the petrous bone.
- z.* The entrance of the pterygoid cavity.

The petrous bone in the Greenland whale (as in whalebone-whales, generally speaking) is so exceedingly closely wedged in between the surrounding bones of the skull, that it can hardly in any case be separated from them, at least not in a full-grown cranium, without considerable injury either to itself or to the surrounding parts. Again, the tympanic so firmly coalesces with the petrous bone that it can never be loosened from it by the decomposition of the soft parts; but the firm union between these two osseous portions depends on two processes of bone so thin that the tympanic may very easily be broken off, wherefore it is very frequently found in museums in a more or less injured state. In half- or full-grown right-whales these bones are very easily to be distinguished from those of the rorquals, especially by their being almost as broad as long, whereas those of all the rorquals are perceptibly longer, those of the fin-whales even much longer, than broad. In very young specimens this distinguishing mark, and in a still greater degree all the other characters that may be taken from their form, are but slightly developed. We have hitherto been unable to institute a comparison between the tympanic bones of the Greenland whale and those of the remaining right-whales in full-grown specimens.

In order to show the internal concealed parts of the skull of the Greenland whale, its right half has been figured from the inside from the same forty-seven and a half feet long specimen on the fifth plate. In dividing it with the saw the cut on the whole went vertically through the middle line, deviating, however, a little to the left behind, so that in the figure the left lateral surface ($e-v^x$) of the nasal septum covers the right nasal cavity. By this we have gained the advantage that the vomer, which is almost invisible on the surface, appears in our figure from several sides.¹

The cerebral cavity (A), so extraordinarily small, comparatively speaking, will be seen behind, together with the occipital foramen ($oo-oo$), which is displaced entirely on to the upper surface of the skull; in front we see the immensely thick mass of bone, into which the anterior wall of the above-mentioned cavity has been changed by the coalescence of the occipital (*squama occipitalis*), the interparietal, the frontals, the ethmoid and the nasal bones. In the vertical longitudinal section of this bony mass it is impossible to distinguish the limits of each of these single bones. It is only according to an arbitrary judgment that we have designated the share of the occipital with the letter o , that of the frontals with f , that of the nasals with n , and that of the ethmoid with e . Just as the ethmoid in its ossified state coalesces with the frontals, so it will further be seen in the interior of the nasal cavity to be immediately connected with the turbinated bones (c), also perfectly ossified, and the hindmost part of the cartilaginous lining of the nasal cavity, as far as that, too, is ossified (m^o). The unossified part of the cartilaginous primordial cranium has disappeared during the maceration, so that not only that surface of the superior maxillary (m^s), and of the intermaxillary (i), which form the front part of the anterior walls of the nose, and in their natural condition have a carti-

¹ It was necessary to saw through the cranium, as, undivided, it could not be taken through any of the doors of the museum. But the specimen was by no means deteriorated by this proceeding, as we succeeded in having it fitted up in such a way that its two halves, by a special mechanism, may be screwed quite closely together. As an object of study, it has, indeed, gained much, for by the same mechanism the two halves may easily be screwed away from each other, so that all the parts situated along the mesial line can be seen as represented in the figure described above.

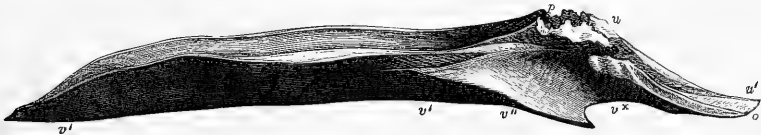
laminous lining, but also the interior surface of the vomer ($v-v$) which formerly enclosed the primordial vomer, have been laid bare. For just as the primordial cranium, as it has been called, to which the ethmoid and the turbinated bones also belong, is prolonged above in a cartilaginous lining of the entire nasal cavity (m^o-m^x-i), it is prolonged downwards in the enormous primordial vomer, which not only fills the very capacious cavity of the vomer ($v-v$), but even where this ceases at the foremost third of the superior maxillary is still prolonged to the very tip of the upper jaw.¹ Of these two anterior prolongations of the primordial cranium, only the most posterior part will be found in an ossified state in the full-grown Greenland whale, and a special figure of this region, presenting several difficulties to the interpreter, is given in the fifth figure of the same plate.

The letters have here the following significations :

- a.* The first turbinated bone.
- b.* The second „
- c.* The third² „
- d.* A cavity in the side wall of the nasal cartilage.
- f.* The left lateral surface of the ossified part of the primordial vomer.
- m^o.* The side wall of the ossified nasal cartilage.
- mⁱ.* A prolongation of the same, also ossified.
- m^x.* The internal surface of the superior maxillary.
- x.* A spongy bony mass between the superior maxillary and the vomer.
- v.* The foremost surface of the osseous part of the primordial vomer.
- v.* The internal surface of the vomer.

As far as the vomer has been left untouched by the section, by which means its external surface appears on the left side, we may distinguish three parts in it; anteriorly (v'), the part covered by the palatine portion (m) of the superior maxillary, in the middle (v''), the part covered by the palatine bone, and behind, that part (v^x) in which the external surface of the vomer is free and forms the left lateral surface of the nasal septum.

As it is scarcely possible, however, to have a clear conception of the form of this bone, deeply concealed in the interior of the cranium, except by seeing it perfectly isolated, it is shown in this state in the accompanying illustration, taken while we were examining it in the unborn individual.



Just before v^x the posterior free edge of the septum of the nasal canals will be seen, as well

¹ Compare the description of the primordial cranium of the "Vaagehval" (*Balenoptera minor*), in the 'Transactions of the Danish Royal Society,' 4th series, vol. xii, p. 249 et seq., tab. xiii and xiv. [Republished in the "Zoologisch-Anatomisch-Physiologische Untersuchungen über die Nordischen Walthiere," by D. F. Eschricht, Leipzig, 1849.]

² Compare figures of these parts in *Balenoptera minor*, l. c., tab. xiii.

as its left lateral surface, turned forwards and upwards; and which, in fig. 1, Plate V, is indicated by the same sign; above v'' and v' the left arched lateral surface will be seen, which joins the palatine and superior maxillary bone. In the right half of the cranium, (Plate V, fig. 1,) this surface had mostly disappeared by the sawing through of the vomer, by which means a fairer view had been gained into the great cavity of the bone ($v-v$) adapted for the cartilaginous primordial vomer; in the woodcut it will be seen, on the contrary, how this great cavity in its posterior part, first (from p to u) is continued in a narrower and flattened pit, in which the anterior sphenoid is placed, and then (from u to u') gradually loses itself in an extremely slight groove in the hindmost, flattened, horizontal end of the vomer, which covers the inferior surface of the posterior sphenoid. The posterior edge of the vomer (o), which is quite thin, joins the anterior part of the basilar portion of the occipital. The lateral margins are placed in their most anterior part in contact with the intermaxillaries, and in the middle with the maxillaries. Above the septum of the nasal canals, where they are very broad and rough, they are united with the palatines (near p), and in their entire posterior extent ($u-u'$) with the pterygoids. Those parts which are covered by the vomer from below, namely, the primordial vomer and both sphenoids, consisted still in this unborn individual of one single cartilage, without traces of its being divided into several pieces, and into which the basilar part of the occipital, adjoining behind, and the ethmoid, placed above, were also included.

To illustrate more fully the internal structure of the cranium of the Greenland whale, as far as it appears after having been sawed through vertically in the mesial line, we shall here insert the interpretation of all the letters employed in fig. 1, Plate V.

- A.* The cerebral cavity.
- B.* The orbit.
- C.* The nasal opening.
- D.* The glenoid articulation.
 - a.* The articular process of the temporal.
 - c.* The anterior parts of the turbinated bones (*conchæ nasi*) of the nasal canals.
 - e.* The ethmoid.
 - f.* The frontals.
 - f'*. *Processus orbitalis ossis frontalis*.
 - h.* The hook of the pterygoid (*hamulus pterygoideus*).
 - i.* The intermaxillary.
 - i'*. The surface of the part of the intermaxillaries bounding the nasal cavity (*superficies nasalis ossis intermaxillaris*).
 - k.* The right condyle of the occipital.
 - m.* The superior maxillary.
 - m'*. The lateral prolongation of the superior maxillary (*processus orbitalis ossis maxillaris superioris*).
 - m''*. A thin and hollow plate of the superior maxillary, joining that wall of the canal for the optic nerve which is formed by the frontal.
 - m*. The palatine process of the superior maxillary.
 - m^x*. The surface of the superior maxillary bounding the nasal canal (*superficies nasalis ossis maxillaris*).

- m*^o. The most posterior part of the same surface, lined by an ossified cartilaginous layer from the primordial cranium.
- n*. The inner surface of the nasal bone meeting the corresponding surface of the other nasal bone.
- n*^x. The inferior surface of the nasal bone.
- o*. The surface of the section of the occipital.
- o*^o. The inferior and posterior part of the free surface of the occipital.
- o*^x. The superior part of the same surface.
- o*^o. The occipital foramen (*foramen magnum*).
- p*. The palatine.
- t*. The temporal.
- z*. The pterygoid.
- v*. The right internal surface of the vomer.
- v*^o. The surface of the section of the vomer in the mesial line.
- v*^o. The external surface of the vomer, as far as it is covered by the superior maxillary.
- v*^o. The same surface, as far as it is covered by the left palatine bone.
- v*^x. The same surface, as far as it forms the internal wall of the nasal canal.
- v*. The posterior free extremity of the vomer.
- z*. The zygomatic.

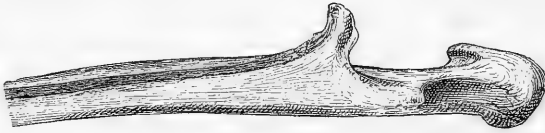
The lower jaw of our forty-seven and a half feet long Greenland whale skeleton will be found represented, as seen from behind, in Plate II, fig. 2; its left ramus, as seen from the outside, in Plate II, fig. 1; the right ramus, as seen from the inside, in Plate V, fig. 2; and finally, the posterior extremity of the same ramus, as seen from above, in Plate V, fig. 3.

Compared with the rami of the lower jaw in the newborn Greenland whale, those of the fully grown animal are unquestionably much curved, but by no means so much as those of the rorquals in general, more especially those of the humpbacks (Plate III, fig. 2). The curvature, it will be seen, is also completely limited to its anterior half. This is evidently caused by the glenoid articulation being placed so outwardly on the greatly projecting lateral processes of the temporal bone that even at this place they are separated from each other by the breadth of the entire skull, whereas in the rorquals, as we have stated already (compare Plate III, figs. 2 and 3), the case is quite different. As the branches of the lower jaw of the full-grown Greenland whale, though bounding the enormously broad cavity of the mouth, and though approaching very close to each other at the symphysis, are comparatively but slightly curved, so they must also, on the whole, be called slender, that is, in comparison with the branches of the lower jaw of the humpbacks, although they are so heavy that a single one of them in its recent state can scarcely be lifted from the ground by the united efforts of six men. It is only in their hindmost ends that their thickness is very great; towards the front it gradually decreases, so that at their points they become completely flattened. Their great weight depends, accordingly, partly on the thickness of their posterior ends, partly on their extraordinary length. (See especially Pl. II, fig. 2, where, however, some allowance must be made for the diminution of the anterior ends, nineteen feet distant, in consequence of the perspective.)

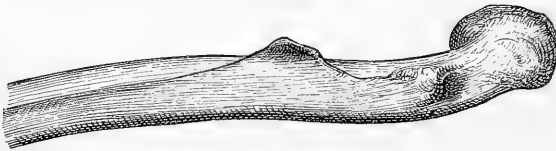
Of peculiarities in the lower jaw of the adult Greenland whale, we shall first point out that at their anterior flattened end the rami are twisted in such a manner that their inner surface is turned upwards and the outer surface downwards, so that at their junction they do not meet each other so much by their points as by the most anterior part of their inferior margins (see Plate V, fig. 2, *f*). This peculiar twisting of the anterior ends of the rami of the lower jaw is not yet perceptible in very young individuals, and in the rorquals it can only, at the most, be said to be indicated by a slight inflection.

We shall find many other, and scarcely less conspicuous, characters in the posterior ends of the branches of the lower jaw in the Greenland whale.

As such, we have already mentioned the perfectly different position of the articular surfaces, which may be pointed out even in the newborn animal, and also the surprising thickness of this region as compared with the middle and foremost parts of the bones. To enter on a somewhat more detailed examination of the peculiarities appearing here we must refer our readers to Plate V, fig. 2, where the right branch of the lower jaw of the full-grown Greenland whale is shown, seen from the inside; and fig. 3, where the posterior part of the same is seen from above. For a comparison we shall insert here a woodcut illustration of the hindmost parts of the right lower jaw-bone of a fin-whale (*Balænoptera musculus*, J. Müll.; *Rorqual de la Méditerranée*, G. Cuv.), fifty-three and two thirds feet long, and of a Greenland humpback



(Krepokak, *Balæna boops*, O. Fabr., *Megaptera longimana*, Gray), forty-three feet long, both seen



from above, like that of the Greenland whale. In this position the articular surface of the lower jaw of the Greenland whale (though by no means sharply defined) is visible in almost its whole extent, whereas in that of both the rorquals it is completely hidden, in accordance with its different direction already frequently mentioned.

A not less conspicuous difference is that the part of the bone adjoining the articular surface is somewhat contracted in both the rorquals, so that the articular surface constitutes a distinct condyle, and the part situated between it and the opening for the vessels and nerves may be said to form a neck, whereas the lower jaw of the Greenland whale is thickest in this place (see especially Plate V, fig. 2). Further, the part between the articular surface and the great opening for vessels and nerves is extremely short in the Greenland whale compared with the neck of the condyle in the rorquals; the distance between this opening and the coronoid

process (*c*) on the upper margin of the bone is, at the same time, shorter, so that the temporal muscles are far more disadvantageously placed for lifting up the jaw than in the rorquals. But besides this, it must be observed that this coronoid process (*c*) is extremely small in the Greenland whale, an evidence of the feeble action of the temporal muscle, whereas in the humpback it has the form of a broad and powerful prominence, and in the fin-whales is developed into a highly projecting crest.

The great opening for the vessels and nerves entering the lower jaw also shows some very striking peculiarities in the Greenland whale, when compared with that of the rorquals. It is situated, as usual, on the inner surface of the bone, close to the upper margin; but its form is almost circular, whereas in the rorquals it appears rather like an oblong fissure, and, what is most characteristic, it is prolonged downwards into a narrow groove or cleft (Plate V, fig. 2, *x, x, x*), which turns forwards near the inferior margin and runs along it, not to disappear until about the anterior fourth of the bone. Although this groove is only to be considered as a vestige of the cavity in which the primordial lower jaw (Meckel's cartilage) was situated during the embryonic state, it is preserved in the Greenland whale at least until the full-grown age, whereas in the rorquals it has disappeared without leaving any traces even in very young individuals.

In the inferior maxillaries of the Cape whale there is the same twisting of the surfaces in front, the same want of any contraction behind that may deserve the name of a neck, the same large opening for the vessels and nerves entering the lower jaw, as well as the fissure or groove for Meckel's cartilage issuing therefrom; but from those of the Greenland whale they may be distinguished, partly by the bending of their posterior end mentioned above, partly by their greater height as compared with their length, and, generally speaking, by their less slender form. Judging from a very young individual of the group of the South whales (from the Bay of Biscay), we might find an excellent distinguishing mark in the inner surface being almost as convex from above downwards as the outer surface, whereas in the Greenland whale it is quite flat in this direction. But, in reference to this point especially, we regret that we have not had before us the skeleton of a Cape whale for direct comparison while making our researches.

To the bony frame of the hind part of the head may still be referred the two stylo-hyal bones; with these follows, naturally, the os hyoides itself, and with this, again, the larynx and the trachea. This, therefore, may be the proper place for a description of these parts, and we feel ourselves the more called upon to give it, as we have not only examined them in our very young individuals, but also in the two full-grown ones of which the skeletons were at our disposal.

The hyoid is in the Greenland whale, as in all other Cetaceans, composed of three bones—the os hyoides properly so-called (see Plate VI, fig. 1, *a*), and the two stylo-hyal bones (*b*); these are attached at their inner ends by means of a ligament (*c*) to a pair of wart-like processes (the anterior hyoid cornua) on the anterior margin of the middle piece of the hyoid, externally by means of a similar ligament (*d*) to the petrous bone. In the hyoid, properly so called, we must distinguish between the middle piece and the two lateral cornua, all of which have special points of ossification in the originally undivided cartilage. The middle piece of the hyoid passes imperceptibly at the sides into the two lateral cornua; on its anterior margin are the two anterior hyoid cornua, as they are called, separated from each other by a deep notch in the mesial line; its posterior margin is evenly concave.

The hyoid of the right-whales differs from that of the rorquals by the posterior margin of its middle portion being evenly excavated, instead of presenting two processes with a notch between them, almost as in the anterior margin. That of the Greenland whale seems to differ from that of the Cape whale by the lateral cornua as well as the stylo-hyal bones becoming thicker at their outer ends. During the growth of the animal the length of the lateral cornua increases very considerably, comparatively speaking. Such is even to a greater extent the case with the anterior cornua, by which means they at the same time appear to approach each other, so that the notch between them becomes deeper and narrower. In the newborn Greenland whale the ossified part of the middle portion was placed close to the anterior margin; the anterior cornua were still perfectly cartilaginous, the lateral cornua, on the other hand, only in their outer conical ends; the stylo-hyal bones were only ossified in their middle parts, both their ends being still cartilaginous, and making together half the length of the bone.

It seemed strange to us that even in our two full-grown specimens the stylo-hyal bones, as well as the lateral cornua of the hyoid, were still found cartilaginous in their outer ends (*a'*); they must therefore either not ossify at all or, at all events, at an exceedingly late period.

The larynx is an organ which has, quite exceptionally, already been accurately studied not only in several rorquals, but has also been the object of a minute description in the case of the Greenland whale, although it has not hitherto been examined in any other species of right-whale. We here allude especially to the excellent memoir on this organ by Sandifort,¹ who, perhaps, would not have left anything for our further elucidation, still less for any emendations, if he had not, as regards the Greenland whale, been limited to the examination of two small fetuses, while we have had at our disposal the entire organ of the newborn individual and the cartilaginous parts from the two full-grown ones.

These cartilages of the larynx of the animal forty-seven feet and a half long are figured in Plate VI, one sixth of the natural size. Fig. 1 shows the entire larynx from behind, or rather from the upper surface, in its natural connection with the hyoid; fig. 2, the cricoid and arytenoid cartilages as well as the epiglottis from the right side; fig. 3 shows the relation of the epiglottis to the arytenoid cartilages, while the respiratory canals are closed, as seen from the inferior (ventral) side; fig. 4, the entire larynx, seen from the ventral surface; fig. 5, the same seen from the right side.

In all the figures the letters have the following significations:

- e.* The outer or ventral surface of the thyroid cartilage.
- f.* The anterior cornu of the same.
- g.* The posterior cornu of the same.
- h.* The ligament by which the anterior cornu of the thyroid cartilage is attached to the hyoid (*ligamentum thyreo-hyoideum*).

¹ Nieuwe Verhand. d. 1ste. Kl. van het Kon. Nederl. Instit. van Wetensch. te Amsterdam. Derden Deels eerste Stuk. Amsterd. 1831, page 223.

- i.* *Ligamentum thyreo-cricoideum inferius.*
- k.* The epiglottis.
- l.* *Ligamentum thyreo-epiglottideum.*
- m.* The chief piece or body of the arytenoid cartilage.
- n.* The anterior or ascending cornu of the same.
- o.* The posterior or descending cornu of the same.
- p.* The transverse ligament between the posterior cornu of the arytenoid cartilages.
- r.* The exterior or dorsal surface of the cricoid cartilage.
- s.* The interior or ventral surface of the same.
- t.* A ligamentous membrane between the lateral edges of the cricoid cartilage and the posterior cornua of the arytenoid cartilages.
- u.* The anterior part of the sacculus of the trachea, as seen from the side in its place between the posterior cornua of the thyroid and arytenoid cartilages.

We know that the most essential peculiarity of the larynx of the whalebone-whales, as compared with that of the toothed-whales, consists in its allowing the mucous membrane of the respiratory canals, by means of an opening on its ventral surface, to appear in the form of a sac with an exterior covering of a strong layer of muscles. A similar sac is found on the respiratory canals of many terrestrial mammals, as is very well known; in most cases it appears between the hyoid bone and the thyroid cartilage, though in others, especially in some of the apes, between the thyroid and cricoid cartilages, or between the latter and the first ring of the trachea, and the last-mentioned case most resembles that of the whalebone-whales, although these latter have also some characteristics peculiar to themselves, which have already been distinctly pointed out in earlier researches. Of the cricoid cartilages only the posterior half (fig. 1, *r*) is present, which accordingly has too free lateral margins (figs. 2 and 5, *r*), whereas the arytenoid cartilages are continued towards the ventral surface in a pair of processes (figs. 2 and 5, *o*), which run for a considerable extent along these lateral edges of the cricoid, though always with a certain interval, closed by means of a ligamentous membrane (fig. 5, *t*), but which at length approach each other in the mesial line of the ventral surface, where they are united by means of a special ligament (fig. 2, *q*). The arytenoid (*m*) have accordingly, besides their two usual prolongations, or cornua (*n*), which on the dorsal side strengthen the opening of the respiratory canals into the nasal cavity, still two other cornua running in the opposite direction, which together form a complete frame round that opening which connects the respiratory canals with the air-sac on the ventral surface of the larynx. The opening, however, does not extend quite to the hindmost connecting ligaments of the two cartilaginous prolongations, being here somewhat diminished by a fold of the mucous membrane.

In the rorquals the plate of the thyroid is short, the posterior or descending cornua of the arytenoid cartilages just mentioned are almost entirely uncovered by it, and the opening of the air-sac may therefore be said to be placed, to a certain degree, on the ventral surface of the larynx, between the thyroid cartilage and that ligament, which in this surface assumes the place of cricoid cartilage. But in the Greenland whale the thyroid plate (fig. 4, *e*), extends so far backwards as to cover this opening completely, and in this place it becomes perfectly clear that the

thyroid, in connection with the hyoid, only serves as a semitubular sheath around the trachea properly so called, the anterior (superior) limits of which must be set down at the beginning of the arytenoid cartilage. At the same time it is the more evident that the cricoid, on the contrary, may most properly be said to form part of the trachea itself, as it is itself united with the anterior tracheal rings, and as the ligamentous membrane, compensating for its absent ventral moiety, is united with the one which fills out the place of the wanting pieces of the tracheal rings on the ventral surface. In the Greenland whale fœtuses examined by Sandifort the tracheal bag did not extend further backwards than the hindmost extremities of the plate of the thyroid, so that it only became visible in the notch between these on the hindmost margin of the cartilage. But he was very well aware that such could not be the case in a more advanced age of the animal. And, indeed, in the newborn individual it already extends backwards as far as to the division of the trachea into its two bronchi, or as far along the trachea as its cartilaginous rings are compensated for by an aponeurotic membrane.

The air-bag of the Greenland whale has, like that of the whalebone-whales in general, an exceedingly thick covering of muscles. This covering had in a young hump-back (*Megaptera*), a thickness of two or three inches. But the muscles by which the air-bag is covered have by no means the form of a membrane. They consist entirely of transversely striped muscular fibres, attached to the lateral margin of the cricoid cartilage, as well as to the interrupted extremities of the tracheal rings, forming fascicles, of which the inferior (posterior), at least in their external strata, are turned directly upwards (forwards), the superior (anterior) transversely towards a tendon placed in the mesial line of the fleshy mass, the rest obliquely towards this tendon. From without the bag seems to be very large, on account of the thickness of this fleshy mass. But its cavity lined with the mucous membrane appears to be comparatively very small, at least in the dead animal. On cutting through the fleshy mass, it is not met with by the knife until about midway between the division of the trachea and the posterior margin of the thyroid cartilage. When the bag becomes distended by the air which is forced into it during the relaxation of the muscles, the relative size of these parts will, no doubt, be completely altered.

As the larynx of the whalebone-whales in its ventral surface is so very differently formed from that of the toothed-whales, it is also known to be essentially different from the same in its superior (anterior) extremity, at least as far as it is not nearly so completely enclosed by the muscles of the soft palate. This is especially the case with the Greenland whale. The ascending cornua of the arytenoid cartilages are, as usual, placed in close contact with the epiglottis (fig. 3), forming with the latter an elevation ascending towards the palate. But this elevation is comparatively far shorter than that of the toothed-whales, and accordingly the membrane in which its three cartilaginous parts are enveloped is not continued to their very outmost extremities, so that the respiratory canals appear undoubtedly to be less completely closed before than in the toothed-whales. But we know how unsafe it is, both generally and in respect to these organs in particular, to make inferences from parts as they appear in the dead body, as to their appearance during the life of the animal, and we must consider any such supposition as that the water may penetrate from the cavity of the mouth into the respiratory canals, and particularly into the tracheal bag on the larynx, and be again expelled from thence through the nostrils, to be quite improbable.

Before we leave the examination of the larynx we must still add some observations relative

to the description of its separate parts given by Sandifort. Of emendations, properly so called, we have only one to make, namely, that the two descending cornua ($g-g$) of the thyroid are really, in the Greenland whale, as in the rorquals, firmly united as one continuous cartilaginous mass with the plate. That Sandifort should have believed that he found an articulation between them must, no doubt, only be ascribed to these brittle parts having been accidentally broken in the tender fetuses. The rest of our observations will be limited to some unessential differences of form, very conspicuous in our more developed specimens.

The plate of the thyroid we found much thickened along the mesial line in the form of a ridge, which, however, towards the posterior margin was turned towards the left side, so that the cartilage in this place became rather unsymmetrical. On the posterior margin of the thyroid the notch was further found to be considerably more obtuse than represented by Sandifort, and the two posterior cornua were not so very little inflected in an outward direction. But his statement that the two great foramina on the thyroid of the rorquals are quite wanting in the Greenland whale we found fully confirmed. As to the arytenoid cartilages, we shall only point out the fact that their anterior cornua in the full-grown individuals presented a far more beautiful form than in the imperfectly developed fetuses examined by him. While *in situ* they resemble, especially when seen from behind (fig. 1, $n-p-n$), two swans' necks inclined towards each other. The epiglottis (k), too, has a much more elegant form than was observed in the fetuses. It is provided with a longitudinal ridge on its posterior surface (fig. 3). By a special ligament (figs. 4 and 5, l), it is attached to the anterior notch of the thyroid; but we found, moreover, a very long and strong muscle placed along the mesial line of its inner surface and of that of the thyroid, which muscle, apparently at least, was connected with the muscular layer around the tracheal air-sac.

The trachea of the Greenland whale is, as usually among the Cetaceans, very wide, but at the same time extremely short. In the newborn specimen it had a width of seven and a half inches and a length of about four and a half inches. It has already been stated that its cartilaginous rings do not enclose the ventral surface of the tube. The three hindmost rings, however, form an exception in this respect. They are placed very close to one another, and are exceedingly irregular, being frequently split or turned in different manners. As the cricoid cartilage is united with the anterior ring, so the latter is again united with the two next following.

A very remarkable deviation in the trachea of the Greenland whale, not only from that of rorquals, but, as far as we know, from that of Cetaceans in general, has already been noticed by Sandifort, and thus it only remains for us to corroborate it in its full extent—we mean the peculiarity of its being only bifurcated into two bronchi, that branch which in other Cetaceans (and several land mammals) issues from the trachea before its division into those two bronchi not being found here. The two tracheal branches have not quite the same width; that of the right one is somewhat larger than that of the left.

After having followed the cartilaginous respiratory canals to their hindmost extremity, we must yet glance at their very foremost extremity at the outlet from the nostrils.

The air-reservoirs situated immediately inside the nostrils of the toothed-whales are very generally known, and their rather complicated structure has found several describers, especially in the porpoise. That no such superadded cavities are to be found in the right-whales has already been shortly stated by Roussel de Vanzème.¹ In examining more closely our newborn cub and

¹ 'Annales des Sc. Nat.,' sec. ser., tome ii, p. 125.

the full-grown fœtus we have been completely convinced about the correctness of this statement. The result of our examination is the following.

In the description of the external appearance of the newborn Greenland whale it has already been mentioned that the inner margin of either of the nostrils is stiff and immovable in its curved form, with its concavity turned outwards and forwards. The margin is supported by a strong cartilaginous plate standing vertically on the cranium, near which it is divided into several much-convoluted cartilaginous parts, which we cut through in order to convince ourselves that they do not contain any cavity. They are placed in immediate connection with the cartilaginous lining of the nasal cavity, which, again, is itself part of the primordial cranium. The outer convex margin of the nostrils is, on the contrary, quite soft and very tumid. When its cutaneous covering is removed, it looks, at first sight, like a large round bag. But when it is cut through it appears to be composed entirely of muscular fibres, the arrangement of which, relative to one another, it would scarcely be easy to describe. If we further examine the canals from the nostrils into the nasal opening in the cranium, either by putting a finger into them or by opening them by means of a knife, we shall see that these canals, in their whole extent, are almost entirely closed in the same manner as the openings of the nostrils, for a soft and rounded ridge on their outer wall fits closely into the inner wall, so that a transverse section of these canals presents everywhere the same semicircular figure as the external opening, though not always placed in the same direction, the soft ridge just mentioned winding somewhat in its course. We shall hardly need to state that this soft ridge also contains muscular fibres, and the mechanism of the whole structure of these parts may easily be understood. Not only the nostrils, but both the nasal cavities, are throughout their course, from the nostrils to the nasal opening in the cranium, closely shut up when the animal is not breathing, because the muscles in the exterior labia of the nostrils, and in the soft ridge of the nasal canals, are then in a relaxed state; but the soft labia of the nostrils, as well as both the ridges in the nasal canals, disappear when the animal is breathing, by the contraction of the enclosed muscles, and the semicircular openings of the nostrils are changed into two circular orifices, and the narrow nasal canals into two cylindrical tubes.

In enumerating the vertebræ it will be most convenient and safest to choose the foremost chevron bone (*hæmapophysis, os en V*) for our starting-point. Before this we have found in all our five skeletons (the ankylosed cervical vertebræ being reckoned as seven) thirty-three vertebræ; behind it, in the fœtus and the young individual twenty-two, in the two older individuals and the newborn one twenty-one. In the former case the entire number will therefore be fifty-five, in the latter fifty-four, a difference in the number of the vertebræ insignificant compared with what is to be found in some other Cetaceans provided with vertebræ as numerous. Which of the two numbers, fifty-four or fifty-five, should be put down as the most frequent, and therefore the normal one for the species, it would be scarcely safe to decide upon an enumeration in such a small number of individuals; nevertheless, we are inclined to favour the supposition of fifty-five, the more especially because one vertebra seemed to be wanting in both of our two large skeletons, namely, in the forty-four and a half feet long one, between the eleventh and the twelfth caudal vertebra, and in the forty-seven and a half

feet long one, at the extreme point of the tail (where in our illustration Plate II, fig. 1, it has been added), so that only one of our five individuals remains (the newborn one), in which the number may with certainty be stated not to have exceeded fifty-four. As to the number of vertebræ the Greenland whale is accordingly inferior to the Cape whale, in which the number, according to Cuvier, is fifty-nine. Of the rorquals, *B. musculus* has sixty-three, the Greenland hump-back (*Megaptera boops*, Fabr.), only fifty-three, the Vaagehval (*Balænoptera minor*, Knox), forty-eight vertebræ.

Of ribs, thirteen pairs were most certainly found in the smaller of the two full-grown individuals, and in the newborn one. In the fœtus we found on the right side a fourteenth rudimentary one, which was attached to the transverse process of the twenty-first vertebra by means of a ligament, whereas no trace of any such rib is visible in the opposite side. That the same was the case in the larger of the two full-grown individuals, we may, perhaps, be permitted to infer from the circumstance that a single rib-like bone, only twenty inches long, was sent with the rest, which did not admit of any other interpretation. But only twelve pairs of ribs were found in the young individual, and the extremely careful preservation which this skeleton had evidently undergone in all other respects, as well as still more the length and form of the twelfth rib of either side, afford us good reason to suppose, that really in this case only twelve pairs existed, or that, at least, the thirteenth was rudimentary.

If we consider the first chevron bone, or hæmapophysis, as the limiting point between the lumbar and caudal regions, and supposing thirteen pairs of ribs to be the normal number for the Greenland whale, then of its fifty-five vertebræ, seven will be cervical, thirteen dorsal, thirteen lumbar, and twenty-two caudal vertebræ. If, however, we refer the vertebra to the posterior extremity of which the first chevron bone is affixed, to the caudal series, we shall of course have seven cervical, thirteen dorsal, twelve lumbar, and twenty-three caudal vertebræ. We shall, however, prefer the former of these computations, the more so as the anus, that may justly be said to mark externally the limits between the abdomen and the tail, is situated directly beneath the first chevron bone. To subdivide the caudal vertebræ into those provided with hæmapophyses and those without them, can only serve to show how far towards the point of the tail the preparation of the skeleton has been perfectly made. We have only received ten of these arches with either of our two large skeletons, but in the fœtus we have found them (in a completely cartilaginous state) as far as between the forty-seventh and forty-eighth vertebra, to the number therefore of fourteen.

The seven cervical vertebræ are always ankylosed (sometimes even also with the first dorsal vertebra), and this is not only the case in older animals, in which these seven vertebræ together form one inseparable osseous mass, but also in the newborn specimen and in the fœtus, in which they form one mass of cartilage, as undivided as the former. This ankylosis therefore belongs to the original and normal formation of these parts, and we can scarcely venture to compare it with the more casual one between the last cervical and the first dorsal vertebra, and most certainly not with the mere pathological union, which occurs not unfrequently in animals and man. Ankylosed, and accordingly quite immoveably united with each other as the seven cervical vertebræ are, yet a layer of intermediate cartilage will be found, even in the full-grown individuals, between the sixth and the seventh, and still more between the latter and the first dorsal vertebra. This ligamentous intervertebral substance increases in thickness in the remaining course of the vertebral column down to the anterior caudal vertebræ, between which

it attains its greatest thickness; from this point it decreases uniformly between each of the following pairs of vertebræ, though even between the very hindmost it is still very considerable as compared with the size of these bones.

All the intervertebral cartilages in the vertebral column of the Greenland whale appear from without to be of such thickness that, when taken together, whether in a dried or in a fresh state, we can hardly help imagining that they must be of great account in measuring the length of the animal. In the tail the intervertebral cartilages often appear even as thick as the vertebræ themselves between which they are placed. But when in the full-grown skeleton we remove these ligamentous substances, and then measure the length of the column consisting of the vertebræ alone, piled up in their proper order on one another, the whole of the intermediate cartilages will be found to make scarcely more than three feet of the entire length of the vertebral column in a full-grown whale; much less, therefore, than appeared when seen from without. The cause of this is obvious, for these cylindrical ligamentous cartilages are far thicker at their external circular margins than at their centres, in which part they are scarcely anywhere thicker than one inch and a half, in most places only half an inch thick, in the dorsal region scarcely above one third of an inch. The intervertebral substances are undoubtedly thicker, comparatively speaking, in skeletons of younger individuals; but about these we may state with even greater truth, that the distances between the vertebræ seem larger than they really are, because in them the epiphyses of the bodies of the vertebræ look as if they belonged to the intermediate cartilages (see Plate II, fig. 3).

In order to ascertain the proportionate lengths of the different regions of the vertebral column in the full-grown Greenland whale we have principally been guided by our examination of the forty-four and a half feet long skeleton, because in that, when it arrived at Copenhagen, we still found the intervertebral cartilages mostly in good condition, and not perceptibly dried up. The whole vertebral column was then twenty-six feet ten inches. Of this length

10 inches, or proportionately, $\frac{5}{161} = 0.03$ belonged to the 7 cervical vertebræ.					
6 feet	2	„	„	$\frac{37}{161} = 0.23$	„ 13 dorsal „
9	„	8	„	„	„ 13 lumbar „
10	„	2	„	„	„ 22 caudal „

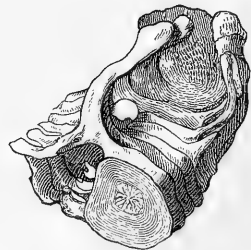
The vertebræ of the Greenland whale surpass in weight even those of the great fin-whales and hump-backs, yet they appear, generally speaking, to be less bulky; and the reason, we suppose, is that the transverse processes are very long in the largest of them, especially in the lumbar and the anterior caudal vertebræ, wherefore the bodies themselves are comparatively smaller, the arch being also broader, so that the articular processes are spread to a greater distance from each other, and the body itself forms a comparatively smaller part of the whole vertebræ.

As for the rest we can scarcely point out any common distinguishing mark for all the vertebræ of the Greenland whale. They are, on the contrary, rather characterised by different peculiarities in each separate region of the vertebral column.

To begin with the cervical vertebræ, here we immediately find the Greenland whale very markedly characterised by the form and ankylosis of these bones, especially in opposition to the porquals. Thus especially as regards the transverse processes from the second to the seventh vertebra. These processes are, properly speaking, shaped in the form of a ring in all the whalebone-

whales, especially in consequence of the great distance between their superior and inferior roots ; but, it is less essential, whether the ring becomes completely ossified (as is most commonly the case in the fin-whales), or remains cartilaginous in its outer part throughout the life of the animal (as in the hump-backs). Of the two roots of the transverse processes, the superior, as our readers may know, are never wanting, whereas the inferior are usually only found in the five middle cervical vertebræ. Such is also the case in the Greenland whale ; yet traces of them have even in some cases been discovered in the seventh cervical vertebra also (although in the hump-back they are wanting even in the sixth). But a complete ossification of the two roots, by which the transverse processes become bony rings, does not take place in the Greenland whale in any of the vertebræ, not even in the axis.

These vertebræ of the Greenland whale agree in another respect with the corresponding ones, both of the fin-whales and of the hump-backs—the transverse processes of the axis and those of all the succeeding cervical and the first dorsal vertebræ, approach each other so closely on either side, that all these processes assist one another in forming a point of attachment for the first rib. But while this approximation is brought about in the fin-whales and hump-backs by the ring-like transverse process of the axis being bent backwards over the succeeding transverse processes, which are at all events only slightly turned forwards to meet it, the case is quite reversed in the Greenland whale. For, in the latter, the transverse processes of the axis are directed only very slightly backwards, but those of the other cervical vertebræ, especially that of the seventh cervical, together with that of the first dorsal, are turned very much in a forward direction (see Plate II, fig. 3), and the third, fourth, fifth, and sixth cervical vertebræ being greatly compressed, and the whole neck also being very short, these processes reach as far upwards as the superior root of the transverse processes of the axis. All this anterior part of the vertebral column has on this account a very different appearance in the Greenland whale from that in the rorquals (see the adjoining woodcut, representing the seven cervical vertebræ, together with the first dorsal vertebra of our largest Greenland whale skeleton from the right side, thirteen times diminished, and the two following woodcuts in the next page and page 109, showing these ankylosed bones from below and from above). Not less characteristic is the appearance of the cervical region of the Greenland whale's vertebral column from the ankylosis of its individual vertebra. Such an ankylosis of the cervical vertebræ, so common in the toothed whales that it is never wanting in them as far as the two foremost ones are concerned, except in the narwal, the beluga, and the platanista, is, on the contrary, so rare in the rorquals, that we have never ourselves found any traces of it in others among them, than in the little fin-whale, and that even only in the Greenland variety (*Tikagulik*, *B. rostrata* Fabr.), and in these more especially or only between the second and third cervical vertebræ. In the Greenland whale, on the contrary, the ankylosis of the cervical vertebræ is even more complete than in the porpoises, the true dolphins, and the hyperoodons.



Considered more minutely, the ankylosis will be found especially marked in the following places. In the ventral surface of the vertebræ it is complete between the atlas and the axis. Between the latter and the four succeeding vertebræ the division becomes gradually distinguish-

able in an outward direction towards both sides, and in its entire transverse course between the sixth and the seventh; between the most posterior cervical vertebra (7 in the woodcut) and the foremost dorsal one an ankylosis also sometimes takes place. The inferior transverse processes are only partially ankylosed, and in different ways, frequently not at all.



In the lateral surfaces (see the woodcut in the preceding page) the bodies of the two foremost vertebrae appear to be so completely ankylosed that here, as in the ventral surface, not even the limits between them can be distinguished, while in all the succeeding vertebrae these are indicated by deep transverse grooves. The same is also the case with the superior surface (that which forms the floor of the spinal canal) of these vertebrae.

On the dorsal surface of the osseous block formed by these eight ankylosed vertebrae, the ankyloses will be observed to be most complete along the mesial line of the arches, where all the foremost six vertebrae form one continuous ridge, with the exception that this ridge in the specimen before us is interrupted between the fourth and fifth, in other cases between the fifth and sixth vertebrae. At either side of this osseous ridge the atlas and the axis appear completely separated when seen from this (the dorsal) side, and the same is the case with the sixth and seventh vertebrae.

The arches of the third, fourth, fifth, and sixth vertebrae, as well as the superior transverse processes issuing from them, are irregularly ankylosed, and these processes partially rudimentary. Thus, as not only nearly all the inferior processes of the cervical vertebrae, but also the superior ones of the greater part of these vertebrae are only rudimentary, the wide-gaping but very short *canalis intervertebralis* (see the woodcut, page 107, and Plate II, fig. 3), is of course only very imperfectly surrounded. The broad lateral parts of the atlas project as a wall before it (Plate II, fig. 3, 1'). The blood in that arterial *rete mirabile*, which represents the vertebral artery, is observed to find its way into a large trunk, the deep groove for which is placed on the dorsal surface between the atlas and the axis. Parallel with this another deep arterial groove, sometimes partially changed by means of an osseous bridge into a short tube, runs on the anterior surface of the atlas.

The spinal canal, formed by the dorsal surface of the bodies of the vertebrae and the vertebral arches, is in its most anterior part almost circular in circumference, six inches in diameter, but posteriorly its breadth (eight and a half inches) becomes much greater than its height (five and a half inches). When the ossification is complete, there is no other communication between it and the cavities for the *arteria intervertebralis* than through the intervals between the inferior half of the arches (that between the body of the vertebra and the superior transverse processes), but very frequently this half of the arch is either not at all or only partially ossified, either in the third vertebra alone or in the fourth, fifth, and sixth, and in macerated skeletons the spinal canal becomes thus, as it were, united into one with the two lateral canals, and the arches in question are seen hanging over the canal in the form of a bridge suspended in position only by their ankylosis with the arches of the vertebrae placed before and behind.

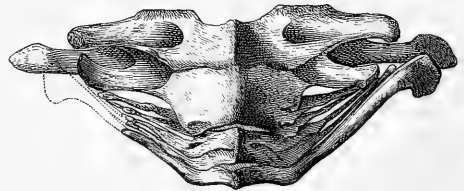
On the dorsal side of the osseous mass formed by the cervical vertebræ the spinous processes of the anterior six have already been described as a strong ridge, which is most prominent where it is formed by the axis. The spinous process of the seventh cervical vertebra is always free and rather prominent.

As far as the five middle arches of the cervical vertebræ can be separated from one another, we may already observe in them the imbricated overlapping position, by which the preceding one on either side projects over the one following next, in which position we have at the same time the first trace of posterior articular processes.

The osseous mass composed of the cervical vertebræ has in our forty-seven and a half feet long skeleton a length of about thirteen inches, of which the atlas and the axis together seem to occupy about six and a half inches, the four succeeding vertebræ scarcely four and a half inches, the last two and a quarter inches. In the forty-four and a half feet long skeleton the length of the cervical vertebræ is altogether only ten inches.

We have had several additional specimens of this foremost part of the vertebral column of the Greenland whale for comparison, and thus we have been convinced, that though the description given above, which has been made according to the condition of these vertebræ as they appeared in the forty-seven and a half feet long skeleton, may in all essential points be found correct, even when we are speaking also of all the others, yet some differences may take place both as to the manner in which the vertebræ are ankylosed, and also as to the degree to which the roots of the transverse processes are developed, and that not only in the different individuals, but even in the right and left side of the same individual.

The most essential deviations from the condition of these parts, as represented in the woodcuts above, may perhaps be those which very frequently appear in the anterior dorsal vertebra. Its transverse processes are always very much compressed, and at the same time point so much in a forward direction, that they nearly reach the transverse processes of the axis, but frequently, perhaps we may say most commonly, they have their outward extremities expanded into the form of a shovel. This is already the case in our forty-four and a half feet long skeleton, but to a still higher degree in a group of the eight foremost vertebræ of a full-grown Greenland whale, which has been for a long time in the Royal Museum of Natural History, and in which the bodies of the first dorsal and the cervical vertebræ are also completely ankylosed. We shall therefore add a figure of this group twelve times diminished, and seen from the dorsal surface. On the left side the transverse processes have been broken off in the dorsal, as well as in the two posterior cervical vertebræ, where they have been indicated by a dotted outline.



Each of these groups of vertebræ differs so much in appearance from the cervical vertebræ of the fin-whales and hump-backs, which are only seldom and partially ankylosed, even in full-grown individuals, that it could not possibly be mistaken for one belonging to either of the latter species. Any specimen, however much damaged, of such an osseous mass will always be sufficient to show that it belonged to the cervical vertebræ of a right-whale. We have been thus minute in our

description, especially with a view of pointing out the specific differences between the Greenland whale and the Cape whale, or the remaining species of right-whales. According to Cuvier's and Schlegel's descriptions of the cervical vertebræ of the Cape whale the difference is considerable, especially in the following respects :

1. The ankylosis comprised, in the Parisian specimen of the Cape whale, as in all our specimens of the Greenland whale, all seven cervical vertebræ, but in the Leyden specimen of the Cape whale only the four foremost. A difference which has not appeared in our North whale skeletons, seems accordingly to occur in the Southern species in this respect, provided the Leyden skeleton is really of the same species as that described by Cuvier.

2. The spinous processes of the cervical vertebræ in the Cape whale are ankylosed in one single ridge ; in all our North whale skeletons, some interruption takes place between them.

3. In the Cape whale inferior transverse processes are wanting in all the four hindmost cervical vertebræ, in the North whale only in the seventh.

4. The superior transverse processes of the atlas and the axis are ankylosed in the Cape whale, but not in the North whale.¹

5. A difference occurring in the first dorsal vertebra, may perhaps most conveniently be mentioned in this place in connection with the differences in the cervical vertebræ, we mean the peculiarity that the long and flat transverse processes of the first dorsal vertebra, which in the North whale are turned in a manner so characteristic obliquely forwards, to meet the transverse processes of the two foremost cervical vertebræ, are not placed at all in this manner in the Cape whale.²

In the dorsal region the length of the vertebræ uniformly increases, so that in the forty-four and a half feet long skeleton it augments from two inches and three quarters to six inches and three quarters. The bodies of the dorsal vertebræ do not increase so much by far in breadth.

Of the dorsal vertebræ of the Greenland whale we have already examined the foremost one in its ankylosis with the cervical vertebræ. It is almost as compressed in its disk-like form as the last cervical vertebra ; in our forty-four and a half feet long skeleton its body occupied only two inches and three quarters of the length of the spinal column, but then it was eight inches high and ten inches broad. Seen from either end it had the form of a broad symmetrical heart, its superior surface (the one forming the floor of the spinal canal) being excavated in the shape of a groove in its middle line, whereas its inferior free surface was slightly carinated in a longitudinal direction. The arch of this foremost dorsal vertebra arises in common with the transverse processes on either side from the two uppermost corners of the body (see the woodcut, page 107) ; and as its two lateral branches are far more slender than these processes, the lateral branches of the arch may rather be said to issue from the transverse processes than *vice versâ*. Arising from these processes, the two lateral branches of the arch extend in an

¹ [In the British Museum is a specimen consisting of the ankylosed cervical vertebræ of a right-whale, dredged up in 1860 near Lyme Regis, Dorsetshire. In all the above-mentioned characters it agrees with the southern group of whales, rather than with *Balæna mysticetus*. It therefore probably belonged to the "Nordkaper" or "Sarde" (*Balæna biscayensis*, Eschr.), so frequently spoken of in the first part of this memoir. Although the hinder part of the united bodies is fully as large as in the Greenland whale, the comparatively small size of the articular surface for the occipital condyles, indicates an animal with a considerably smaller head.—(See J. E. Gray, 'Proc. Zool. Soc.,' 1864, p. 591).—W. H. F.]

² Cuvier, 'Ossemens foss.,' v, page 380.

almost horizontal position to meet each other in the mesial line, close to which they are raised, as it were, to form the slight spinous process. The spinal canal is here very large, and especially very broad (five inches high, eight inches broad). The arch of this vertebra has in front and on either side of its superior surface rather a sharp transverse depression, into which the arch of the seventh cervical vertebra fits with its prominent hindmost squamous portion, the posterior articular processes as they are called (see the woodcut, page 109). But the arch of this first dorsal vertebra projects in return, scale-like, fitting into the transverse depression on the arch of the succeeding vertebra. In opposition to its low spinous process the first dorsal vertebra is distinguished in a very conspicuous way by its exceedingly long, flat transverse processes pointing forwards to an extraordinary degree, as already described (see all the last three woodcuts).

The peculiarities here described of the first dorsal vertebra become less pronounced in those next following, and at last they disappear to make room for very different special characters in the posterior part of the dorsal region.

The vertebral bodies gradually increase, even to double the length of those in front, whereas they become but very little higher, and scarcely broader at all (eight inches long, eight and a half inches high, and ten inches broad); they quite lose, therefore, the disk-like form by which the first dorsal vertebra still so closely resembles the cervical vertebræ. From the inferior surface of the bodies the carinated form just mentioned disappears entirely, and in their superior surface instead of the groove a longitudinal elevation is seen, so that the heart-like outline of the transverse section has become circular.

The transverse processes in this region of the spine continually descend more and more, so that in the most posterior dorsal vertebræ they spring directly from the vertebral bodies themselves close to their superior angles. Thus it happens, that the common root for these and the corresponding lateral branch of the vertebral arch now belongs exclusively to the arch, and as it always stands rather vertically erect, the vertebral arches themselves appear by this change to have become more erect, and accordingly to have completely lost their horizontal position. The spinal canal, too, gradually becomes less wide, though it always keeps comparatively broader in the Greenland whale than in the rorquals. In the forty-four and a half feet long skeleton it is, measured anteriorly, five inches high, eight inches broad, posteriorly four inches high, and six inches broad.

The spinous processes at the same time become more and more prominent, and it is only at their origin in the mesial line of the arch that they appear as prolongations of its two lateral branches. In the foremost dorsal vertebra, where they are very short, they are somewhat inclined in a forward direction; in the following they are raised so as to stand vertically on the spine, then (from the eighth dorsal vertebra) they become more and more inclined in a backward direction, even so much in the hindmost dorsal vertebræ that they completely overhang the succeeding vertebra, and at the same time they increase so considerably in height, that whereas in our largest skeleton the spinous process of the first dorsal vertebra was only four inches high, that of the hindmost one was fifteen inches. At the same time their form is not less conspicuously altered. They become much compressed with a short superior and longer anterior and posterior margins. Of these three margins the superior becomes continually broader from the fourth to the eighth dorsal vertebra, especially in the hindmost half, but again more narrow in the posterior dorsal vertebræ; the anterior and posterior margins become sharp, reckoned from the third dorsal vertebra; from the tenth vertebra they become hollowed, too, in their upper half, by which

means the upper part of the process looks as if it were slightly expanded, and the whole margin becomes sigmoid.

As the arches of the dorsal vertebræ leave their horizontal position, they lose also their imbricate or overlapping position relative to each other, and every trace of the posterior articular processes has disappeared in the ninth dorsal vertebra.

The anterior articular processes are developed in inverse proportion. We find their first traces in the second or third dorsal vertebra in the form of a small knob quite externally on the anterior margin of the transverse process, and they are placed here close outside the posterior articular process of the preceding vertebra. In the fourth and fifth dorsal vertebræ they are already rather prominent on the anterior margin of the transverse processes, causing the exterior half of this margin to become very concave; in the sixth and seventh they appear in the form of a pair of wings quite inwardly on the anterior margin of these processes, causing this margin to become uniformly concave throughout its entire length; in the eighth and ninth they are removed upwards to the most external part of the neural arch, and at the same time they are bent in an outward direction, so that the exterior lateral surfaces of the vertebræ are made to form a deep excavation in the longitudinal axis of the vertebral body. But that part of the articular processes which is bent in the manner described, assumes in these vertebræ the character of an extremely rough osseous protuberance (perhaps the so-called *processus mamillaris*). In the tenth and eleventh dorsal vertebræ these articular processes have ascended upwards on the branches of the neural arch, and have accordingly been separated from direct connection with the transverse processes. The rough osseous protuberance has become more narrow, lengthened, and points more upwards than outwards. They now appear like wing-like, vertically placed, osseous plates, and the extended and rough protuberance is changed into the superior rough margin of these plates. At the same time they clasp the spinous process of the preceding vertebra, though never so closely as in the rorquals.

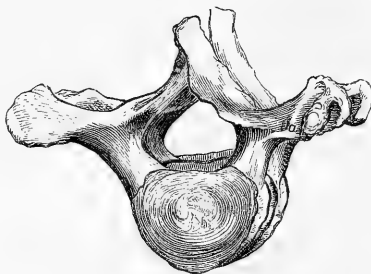
Of the different processes of the dorsal vertebræ, the transverse processes unquestionably deserve the greatest attention. These processes differ much from one another. In the five foremost dorsal vertebræ they appear as long and narrow prolongations, pointing very much forwards; in the five middle ones they are short and flat, and form right angles with the bodies. They become continually broader, as they succeed one another from before backwards, though, especially at their inner and outer extremities, recalling the form of an hour-glass (having its inner and posterior angle worn off); finally, in the three hindmost, they resemble a pair of long, flat bone-plates with direction exactly transverse and horizontal. We have already mentioned, that they have their origin in the same points as the lateral branches of the arches in the foremost dorsal vertebræ, whereas in the very hindmost ones they arise only very close to these arches, but independently from the upper part of the lateral surfaces of the vertebral bodies.

As to the differences between the transverse processes in the five foremost dorsal vertebræ as compared with one another, we may refer our readers partly to the three woodcuts, pp. 107, 108, and 109, as far as the first dorsal vertebra is shown there, together with the cervical vertebræ, and partly to the illustration given at Plate II, fig. 3, copied from a photographic representation of the cervical and the anterior dorsal regions of our twenty-two and one third feet long skeleton. In this figure the transverse processes, as far as they are visible, are in the right side marked with 2, 3, 4, and in the left side with 1, 2, 3, 5. They were not yet ossified to their outer

extremity, and their cartilaginous external parts had shrunk as usual; but, nevertheless, so much, at least, may be discerned in them that they become continually shorter, thicker, and more transverse in their positions as they advance progressively backwards.

The transverse processes of the second dorsal vertebra are a little longer than those of the first (ten inches in our forty-four and a half feet long skeleton); they are also flat, though less so than those of the first, and stumpy at their extremities. In the third dorsal vertebra, the transverse processes have also almost the same length as in the first (eight and a half inches), but they can no longer be called flat; and externally on their superior surface, the small protuberant articular process is seen, separated from the exterior stumpy and triangular extremity of the transverse process only by a narrow depression.

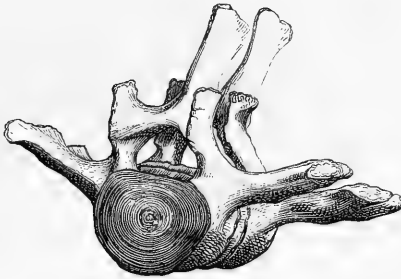
Of the fourth and fifth dorsal vertebrae we give the adjoining woodcut illustration. It would be easy to recognise them, as belonging to the anterior part of the dorsal region, from the circumstance, that the arches and transverse processes arise from one common root on the uppermost corners of the vertebral bodies, and that the posterior articular processes still exist. That we have the fourth and fifth dorsal vertebrae before us, would besides be evident from what we have stated above of the appearance of the anterior articular processes, for they are seen here as small protuberances (*a*), on the extreme outer extremity of the anterior margin of the transverse processes; but the most certain characteristics are to be found in the transverse processes, especially in their not only having an almost entirely transverse direction, different from those of the three most anterior dorsal vertebrae, but also an articular excavation on the inferior surface of their ends, though these ends are not, as in the succeeding ones, developed in the form of broad and shallow cotyloid cavities. In the fourth dorsal vertebra, the extremities of the transverse processes are, on the contrary, even so thick and stumpy, that they may be said to be rather high than broad, triangular, with the smaller surface turned downwards and provided with the articular cavity, and with the two larger surfaces turned upwards, the one forwards, and the other backwards. But while we shall thus consider the fourth dorsal vertebra as still belonging to those with short transverse processes, the fifth dorsal vertebra might on the other hand rather be reckoned among those of which the transverse processes are provided with articular excavations at their extremities, and of which the outline may, perhaps, be said, on the whole, to resemble that of an hour-glass. The cotyloid form of the terminal margin of the transverse processes is produced by their becoming perfectly flat and broad, and at the same time concave on their inferior surfaces, and convex in the superior ones, instead of being high rather than broad, as was the case in the fourth dorsal vertebra. The hour-glass form of these transverse processes is produced by their appearing narrowed in the middle and expanded outwardly into an anterior and posterior angle, while inwardly they are also, at least, in the anterior edge, provided with a projecting tuberosity by the anterior articular process appearing in this place. The transverse processes of the fifth dorsal vertebra are not, however, particularly broad at their terminal margin, and the articular process is still placed too near to the anterior corner of



the extremity to allow the hour-glass form to be very distinctly recognised. Of all the dorsal vertebræ, the fifth has the shortest transverse processes (seven and three quarter inches).

In the sixth and seventh dorsal vertebræ the transverse processes are perceptibly longer (eight and a half to nine inches), and in them the hour-glass form just mentioned appears most distinctly, as they are bounded by concave margins both before and behind and outwardly, while the anterior articular processes, in the shape of a pair of small wings, are placed quite inwardly on the transverse processes close to their root.

The transverse processes of the eighth and ninth dorsal vertebræ have much more than those of the preceding ones, the form of broad, flat, and convex cotyloid bodies, and have also still some likeness to hour-glasses, although the articular processes, that should form the anterior corners of these hour-glasses in an inward direction, have already been removed upwards on to the arches. The most certain distinguishing mark of the transverse processes of these vertebræ is, however, the great concavity of the innermost part of their superior surface produced by the great inflection of the articular processes above mentioned.



The tenth and eleventh dorsal vertebræ (from the forty-four and a half feet long skeleton) are represented in the adjoining woodcut, twelve times diminished.

The transverse processes arise here without any connection with the vertebral arches from the uppermost corners of the vertebral bodies, and the articular processes are not only removed to the very top of the arches, but they have also become pressed upwards, in such a manner, from the transverse processes, as to be no longer parallel with them. Thus the transverse processes have completely lost that hour-glass form, as we have called it, and the cotyloid form has also partially disappeared, as they are more extended in length (nine to ten inches long), and only slightly convex, although they have still the cup-like cavity for the rib on the inferior surface of their extremities.

Finally, the transverse processes appear in the last two dorsal vertebræ in the form of long (thirteen to fourteen and a half inches) horizontal wings, standing out in an exactly transverse direction, and of which the articular cavities for the ribs are not on the inferior surface, but most commonly on the external broad margin itself close to its hindmost corner, especially in the thirteenth dorsal vertebra.

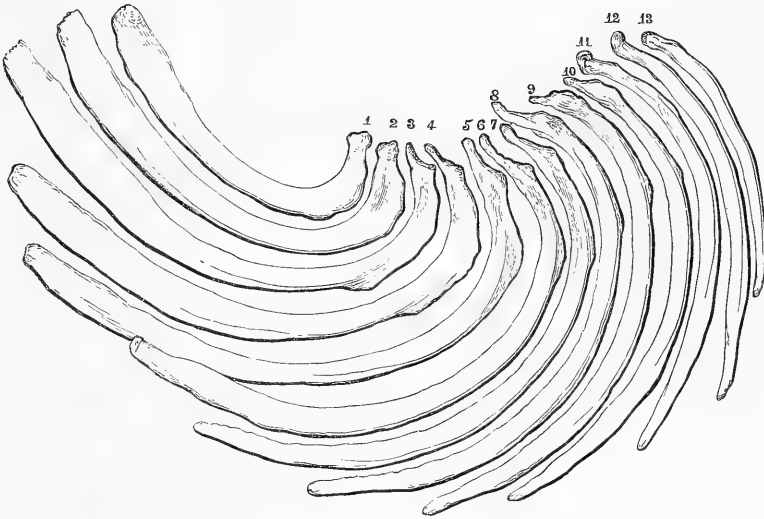
From the consideration of the dorsal vertebræ, and especially of their transverse processes, we shall now turn to the examination of the ribs and the thoracic cavity in general.

As to the ribs of the Greenland whale, we shall scarcely be more successful in pointing out a common distinguishing mark, that may be applied to all of them, than we have been when speaking of the bodies of its vertebræ. Generally speaking, they are thicker and heavier than those of the fin-whales, but considerably thinner and more slender than those of the hump-backs, most of them also more strongly curved than in either of these species. The longest of them, the fifth, sixth, and seventh pairs, were in our forty-four and a half feet long skeleton, when measured along the curvature, almost ten feet long, but when measured by a straight line between their two

extremities, only six and a quarter feet, the first pair according to the former measurement five feet and three quarters, and according to the latter three feet and two thirds; the thirteenth pair according to the former measurement four feet and one third, according to the latter four feet.

Of an ankylosis of the two foremost ribs which Schlegel¹ has found in the skeleton of a Cape whale preserved in the Leyden Museum, we have discovered no traces in any of the specimens of the Greenland whale which have been at our disposal.

When we consider the ribs separated from their natural connections and placed in their order of succession close to one another, as they are shown in the woodcut below, twenty-four times diminished, of those of the left side of our forty-four and a half feet long skeleton, we are immediately struck by the great difference between them, both as to size and form, and in the latter respect, both generally speaking and especially as regards their vertebral or proximal ends, to which we must first direct the attention of our readers.



With respect to the differences of the vertebral ends of these thirteen pairs of ribs, we may naturally divide them into three classes, the first of which comprises the two foremost pairs, the second the eight succeeding ones, the third the three hindmost ones. In those mentioned first, the vertebral extremity is broad and strong, but truncated at the end; in the eight middle pairs, on the contrary, it runs out into a shaft, especially from the side nearest to the concave edge of the bone; and in the three posterior pairs, the vertebral end presents a slight (hardly perceptible in the thirteenth) knob-like enlargement of the otherwise slender bone. It will easily be conceived, that the attachment to the corresponding vertebral bones must be different

¹ Loc. cit., 1st part, page 37.

for each of these three classes, and, perhaps, the mode in which this attachment takes place may be surmised from the analogous manner in which it occurs in other Cetaceans; but we should not, however, have been able to speak with certainty on this point, had we not had these parts before us in their natural connection in the fœtus preserved in spirit, and partially in the twenty-two feet and one third long skeleton. According to the information obtained from these sources, we may now give the following statements.

All thirteen pairs of ribs of the Greenland whale have at least this in common in their manner of attachment, that each of them is connected with the distal end of the transverse process of its particular vertebra, the first pair of ribs to the transverse processes of the first, the thirteenth to those of the thirteenth dorsal vertebra. That point on the rib where this attachment to the corresponding transverse process takes place must undoubtedly be considered as the tubercle of the rib (*tuberculum costæ*); but at the first glance, at least, this tubercle seems to be rather differently placed. In the three posterior pairs of ribs the knob-like enlargement of the vertebral extremity of the bone serves itself as its tubercle; but in the eight middle pairs of ribs the attachment to the extremity of the transverse processes is effected in the more or less sharp angle from whence the inwardly-turned shaft issues, and in the two anterior pairs of ribs it takes place close behind their uppermost obtuse end.

Thus while we consider ourselves to be right in interpreting the places where all the ribs are attached to the transverse processes as their tubercles, we must necessarily interpret, not only the said shafts of the eight middle pairs of ribs, but also the rounded points of the vertebral extremities of the two foremost pairs as necks of the ribs (*collum costæ*).

It was especially the twenty-two feet and a third long skeleton that was serviceable to us in accurately pointing out the tubercles, and so it still continues to be, after most of the ribs have been separated from the vertebræ, because the connecting ligaments have been preserved, and are still attached to the ribs in a dried state. By this we are taught that they are not affixed to the external surface of the said angle, accordingly not to the one that is visible in the woodcut above, but to the opposite corner, though at its very innermost edge, the one that just touches the cotyloid cavity of the inferior surface of the transverse processes, when these bones are in their natural position. Thus the neck will point in an almost entirely inward direction, and we are much inclined to suppose that it reaches the inferior surface of the preceding vertebra, where the stumpy point of the neck may thus be attached like a condyle, at least in the most long-necked ribs, namely, the fifth, sixth, seventh, and eighth pairs. We even believe that we have discovered a cavity in the very hindmost part of some of the bodies of the middle dorsal vertebræ, in which such an articulation might, perhaps, have taken place; but in our fœtus we have not found any certain confirmation of this supposition. For, strange enough, all the ribs of this fœtus, though now very soft, almost spongy, were already ossified, with the exception of a very small piece of their most inferior extremity and of the entire shaft or costal neck just mentioned, which still appears like the transverse processes of the vertebræ as a diaphanous, bluish cartilage. As long as the very thick external membrane (perichondrium) of this cartilage has not been removed, a removal that always causes some risk of breaking the cartilage, all the ribs appear to be attached to the transverse processes by their uppermost extremities, and besides to be only affixed to the preceding intervertebral cartilage by means of a thick cord. But when we cut into this thick cord we discover that it is cartilaginous in its interior, though not in all cases, and more especially not as far as the place of attachment itself in the cases of the short-necked

ribs (the third and the tenth). As we have stated just now, the cartilaginous cord, enclosed in its thick, perichondrial sheath, and evidently analogous to the neck of the rib in its state of complete ossification, has always appeared to us to be attached to the intervertebral substance; but it is very difficult in parts so soft, and having such solid exterior sheaths as this perichondrium, to point out the places of attachment with precision; and we have therefore been unwilling to give up entirely the supposition mentioned above, that the necks of the ribs may properly be said to be attached to the preceding vertebra.

By considering the fact that in many cases these cartilaginous cords are not continued throughout the thick clothing of ligamentous membranes, especially not in the third pair of ribs and the short-necked ribs generally speaking, we shall surely obtain a correct notion of the strange way in which the two foremost pairs of ribs are attached in the Greenland whale, as well as in all other whalebone-whales. We know that both these pairs of ribs have their proximal ends attached to the transverse processes of the cervical vertebræ by means of extremely strong ligaments, the first pair even especially to the second cervical vertebra. But besides they are, indeed, also attached to the extremities of the two corresponding dorsal vertebræ, especially by means of ligaments arising from immediately behind their obtuse extremities; and it has already been intimated that it is this which evidently corresponds with the attachment common to all the ribs, however unimportant it may seem to be when compared with that with the vertebræ placed in front. For all those ligaments by means of which these two foremost pairs of ribs are attached to the transverse processes of the cervical vertebræ, we must consider as corresponding to those thick cords of the succeeding ribs, which are most commonly, though by no means always, at least not in their entire length, developed into osseous necks of ribs. Nay, we should not wonder if the inferior transverse processes of the cervical vertebræ themselves might be considered as homologous with the innermost part of those osseous shafts, even though they are separated from the ribs, and form inseparable parts of the vertebræ.

The ribs of the Greenland whale are, as usual, in the greater part of their length curved in such a way as to have an external convex and an internal concave surface, the former of which is at the same time turned somewhat backwards, the latter somewhat forwards; and the external surface is not only convex longitudinally, but also transversely. In the uppermost fourth, however, the appearance of most of the ribs is very considerably altered, and in a manner which is very difficult to describe. The external convex surface is here twisted round, so that the posterior edge the bone becomes very prominent on the inner surface (especially so in all the middle ribs from the third to the tenth); but in the same upper fourth each of these bones is distorted so as to have the inner concave surface turned backwards, by which means also the articular face placed on this very surface receives a directly inward and backward direction towards the extremity of the corresponding transverse process. This distortion is most visible in the third pair of ribs. That inverted part of the posterior edge is, at its inferior termination, very prominent in most of the ribs in the shape of an *angulus costæ*.

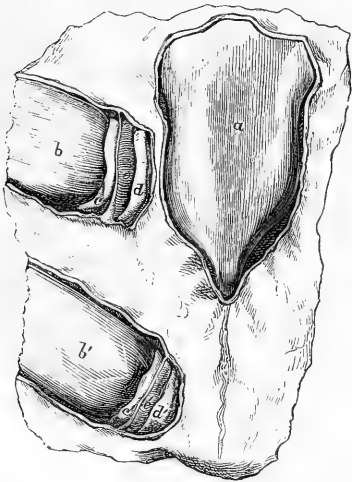
In the inferior ends of the ribs it is not so easy to point out distinguishing marks for each of them, as it is in the superior ends. We shall scarcely, however; find it difficult here to distinguish at least the four foremost by their considerable breadth, and the four or five hindmost by their slender form, from the four or five middle ones.

We have at length succeeded, by the assistance of our Greenland whale fetus preserved in spirits of wine, in clearing up a not unimportant question as to the structure of the thoracic cavity

of the whalebone-whales. We know that in all whalebone-whales only the first pair of ribs is connected with the sternum. All statements disagreeing with this we do not hesitate to call erroneous. That the Greenland whale is no exception from this rule, will be evident to our readers when they look at Plate II, fig. 3, which, as we have stated already, is drawn from a photograph of this region in our twenty-two feet long skeleton, in which all the parts were still preserved in their natural connection.

It being only the first pair of ribs which is connected with the sternum, we should not be surprised if in all whalebone-whales this pair were the only one provided with sternal ribs, whether ossified, as in the toothed-whales, or cartilaginous, as in land-mammalia generally. But that these bones found in all air-breathing vertebrated animals should be entirely wanting even in this foremost pair of ribs of the whalebone-whales, must justly be considered as a strange anomaly. Now we have at length been convinced, in examining the fetus preserved in spirit, that these sternal ribs are not indeed wanting in it.

As long as the anterior rib of either side was still enclosed in its extraordinarily (one line) thick periosteum, it seemed indeed to be immediately connected with the sternum, also enclosed in its perichondrium of no less considerable thickness; and as far as everything enclosed in the same periosteal membrane be considered as one single bone, each of these ribs must also be considered as one such; but, as far as we know, the vertebral and sternal parts of each rib are also enclosed in one common thick perichondrial or periosteal membrane in the fetuses of the other mammalia. The question, therefore, whether the sternal ribs were wanting, had not as yet been answered in this way. It was therefore necessary to cut through this thick exterior membrane in order to get a sight of the bone itself, and the adjoining figure gives a representation (half the natural size) of what we discovered.



A is the sternum still entirely cartilaginous; its perichondrium is removed on all sides, so that its external surface is completely bare, and the perichondrial membrane is only indicated by means of a double line. In the same way the periosteum has been removed, and indicated in the figure round the fragment of that part of the anterior rib at the right hand side, which is placed nearest to the sternum. It will now be seen that this portion of the rib consists of several parts somewhat dissimilar to one another, and what, we think, will be perfectly decisive in answering our present question, the interior of the periosteal sheath, rather loosely connected with the surface of the bone, is divided by means of a very fine but strong membrane into two separate parts, the one exceeding the other very much in size, in which is found the rib properly so called, or the vertebral rib (*b* and *c*), and the other, very small in comparison, in which the sternal rib (*d* and *e*) is enclosed.

Each of these osseous parts had its own special character. Though almost like a sponge impregnated with spirits of wine, yet the long vertebral rib was, to about four

lines from the above-mentioned thin division, already completely calcified, and composed entirely of osseous fibres arranged in layers ; and even in that most distal, not yet ossified small portion, it had a similar fibrous appearance, though here it was not observed to contain any earthy matter. The part of the sternal rib (*e*) adjoining the thin membranous partition was quite similar to this soft innermost extremity of the vertebral rib ; but the sternal rib itself (*d*) was a perfectly compact and uniformly diaphanous genuine cartilage without the least trace of any inserted fibrous tissue.

After having found the sternal ribs of the first pair of ribs attached to the sternum, our next object was to discover whether any trace of them might be found also in the succeeding pairs of ribs. Our examination of the same foetal skeleton gave us an affirmative answer to this question, as may be observed from the woodcut, page 118, as far as the second rib was concerned ; in this figure, *b'*, *c'*, *d'*, and *e'* have the same signification as to this rib, as *b*, *c*, *d*, and *e* have to the former. In the succeeding ribs a similar trace of sternal ribs was scarcely perceptible.

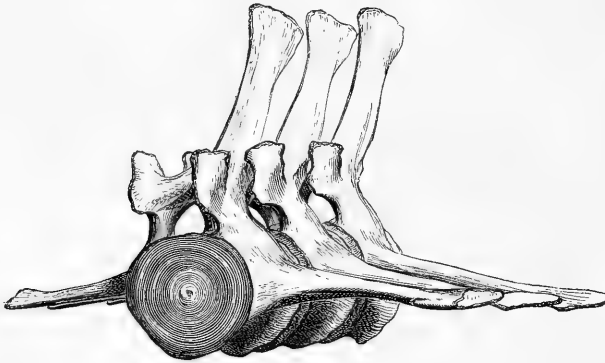
The sternum of the Greenland whale, like that of all the rorquals, serves, as we have stated just now, as an attachment to the first pair of ribs. Only one question might still arise as to the relative position of the sternum and the ribs, namely, whether a rudimentary prolongation might not perhaps issue from the hindmost extremity of the sternum in the mesial line for the attachment of the succeeding ribs ; but this supposition was found, on a careful examination of our foetus, to be without any foundation. For those pairs of ribs immediately succeeding the first approach pretty nearly to the mesial line of the ventral surface, and in this line we only found a slight fibrous tissue corresponding to the so-called *linea alba*, but this fibrous tissue did neither contain any trace of cartilage nor was it in any close connection with the periosteal membrane of the ribs, or that of the sternum.

As to the shape of the sternum of the Greenland whale, we must on the whole refer our readers to our illustrations of those of the foetus and the half-grown individual. In our larger skeletons, however, the sternum had not exactly the same form, and some other examples which we have had for our examination have again proved different. They all agree in the following points. The external surface, which looks forwards and downwards, is flat in the longitudinal direction, but convex transversely, the internal surface looking backwards and upwards is convex longitudinally and concave transversely ; the sternum has its greatest breadth anteriorly, especially before the attachment of the ribs ; behind it runs out into an obtuse point. The lateral margins are in the middle, or a little in front of this, very much thickened, by which the attachment of the ribs is indicated ; and posteriorly they become gradually thinner. But the anterior margin is sometimes somewhat convex, as in that of our twenty-two feet long skeleton (Plate II, fig. 3) ; sometimes, on the contrary, having a greater or smaller notch in the middle. The length of the sternum is always somewhat greater than its breadth ; in that of our forty-four and a half feet long skeleton the former is twenty inches, the latter nineteen inches ; in another one the length is twenty-four, the breadth nineteen inches ; in a third the length twenty-three, the breadth sixteen and a half inches.

We shall now return to the vertebral column.

The lumbar vertebræ are, as usual, easily distinguished on the one hand from the dorsal vertebræ by the want of articular excavations for the ribs in the outer extremities of the transverse processes, on the other hand from the caudal vertebræ by the want of articular facets for the chevron bones (hæmapophyses) on the four inferior corners of the vertebral bodies. The first lumbar vertebra may, however, so far be said to make an exception, as an articular surface, or at least a trace of the attachment of a rib, was still found on the outer margin of its transverse processes (at any rate in both our two large skeletons); this may arise from a fourteenth rib having really been attached here, or what seems to us to be a more likely supposition, from the thirteenth rib having here, as so often in the Cetaceans, had an additional attachment to the external margin of the transverse process of the first lumbar vertebra. On the other hand, the characteristic given by us of the lumbar in opposition to the caudal vertebræ is only half true, as far as that lumbar vertebra is concerned, which, according to the division of the vertebræ which we have adopted, must be called the last; for this vertebra has on it the marks of the attachment of the first chevron bone, at least posteriorly.

In the adjoining woodcut the three foremost lumbar vertebræ of our forty-four and a half feet long skeleton are represented twelve times diminished.



In the outer margin of the transverse processes of the first lumbar vertebra we recognise the traces of an attachment of ribs just mentioned; it will, at the same time, be perceived that these traces are to be found anteriorly on the outer margin of the transverse processes, whereas in the hindmost dorsal vertebra they are to be found posteriorly.

Compared with the tenth and eleventh dorsal vertebræ represented at page 114, the lumbar vertebræ have a very different appearance, even when we lose sight of the chief distinguishing mark in the outer extremity of the transverse processes; for not only their transverse, but also their spinous processes, have much greater dimensions. Their bodies, too, are large, though by no means in the same proportion.

After a minute examination, we shall here give the following statements.

The vertebral bodies, which in the hindmost part of the dorsal region are six inches and three quarters long, eight inches high, and ten inches and a half broad, increase in size in the

lumbar region, so that in the thirteen vertebræ belonging to this part, they gradually grow from seven to ten inches in length, from eight inches and three quarters to eleven inches and a half in height, and from ten inches and a half to twelve inches in breadth. Exactly the reverse is the case with the vertebral arches. They continually become narrower and lower, and the canal for the spinal cord, which in the eleventh dorsal vertebra is still six inches broad and four inches and a half high, and in the thirteenth five inches and three quarters broad and four inches and a quarter high, is in the anterior part of the lumbar region diminished to a breadth of five inches and a half, and a height of four inches, after which it gradually decreases to a breadth of three inches and a half, and a height of two inches and three quarters.

While the bodies of the vertebræ in the lumbar region are continually increasing, and their arches at the same time decreasing in size progressively backwards, the case of the processes is quite different, as in the foremost part of this region they become very much larger, and in the hindmost part, on the contrary, their size is diminished in a still greater degree.

The spinous processes resemble those of the hindmost dorsal vertebræ, and like these they have anteriorly a concave, posteriorly a sigmoid margin, and while they are a little more inclined backwards, they are at the same time considerably higher. A vertical line, supposed to be drawn from their uppermost margin down towards the vertebral bodies, would in the anterior part of this region meet the succeeding vertebral body close in front of its posterior end, and would have a length in the first lumbar vertebra of fifteen inches and three quarters, in the fourth of seventeen inches and a half, and in the sixth of sixteen inches and a half; but in the five or six posterior lumbar vertebræ such a line would meet the succeeding vertebral body no farther backwards, than somewhat in front of its middle, and would have a length of only thirteen inches in the tenth lumbar vertebra, and of ten inches and a half in the thirteenth.

The transverse processes also may in the anterior part of the lumbar region be said to resemble those of the two posterior dorsal vertebræ; like these, they have the form of long, flat, narrow, transversely placed osseous plates, are narrower at the root, broader externally, inclined very slightly in a downward direction, generally speaking pointing directly outwards, some of them, however, a little forwards, a few others a very little backwards, following no certain rule in this respect. But in the posterior half of the lumbar region these processes in particular have rather a different appearance, becoming not only shorter, but at the same time broader in proportion to their length, pointing also very decidedly in a forward direction. The different lengths (in the transverse direction of the body) of these processes has an extraordinary influence on the breadth of the lumbar vertebræ in general. The vertebral bodies themselves are not much broader in the lumbar than in the dorsal region, and their breadth, as we have already stated, uniformly increases from before backwards; but in their whole extent, the transverse processes included, the vertebræ are very much broader in the anterior half of the lumbar region than in the hinder part. The first lumbar vertebra, measured in this manner, is already considerably broader than the two most posterior dorsal vertebræ, these being already themselves much broader than the preceding ones. For it is forty inches broad (the most posterior dorsal vertebra thirty-nine inches, the middle ones not more than twenty-seven inches), the third lumbar vertebra forty-four inches, the fourth forty-four inches and a half, but the sixth only forty-two inches, after which the breadth of the eighth and tenth is diminished to thirty-five inches, and that of the thirteenth to twenty-seven inches.

The variations just mentioned in the dimensions of the lumbar vertebræ are not quite uniform in accordance with their natural order of succession. This is especially true in speaking of the transverse processes, the direction of which is somewhat irregular, as we have already stated. Thus it happens that, while the breadth of the vertebræ still perceptibly increases in the anterior part of the lumbar region, yet this increase may be stopped, nay, perhaps a slight decrease may be found in some of the vertebræ, and what might seem even more remarkable, in the same lumbar vertebra the left transverse process may be even one inch longer than the right one, or *vice versâ*.

While these changes are taking place in the dimensions of the lumbar vertebræ, and more especially while the vertebral bodies are continually increasing in circumference, whereas the processes are indeed at first also increasing in size, but then again, on the contrary, very much decreasing, the appearance of the vertebræ must of course be very considerably altered. But the form of these vertebræ is moreover influenced in another and most important way by the altered position of the articular processes in the most posterior part of this region. In the anterior two thirds of the lumbar region these processes are almost similar to those of the very hindmost part of the dorsal region. In the foremost two lumbar vertebræ they still diverge five inches and a quarter and five inches from each other, and at the same time they are almost quite perpendicular. They still retain this perpendicular position in the succeeding six vertebræ, while they also approach somewhat nearer to each other. But from the tenth lumbar vertebra they are bent so towards the sides that their inner surface becomes concave and inclined in a somewhat upward direction, and the distance between them at their upper extremities becomes five inches and three quarters in the eleventh vertebra, seven inches in the twelfth, and nine inches and a half in the thirteenth one. At the same time they retain about the same size, so that in the most posterior lumbar vertebræ they are fully as large as the very much diminished transverse processes, and form at the same time an angle of about thirty degrees with the spinous processes, and one of sixty degrees with the transverse processes, instead of being perpendicular; these five processes in each of the vertebræ here appear like rays regularly shooting out from its uppermost half, only that the spinous process points backwards, and the transverse processes somewhat forwards.

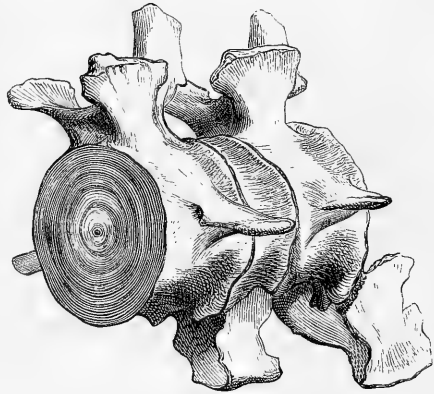
During the increasing growth of the vertebral bodies in the lumbar region from before backwards, their form (as we have already hinted) also becomes essentially altered. In the preceding bodies we can only distinguish an upper or spinal surface, and a semicircular convex ventral surface, between which the limits are to be found at either side, very high up, at the root of the arch and transverse processes; but from the fourth lumbar vertebræ the arch, already considerably reduced, has advanced upwards on the superior surface; whereas the semicircularly convex ventral surface is divided, on either side, into a superior and an inferior part by the two transverse processes, placed much lower in these vertebræ, and the two inferior parts are finally separated from each other by means of a very prominent keel in the mesial line. The anterior, as well as the posterior margin of the body, at the same time, projects so much inferiorly, that two lateral depressions are formed, which seem to have an upward continuation in the broad and shallow grooves behind the transverse processes. But such is not the case in the most posterior lumbar vertebra; for in this these two lateral excavations are united into one transverse groove, which is continued upwards, both before and behind the short transverse process. The transverse groove is limited inferiorly, both in front and behind, at

either side, by a very prominent angle, and to the two hindmost of these angles the first chevron bone is attached.

Thus at last the hindmost lumbar vertebra has attained to an almost perfect resemblance with the foremost caudal vertebra, as will be seen by the subjoined figure of these two vertebræ, from our forty-four and a half feet long skeleton, in their natural connection (twelve times diminished).

It will be observed at once that the resemblance is produced, partly by the size of the body being so much superior to that of the arch, partly by the great diminution of the spinous and transverse processes, and finally and particularly by the form of the inferior part of the body just described, by which the aorta and its great lateral branch is placed in a more sheltered position.

It will also be seen that the first caudal vertebra (when we put aside the less essential differences in the measurements) can only be distinguished from the last lumbar vertebra by having the anterior, as well as the posterior of these angles, provided with articular facets for the chevron bones. By the attachment of these bones the anterior corners are, on both sides, forced in a direction towards the posterior one, and the outer and lower edge of the vertebral body assumes the form of a bridge above the lateral branches of the aorta.



Already in the most posterior part of the lumbar region, but still more in the most anterior part of the caudal region, the intervertebral substance will be found to contribute very perceptibly to the length of the spine. The first of the two last-mentioned vertebræ is eight and a quarter inches, the other seven and three quarter inches long; but in their natural connection they have both together a length of eighteen and a quarter inches, and accordingly two and a quarter inches must be occupied by the intervertebral ligamentous substance, which is here thicker than at any other part of the vertebral column. Posteriorly in the caudal region this intervertebral substance becomes gradually smaller, absolutely speaking at least, though not in proportion to the size of the vertebræ. The second, third, and fourth caudal vertebræ, still united by the intervertebral substance, measured twenty-five inches, while taken each by itself they measured seven and three quarters, seven and a half, and seven inches, in the longitudinal direction of the body; the fifth, sixth, seventh, eighth, and ninth measured thirty-three inches in their natural connection, their own length occupying seven, six and a half, six and a half, five and three quarters, and four and three quarters inches, or, altogether, only thirty and a half inches.

While the twenty-two caudal vertebræ gradually decrease in length, from seven and three quarters to two inches, and their bodies diminish no less uniformly in point of height and breadth, their arches and processes also gradually shrink into smaller dimensions, but much more rapidly, so that the transverse processes have already disappeared from the sixth

and the spinous process and the arch from the eighth vertebra. Of chevron bones we have, in the twenty-two feet long skeleton, as well as in the newborn specimen and the fœtus, found the last traces between the thirteenth and fourteenth caudal vertebrae, so that fourteen of these are altogether to be found in the species, they being only wanting between the eight posterior vertebrae.

While the bodies of the vertebrae gradually dwindle into smaller dimension from before backwards, their shape is also, in the six foremost caudal vertebrae, modified by their having, on their inferior surfaces, the anterior and posterior of the above-mentioned angles, not only approaching each other like hooks, but, from the fourth vertebra to the seventh, meeting each other, and arching over a canal on each side for the ascending lateral branches of the aorta.

The alterations which the transverse processes are subjected to, as they dwindle away, are also very well marked. In the first caudal vertebra they point very much in a forward direction, and have their anterior margins excavated near to their roots, so that a groove is formed for the lateral branch of the aorta. But already in the second caudal vertebra the foremost part of the transverse process will be found to overbridge this excavation, changing it into a foramen. The lateral branch of the aorta, while it ascends along the side of the vertebral body, runs first along the groove formed by the two inferior lateral angles, and then through the canal in the root of the transverse process.

In the fourth caudal vertebra, where the lateral grooves in the inferior surfaces of the body have already become changed into closed canals, the transverse processes have shrunk so much that it is only quite anteriorly that they are seen projecting, looking like a pair of low longitudinal ridges, dividing the two lateral surfaces of the body into a superior and an inferior half; but they have, at the same time, been so much expanded at their roots upwards and downwards, that the lateral surfaces are half covered by them, superiorly as well as inferiorly. The lateral branch of the aorta has here only a short space, comparatively speaking, to traverse in its way from the groove on the lateral edge of the inferior surface to the foramen in the transverse process; and, besides, this inferior part of the lateral surface has now become so much excavated from beneath in an upward direction, that it looks itself like an open groove. The superior half of the lateral surface has also at the same time become so much excavated, and in such a direction as to leave distinct traces of the further course of the arterial branch after it has issued from the hole in the transverse process, that is to say, behind the articular process and into the cavity of the spinal cord. In the fifth caudal vertebra a hole through which the arterial branch is conducted into the cavity of the spinal cord has also formed itself posteriorly in the articular processes. In the sixth caudal vertebra, that open but deep groove on the inferior lateral surface appears still, but only as a round hole leading into a canal having an upward direction in the interior of the bone; the transverse process is scarcely more than rudimentary, forming only a very indistinct boundary between the superior and inferior lateral surfaces of the body. The bridge behind the articular processes has also, in conformity with the root of the transverse process, been so much expanded in breadth, that the part of the superior lateral surface not yet covered by these articular processes, looks like a deep hollow with an outlet beneath leading to the canal, and another above leading into the cavity of the spinal cord. In the sixth caudal vertebra the cavity of the spinal cord is so much constricted as scarcely to measure one inch in diameter, the spinous process is now only very slightly prominent, and the articular processes are changed into a pair

of very broad but low osseous knobs; in the seventh caudal vertebra the arch can hardly be said to have a spinous process in the mesial line of its upper surface.

The eighth, ninth, and tenth caudal vertebrae belong to those which are most easily distinguishable in the entire vertebral column, the arch having disappeared with the spinous process; but the cavity of the spinal cord is nevertheless still perceptible as a deep groove at the bottom of which the two lateral canals are observed to open.

The series of those vertebrae in which every trace of the arch has disappeared with the processes, and which accordingly only consist of the vertebral bodies, begins in the Greenland whale with the eleventh caudal vertebra. Gradually diminishing in circumference, from having at first circular outlines, when divided transversely, and their foremost and hindmost surfaces convex (from the eighth to the eleventh), they become, as usual in the whales, cuboid with rounded corners, nor is their breadth greatly superior to their height, contrary to what is the case with those of the rorquals. As distinguishing marks from the posterior caudal vertebrae of the rorquals, we may still mention, that their four corners, though tolerably obtuse, still project pretty much in the form of roundish knobs, and that the longitudinal groove of the aorta is exceedingly slightly marked, while the transverse groove for its lateral branches is more distinctly traceable on the superior as well as on the inferior surface. Both these grooves, as usual, disappear in the canals of these lateral branches of the aorta.

In our forty-four feet long skeleton, of which the first caudal vertebra was thirteen and a quarter inches broad, twelve and a quarter inches high, and about seven and three quarter inches long; the seventh had still a breadth of eleven inches, a height of eleven inches, and a length of about six and a half inches, but the fourteenth was only five inches eight lines broad, five inches high, and about three and a quarter inches long; the twenty-first, only two inches long, two and a half inches broad, and two and a quarter inches high. The last caudal vertebra was, indeed, in this instance, three and a half inches long; but this extraordinary development of the last caudal vertebra of this specimen, we must consider as something quite accidental, as it was observed neither in the twenty-two feet long skeleton, nor in the newborn young one and the foetus.

Of the inferior arches, or chevron bones, all those which we found in our two large skeletons, or the ten foremost ones, consisted each of a single bone, but in the foetus the four succeeding ones consisted of two separate cartilages. They are attached to the two vertebral bodies between which they are placed in the usual manner, nor do they differ much from those of the rorquals, not even in their form; most different in this respect is the very foremost one, which, together with the second, is shown in the woodcut at p. 123. The first (between the thirty-third and thirty-fourth vertebrae) is smaller than the next following; but after this they decrease uniformly in a backward direction, and it is especially the spine or ridge developed from their ankylosed ends that becomes continually lower, and disappears entirely in the hindmost ones.

The description given above of the vertebral column of the Greenland whale will have proved sufficiently, that it is only in the cervical and the anterior dorsal vertebrae that we can point out certain characters for this species. All the rest of the vertebrae, as well as the ribs, are according to their natural order of succession in every essential point subjected to the same alterations of form, as in other whalebone-whales, and, though it is easy, in almost every case, to point out immediately to what region of the vertebral column any given vertebra of a large Cetacean belongs, we shall, perhaps, often find it difficult to decide whether such a vertebra has

belonged to a Greenland whale or to another large species. We may, however, always find it possible to do so, as the alterations of the form of the different parts of the vertebræ neither take place in the same degree, nor do they follow each other according to the same order, as in the other species. The vertebral bodies increase in size in the rorquals, as in the Greenland whale, up to the first caudal vertebra, and then again decrease, but in the former their circumference at the same time becomes larger both absolutely speaking, and especially in proportion to the remaining parts of the vertebræ; the transverse processes, on the contrary, do not become nearly so prominent. The anterior articular processes ascend in all the rorquals, as in the Greenland whale, gradually from the transverse processes upwards on the arches, where, however, they arrive much earlier, in the fin-whales already in the third or fourth dorsal vertebra, and, generally speaking, they also clasp more closely round the preceding spinous process. Of the ribs, the two foremost pairs are attached in the same manner in the rorquals as in the Greenland whale; the third and fourth pairs have also, in the rorquals, a neck; but in the succeeding pairs this neck is wanting, and the articular surfaces on the transverse processes of the corresponding vertebræ do not so much resemble those cotyloid cavities which, in the Greenland whale, are found on the inferior surface of the transverse processes of the middle dorsal vertebræ, but they are more similar to those, not concave, articular facets which are to be found in the outer margin of its two most posterior ones.

Unable as we are, therefore, to give any distinguishing mark common to all the dorsal, lumbar, and caudal vertebræ of the Greenland whale, in opposition to those of the rorquals, yet it will hardly ever be found impossible to determine whether a vertebra belongs to a rorqual rather than to a Greenland whale, or the reverse. The question is only, whether in the latter case we shall also always be successful in deciding, whether it does not rather belong to another species of right-whale, and this question we are at present unable to answer. In order to answer it in a satisfactory manner, it would probably be necessary to have complete skeletons of the different species placed before us, in such a way, as would admit of a free examination from all sides of every single bone of either of them. Of the vertebral column of the Cape whale, Cuvier has given us figures, besides of the ankylosed cervical vertebræ, of the fourth and eleventh dorsal, the first lumbar, and the first caudal vertebra.¹ This circumstance has caused us to prefer the corresponding ones in the vertebral column of the Greenland whale, in our selection of the woodcuts for the illustration of the text above. If we compare these vertebræ with each other, it will undoubtedly be found that they are more or less different, even in every single part of each of the vertebræ, and that in form as well as in the proportions of the different parts; but to take special characters for each of them from these differences would be to raise a structure on too uncertain a foundation. We shall only direct the attention of our readers to what we have pointed out before, namely, to the less massive form of the vertebræ of Greenland whale, generally speaking, and more especially of its spinous and articular processes. In Cuvier's 'Recherches sur les Ossemens Fossiles,' this part of the skeleton of the whalebone-whales has not only been treated very briefly, but partially, no doubt, also rather carelessly, and in particular, we cannot think but that the statement (quarto edit., p. 379), that all the spinous processes have a forward inclination (*inclinées en avant*) must only be a slip of the pen, as it is completely at variance with the figures, nevertheless, it will be clear from Cuvier's

¹ See figs. 14, 15, 16, and 17, in the often-quoted plate in 'Rech. sur les ossem. foss.'

description that in some respects there is no slight resemblance between the vertebral column of the Greenland whale and that of the Cape whale. Thus, when it is stated, that in the Cape whale the five or six of the last articular processes are almost as high as the spinous processes, with which, in each vertebra, they form a three-lobed prominence, this is evidently the same characteristic position of these parts which has been described above in the Greenland whale, in the three or four last lumbar vertebræ and all those caudal vertebræ in which these processes are still to be found, and from this we can therefore hardly derive any special character; and, when further it is stated, about the fifteen pairs of ribs of the Cape whale, that the two foremost and the four last are not attached to the bodies of the vertebræ but only to the transverse processes, it follows, of course, that all the intermediate ones are joined to the body of the same or the preceding vertebra.

The sternum of the large Cape whale skeleton in the Paris Museum seems, according to the figure given of it (*loc. cit.*, fig. 11), to differ from all our North whale sternums, inasmuch that it is terminated posteriorly in a straight edge; but, perhaps, it ought to be more closely examined to ascertain whether the obtuse hinder point may not have been knocked off.

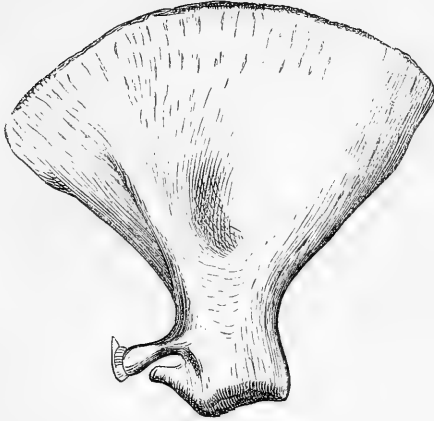
Of the anterior extremities of the Greenland whale, the scapula has already been described and figured by Cuvier,¹ from a specimen in the Paris Museum, supposed to belong to this species. Like that of the Cape whale, it can immediately be distinguished from those of the rorquals and the hump-backs, by its considerable height, quite disproportionate to its breadth, the former measured from the middle of the glenoid cavity to the middle of the convex base, the latter by a straight line between the two angles which this convex margin forms with the anterior and posterior ones; again it may be distinguished from that of the Cape whale by being not only still higher in proportion to its breadth than the latter, and by having further a much longer acromion, but especially by having, besides this, a very distinctly developed coracoid. It is true, that neither the scapula of any of our Greenland whale skeletons, nor the four other additional specimens that have been at our disposal, are so high, comparatively speaking, as the one figured by Cuvier. But it is proved distinctly enough by a comparison of our different specimens, that considerable individual differences are to be found in the proportion between the height and breadth of this bone.

As Cuvier has given several measurements of the scapula of his Cape right-whale, we shall here give the corresponding ones of those of our forty-four and a half feet long Greenland whale skeleton for comparison.

¹ *Loc. cit.*, fig. 8.

	Cape whale.	Greenland whale.	Ft.	in.
Height of the scapula (from the glenoid cavity to the middle of the convex margin)	0.58 m.	1.26 m. =	4	0
Length of the convex margin	0.90 m.	1.35 m. =	4	3½
" anterior "	0.42 m.	1.00 m. =	3	2¼
" posterior "	0.41 m.	1.05 m. =	3	4
Breadth of the neck (where the scapula is narrowest)	0.26 m.	0.28 m. =	0	10⅔
Length of the glenoid cavity	0.23 m.	0.34 m. =	1	1
Breadth " " "	0.18 m.	0.27 m. =	0	10¾

The existence of a coracoid process seems to be one of the most essential distinguishing marks of the scapula of the Greenland whale in opposition to that of the Cape whale. In Cuvier's



North whale scapula this process is seen to have its origin at some distance above the glenoid cavity; but in all our specimens it arises close to the margin of the cavity, as will be seen in the adjoining figure of a left scapula, eighteen times diminished. As usual, it points forwards, upwards, and especially inwards, wherefore it is only in certain positions that it can be seen in its entire length from the outer side.

The acromion has rather a considerable length (five inches), and a slight ridge ascends from its superior margin, evidently the *spina scapulae*, as it is called, dividing it into the smaller and anteriorly situated supraspinous fossa, which is almost perfectly flat, and a disproportionately larger, posteriorly situated infraspinous fossa that is rather strongly excavated, especially in a downward direction. Quite posteriorly, along the hindmost margin, the scapula becomes gradually thinner, so that its edge is quite sharp.

In its natural relation with the surrounding soft parts, the scapula is placed so (see Plate II, fig. 1) that its posterior part covers the inferior half of the three anterior ribs, and its foremost angle is placed almost in immediate connection with the occiput, while the articular cavity is only very little higher than the inferior margin of the lower jaw. In proof of this we have preserved the extraordinarily thick periosteal membrane round the scapula of our fœtus in its natural connection with the ribs.

The remaining parts of the anterior extremities of the Greenland whale are, like the scapula, easily distinguishable, not only from those of all the rorquals, but also from those of the Cape whale. In opposition to the rorquals, it has a distinguishing mark in common with the Cape whale in the presence of a thumb; but whereas the thumb of the Cape whale has three phalanges, that is to say, two digital phalanges besides the metacarpal bone, that of the Greenland whale consists of one single bone. With the anterior extremities of the hump-backs so extraor-

dinarily elongated, and with the comparatively very slender anterior extremities of the fin-whales, those of the Greenland whale have no resemblance; for in proportion to their length they deserve to be called broad, as well as heavy.

Of the arms of our two large Greenland whale skeletons those of the forty-four and a half feet long one were much better preserved than those of the other, especially as to the carpus and the remaining parts still cartilaginous. We shall therefore here give a figure of the left arm of this skeleton twenty-four times diminished.¹

The humerus is very short and thick, almost as broad as long (as 4 to 5), its anterior margin (the arm is supposed to be hanging straight downwards) is very slightly concave, its posterior one has an exceedingly deep concavity, the head is only loosely attached to the flat glenoid cavity of the scapula, admitting of very free motion; the tuberculum is placed almost at the same height as the head, and only separated from it by a slight depression. The two articular surfaces at the distal end form an obtuse angle with each other, that of the ulna ascending obliquely upwards towards the posterior edge.



The forearm is considerably longer than the humerus (as 23 to 16); its two bones are of almost equal length, the ulna, however, a little longer. The radius has an anterior, almost straight, and a posterior concave, margin, so that it is thinnest in the middle, where its breadth is only a third, while at its lower extremity it is equal to half, its length. The ulna is much thinner, especially in its upper third, which is very concave posteriorly. Its breadth is here only one fifth of the length. These bones are, on the whole, both of them compressed, as in the Cetaceans generally. In the middle they are somewhat separated from each other, whereas they are quite contiguous above and below. In conformity with the above-mentioned direction of the two articular surfaces in the humerus, the superior end of the ulna is posteriorly considerably higher than the radius, and it is here prolonged into an olecranon, very prominent, but compressed in the same way as the rest of the bone, in consequence of which the deep excavation of the posterior margin of the humerus, as well as that of the ulna itself, appears still deeper. In the articulation with the humerus a synovial capsule is inserted for each of the bones of the forearm; but that the mobility in their articulation must be most limited may be perceived immediately from their articular surfaces being almost flat, if it were not already shown by the compressed form of the bones. Not only the radius, but the ulna also, widens considerably at the distal extremity; and though they are totally ossified

¹ The humerus is covered with abnormal osseous protuberances, by which it is very much deformed; as to this bone we must therefore refer our readers to the figure of the forty-seven and a half feet long skeleton (Plate II), in which the carpus, however, has been copied from the woodcut above.

in our two large skeletons, in this place as well as above, the limit between the diaphysis and the epiphysis is, nevertheless, indicated by so deep a groove, especially in the ulna, that a cartilaginous layer, penetrating very deeply, must certainly, in this place, have been inserted between them.

Four carpal bones are most commonly in contact with the distal end of the forearm, one with the radius, one with this as well as with the ulna, and two with the latter alone. But these two last-mentioned carpal bones are not in contact with each other, as the metacarpal bone of the fifth finger is wedged in between them, and joined directly with the ulna, so that the latter has four articular surfaces on its distal extremity.

Besides the four bones in the first row, the carpus has only one more, which in an upward direction is in contact with the three first mentioned of the carpal bones, but in a downward direction with the thumb, though only in a very small part of its extent, and also with the index and the middle finger. The radial bone of the carpus is contiguous only with the thumb; the third bone in the superior row, with both the fourth and the fifth finger, and the ulnar bone only with the fifth finger. The last-mentioned carpal bone has the form of a freely projecting hook, and by its relation to the carpus and the forearm, seems rather to be part of the latter than of the former. It certainly projects freely from the distal extremity of the ulna, just as the olecranon does from the superior one. But before we enter on an interpretation of this part, as well as of the remaining bones that undoubtedly must be called carpal, it will be necessary to look at these bones as they are, not only in several different individuals of the present species, especially at an earlier age, but also in other whalebone-whales.

Our first statement must be, then, that the only thing in which the carpal bones of all the specimens of the Greenland whale examined by us agree with one another consists in the existence of (1) the bone, which superiorly is contiguous with the radius as well as with the ulna; (2) the one that supports the index and the middle finger; and (3) the one that supports the fourth and fifth finger. And nevertheless we find, even in these bones, not only several differences, easy to be recognised in the proportions of their dimensions, but in one case, *i. e.* in the left manus of our eight and a half feet long foetus, we found the not unimportant deviation that the bones mentioned under Nos. 1 and 3 are not totally separated from each other. This peculiarity, having only been found in an immature foetus, must make us suppose that the carpus, still perfectly cartilaginous, only gradually becomes divided into its single bones, and the difference in the proportions of their dimensions proves that the division is not always accomplished in the same manner.

Still more important, however, are those deviations which we have observed, both in the carpal bone that is placed towards the radial side and in the one that is situated towards the ulnar side, as to their relations to the adjoining bones.

We have already, in the first section of our memoir, found one character of the Greenland whale in opposition to the Cape whale, in its thumb only consisting of one single bone, whereas in the Cape whale (and the South whales in general) it consists of three, *i. e.* the metacarpal bone and two phalanges. But according to our observations on foetuses and newborn individuals of the Greenland whale, it may be doubtful whether it can be said to have a thumb at all, as long as its carpus is still quite cartilaginous. So much is certain that, in our immature as well as in a full-grown foetus and in the newborn individual, we did not see, nor can we still discover,

any traces of division between the carpal bone situated nearest to the radial side and the thumb.

Having become acquainted with these peculiarities in the radial side of the carpus, we shall be better able to judge of those in the ulnar side, which are still more extraordinary.

In the forty-four and a half feet long skeleton (see the woodcut, p. 129) the fifth finger is in immediate contact with the ulna; and here, accordingly, we have a similar case to the one existing between the thumb and the radius during their less developed condition; but the ulnar bone of the carpus is distinct from the finger as well as from the ulna. Exactly the same peculiarities are placed before us in the cartilaginous carpi of the newborn individual, and those of an almost full-grown foetus, as well as in one carpus of the foetus only eight and a half feet long; but in the other carpus of this same foetus this hook-like carpal bone is not yet completely separated, either from the finger or from the cartilaginous extremity of the ulna. We are accordingly led to the supposition that not only the carpus and the digits, but also the bones of the forearm, have all in the beginning been formed of one single, continuous cartilage; and at all events it will be clear that in this region of the skeleton of the Greenland whale we cannot expect to find any fixed or quite immutable relations between the individual bones.

A similar uncertainty will, no doubt, be found to take place in the porpoises, as to the division of this region into the single bones. By earlier researches one of us has already found out¹ that that hook-like carpal bone in two foetuses of the lesser fin-whale (*Balenoptera rostrata*) was immediately continuous with the fifth finger, whereas in a foetus of the Greenland hump-back (*Megaptera longimana*) it formed a separate bone.

Detached specimens of the carpal bones of the Greenland whale, with their recent cartilaginous surfaces, are scarcely ever placed before the zoologist for his examination. But this may very well happen with their bony nuclei; and we shall not, therefore, in this place, omit to mention the very peculiar appearance these present after they have been deprived of their surrounding cartilaginous layer.

The ossification of the carpal bones, as that of short and thick bones in general, begins from a single nucleus in the middle, and reaches the free surfaces only very slowly. In those of the newborn individual no traces of ossification were as yet found; and even in the forty-four and a half feet long skeleton, which we have pointed out as full-grown, the single carpal bone in the second row was still quite cartilaginous at both its free surfaces, so that it was not till it had been cut through that an osseous nucleus, very small comparatively speaking, appeared in its interior.

As long as the osseous nucleus of any such carpal bone is still buried in its interior its form has not the most distant resemblance to that of the whole bone; it seems, even for a long time, to remain perfectly globular in all of them. Afterwards it grows faster towards the two surfaces, and as soon as it has reached these it spreads gradually on them, becoming flattened at the extremities. Thus, these bones very frequently acquire the shape of a barrel, often showing, at the same time, a contraction between the ends and the middle part, which still retains in some degree its original globular form. It is not till very late that the osseous nucleus spreads chiefly on the two free surfaces of the bone, and then the whole ossification often becomes very irregular.

¹ See the 'Transactions' of this Society, 3rd series, vol. xi; Eschricht, 'Undersøgelser om Hvaldyrene' (Researches upon the Cetaceans), 2nd essay, plates ii and iii.

Nothing of these osseous parts of the Greenland whale skeleton will generally be shown to the zoologist but these two free surfaces at the extremities, and we know from experience that even very practised zoologists and zootomists have been at a loss to interpret them in their isolated condition. We may, however, immediately be led to the just interpretation of them by noticing the extremely different appearance which their free surfaces have when compared with the whole remaining surface. Just as the smoothness of the former shows us, at the first glance, that they have had a free position in the skeleton, so the remarkable roughness of the latter surface, and the internal structure of the whole osseous part, will show us no less distinctly that it has been hidden in a cartilaginous mass, with the exception only of those two surfaces; its form, finally, however it may vary during the progress of ossification, renders it impossible to believe that such an osseous nucleus belonged to a vertebral body, or to any other bone of the skeleton, especially as we cannot find in any other bone two free and smooth surfaces opposite to and almost quite parallel with each other.

For a further illustration of this we give below a figure, half the natural size, of the ossification in one of these carpal bones of our forty-seven and a half feet long skeleton.



This osseous nucleus has only a straight superior surface, its inferior surface is convex, a proof that in the former the nucleus has reached the surface of the carpal cartilage in its whole extent, while it is not so in the latter. The constriction between the centre part and the two extremities is only slight, but, nevertheless, sufficiently marked to denote the original globular form of the nucleus. The exceedingly loose structure of the bone may still be pretty distinctly observed in this diminished representation, as it is grooved in all directions by tubular cavities divided into multifarious branches in which dried-up blood-vessels may still frequently be found.

How many ossifications appear on the free surfaces of a dried carpus of a whale's skeleton depends, of course, on how far its ossification has proceeded. But in every carpal bone the ossification begins only from one single nucleus; the greatest number of such ossifications accordingly correspond to the number of the carpal bones, and this number is in the Greenland whale hardly ever greater than five. Now, as Cuvier has mentioned seven nuclei of ossification in the carpus of the Cape whale, it seems that we may also in this circumstance find a good distinguishing mark between these two species of right-whales.

In the description of the manus itself, in the Greenland whale, we may be brief as far as the thumb is concerned, referring our readers to what we have stated about it in the description of the carpus. That single bone of which it consists must, as it seems to us, be interpreted as a metacarpal bone, or perhaps, as a bone representing the metacarpal as well as the phalanges properly so called. This imperfect bone of the thumb was in our old skeletons, like all other bones belonging to the digits, ossified in the middle and cartilaginous in both its extremities. It is so short, and is placed so high, that it does not reach much below the middle of the metacarpal bone of the index. It is at the same time curved towards the latter

bone, though, perhaps, unusually much so in the specimen here represented. Of the remaining fingers the index has three, the middle finger four, the fourth finger three, and the fifth two phalanges besides the metacarpal bones. This is, strange enough, just one phalanx less in each of the digits than in the Cape whale. The distal phalanx of each of these four digits is long and pointed at the end, especially in the third digit, where the long cartilaginous termination, even in the full-grown skeleton, is three times longer than the ossified middle piece. Thus, the last phalanx of each of the digits is longer than the penultimate, while otherwise the phalanges progressively decrease from above in a downward direction, both in length and thickness.

In conformity with the broad form of the anterior extremities of the Greenland whale, the fingers spread considerably from one another. As usual in the Cetaceans, the thumb and index are placed close to the anterior edge of the fin, while the tip of the index is turned towards its pointed extremity and the end of the minimus towards the obtuse angle of its posterior edge.

To the comparison given above between Cuvier's measurements of the scapula of the Cape whale and ours of that of the full-grown Greenland whale we shall here add a similar comparison of their anterior extremities.

	In the Cape whale.	In the North whale.	Ft.	In.
Length of the humerus	0·45 m.	0·56 m. =	1	9 $\frac{1}{2}$
Breadth „ above	0·32 m.	0·35 m. =	1	1 $\frac{1}{3}$
„ „ below	0·29 m.	0·32 m. =	1	0 $\frac{1}{4}$
Length of the ulna	0·63 m.	0·65 m. =	2	0 $\frac{2}{3}$
Breadth „ above	0·21 m.	0·32 m. =	1	0 $\frac{1}{2}$
„ „ below	0·25 m.	0·25 m. =	0	9 $\frac{1}{2}$
Length of the radius	0·52 m.	0·63 m. =	2	0
Breadth „ above	0·21 m.	0·24 m. =	0	9
„ „ below	0·35 m.	0·33 m. =	1	0 $\frac{1}{2}$
Length of the carpus	0·27 m.	0·25 m. =	0	9 $\frac{1}{2}$
Breadth „	0·74 m.	0·67 m. =	2	1 $\frac{1}{2}$
Length of the thumb	0·29 m.	0·20 m. =	0	7 $\frac{1}{3}$
„ index	0·86 m.	0·83 m. =	2	7 $\frac{2}{3}$
„ 3rd digit	1·06 m.	1·175 m. =	3	8 $\frac{2}{3}$
„ 4th „	0·75 m.	0·92 m. =	2	11
„ 5th „	0·59 m.	0·64 m. =	2	0 $\frac{1}{2}$

In order to conclude our description of the skeleton of the Greenland whale, we have still only to mention a very small part of it, though certainly one in regard to which our researches have led to very interesting results.

It is so utterly inconsistent with the laws of the structure of the skeleton that the pelvis of any whale should be such as, in the 'Recherches sur les Ossemens Fossiles,' it is stated to be in the Cape whale and the Cape hump-back,¹ *i. e.* composed only of an azygous bone situated in the mesial line, or that it should consist even of a single bone, that these statements scarcely deserved,

¹ Ed. 3, tome v, p. 386; Ed. 4, tome viii, 1, p. 302.

nor, indeed, have they found, any great amount of confidence; and, moreover, as other naturalists, as Rudolphi, Dubar, Companyo, and Schlegel, in different whalebone-whales had never found any thing but a single pelvic bone on either side of the vent, just as in the tooth-whales, we were led to consider it as a common rule for the Cetaceans generally that these two pelvic bones were all that was left of the whole osseous system of the posterior extremities.

It was, therefore, not a little surprising to one of the authors, Reinhardt, when, eighteen years ago, in examining the newborn Greenland whale presented to us by Major Fasting, so frequently mentioned in our present memoir, he found on either side, besides the pelvic bone usually present in the whales, two other bones, the larger of which was attached to the pelvic bone, and supported the third suspended from its inferior extremity. Only one of the three bones was ossified, and that even only in its middle part, and it was not the one corresponding with the rudimentary pelvis, properly so called, but the upper one of the two subsidiary bones. In the common pelvic bone not the least trace of any external or internal nucleus of ossification was to be discovered, nor was any such nucleus found in the third, which is attached to the extremity of the larger subsidiary bone. This discovery was shortly afterwards imparted verbally to the other of the authors of this memoir, who took occasion to renew his researches as to this point in examining some fetuses of the lesser fin-whale and the Greenland hump-back,¹ that happened to be at his disposal. In the former of these he found no traces of any subsidiary bone; but in two hump-back fetuses (one of each sex) he succeeded in finding, close to either of the common pelvic bones, another bone several times smaller, having the form of a short club with a thick head. In a fœtus of the same whale afterwards received, and somewhat larger (seventy-eight inches long), he also found, after having prepared the whole pelvis in its natural position, this same additional bone attached to the outer side of either of the common pelvic bones; but he did not, in this case either, find any trace of a third bone; and finally, the examination of one of the pelvic bones of a full-grown hump-back, which at his request had been forwarded to him, still surrounded by the adjacent soft parts, gave also the same result. He therefore, began to doubt whether that third cartilaginous piece found by Reinhardt in the Greenland whale was really an independent part, and the other bone, also found in the hump-back, appeared by its position in relation to the chief bone to be so anomalous in the general structure of the pelvis that this pair of bones almost seemed to him to be most analogous to the marsupial bones of the marsupial animals,² which again would imply that they were, properly speaking, to be compared with *ossa sesamoidea*, or ligamentous ossifications.

Reinhardt, however, had not been mistaken when he made the discovery mentioned above. Both the authors have since found again all those three pairs of bones discovered by him both in the half-grown and in the full-grown Greenland whale; and as we received and immediately assisted each other in examining these bones of the forty-four and a half feet long skeleton, it became perfectly evident to us that, as it is only the one pair that corresponds with the rudimentary pelvis also found in the toothed-whales, the other two hidden in the flesh must be interpreted as *hind legs, of which no traces are to be found in the toothed-whales*.

That this interpretation of these bones became clear to us in this specimen, was partially

¹ Transactions of this Society, 4th series, 12th part, page 306.

² *Ibid.*, 5th series, vol. i, p. 100 (compare also Eschricht, 'Untersuchungen über die Nordischen Wallthiere,' 1ster Band, p. 137).

owing to their being here not only absolutely, but also comparatively speaking,⁷ much larger than in the newborn one (a figure of them, six times diminished, is found in Plate II, fig. 4), by which it became more striking to us that the two pairs of subsidiary bones were suspended almost vertically from the outer extremity of the horizontally situated chief bone. But we were, especially, confirmed in our belief in the correctness of our interpretation by the fact that the articulation between the larger and smaller subsidiary bone might here, with greater certainty than in the newborn specimen, be seen to take place by means of a synovial capsule inserted between them, and that, further, the larger subsidiary bone was again in a similar way attached to the pelvic bone, as those ligaments by means of which it was attached to the latter here, too, contained a synovial capsule, that could not be mistaken, though we have not found one in any of our other specimens.

The principal bone has in the newborn specimen almost the form of a hammer, the long handle of which is turned backwards, a form which we have also observed in some odd specimens of these bones from full-grown whales, and which is produced by the anterior part of the bone being comparatively short, and joined with the long posterior shaft at nearly a right angle. In our forty-four and a half feet long individual, the bone (Plate II, fig. 4 *a—a'*) has not this hammer-like form; it may here rather be said to consist of two pieces joining in an obtuse angle, to which the larger subsidiary bone is attached by means of ligaments enclosing a synovial capsule. We can hardly, however, see anything in this altered form of the bone but a casual and individual deviation, and the hammer-like form will also appear in this instance if we imagine the obtuse angle to be prolonged into an upright process.

If we may venture to compare the place to which the subsidiary bone is attached with an *acetabulum*, it seems natural that we should try to point out those three parts of which the pelvis is usually composed in the pelvic bone of the Greenland whale, and even the common hammer-like form of the bone seems to a certain degree to incite us to make such an attempt, as in the anterior piece (*a'*) we might see the pubic bone, and in the posterior one (*a*) the ischium, while the upward-turned head of the hammer might be considered as the remains of the iliac bone. We must, however, admit that this interpretation is not supported by the development of the bone as far as we know it. For the pelvic bone is in the newborn individual, as we have already stated, perfectly cartilaginous, without any traces of ossification; in the full-grown one it is quite ossified except in its very outmost extremities, but no traces have appeared in any of our more developed pelvic bones, whether those of half-grown or those of the full-grown individuals, of any cartilaginous layer or any line of a former partition at the point of attachment of the greater subsidiary bone, that might lead us to suppose a separate ossification of the different pieces of the pelvic bone. It seems, therefore, that the ossification only begins from one single nucleus; and if we consider this circumstance to settle the question, we suppose that we must only consider the bone to represent one of the usual three pieces of the pelvis, and then, perhaps, especially the *os ischii*, in conformity with the common interpretation of the pelvic bone of the toothed whales.

It cannot, however, be doubted but that this bone, both in its form and its position, corresponds with the pelvic bone also present in the toothed-whales, and that it *alone and by itself* represents all that in the Greenland whale is to be interpreted as belonging to the pelvis. The position of the larger of the subsidiary bones, and its mode of attachment to the pelvic bone, will

at once show us that we have here to do with another part of the osseous system of the posterior extremities, and it is then clear that it can only be interpreted as a femur. It is, moreover, in perfect accord with this interpretation that the ossification of this bone had already proceeded so far in the newborn young one at a time when not the slightest nucleus of ossification had as yet been formed in the pelvic bone. The flat, obtusely triangular, and smaller subsidiary bone may, perhaps, from its situation, be most justly considered as a rudiment of the leg proper.

In the forty-four and a half feet long whale the pelvic bone was on the one side eighteen and a half inches, in the other nineteen and a quarter inches long, of which the posterior portion measured about two thirds; the latter (*a*) is, moreover, flattened, especially posteriorly, and here somewhat more than two inches broad, whereas the anterior piece (*a'*) was quite cylindrical, and only one inch in diameter. In the newborn animal the same bone had only a length of two and a half inches, making, accordingly, in this period of its age, only one sixty-second of the whole length of the animal, whereas in the full-grown animal it made about one twenty-eighth of the same. The femur (*b*) was in the latter eight inches long, almost cylindrical in its upper part, and nearly two inches in diameter; at its inferior extremity it was much compressed, and four inches broad; in the cub it had, on the whole, a similar form, but was only two inches two lines long; the leg (*c*), finally, was much compressed in the full-grown specimen, four inches long, and about two inches broad at its upper end; whereas in the young animal it was about three quarters of an inch long, nearly cylindrical, its length several times greater than its thickness, and, besides, attached in such a manner to the inferior end of the femur that it formed an angle with it, having its free point turned obliquely backwards and downwards.

When once it has been determined that the subsidiary bones of the pelvis of the Greenland whale must be considered as rudimentary hind legs hidden in the flesh, it is obvious that this interpretation must necessarily be transferred to the single pair of subsidiary bones found in the hump-back, even if no one should in future succeed better than hitherto in finding still another pair. We should, finally, feel inclined to suppose that a pair of similar subsidiary bones, as rudiments of the hind legs, may be pointed out in the other rorquals also, though they have not been found in the fin-whale fetuses (*Balanoptera rostrata*) hitherto examined;¹ on the other hand, we are fully convinced that nothing corresponding is to be found in any of the hitherto more carefully examined toothed-whales.

It is evident that the presence of hind limbs, however rudimentary, in the whalebone-whales, and their absence in the toothed-whales, cannot but influence our opinion about the relative positions of these two cetaceous animals in the system; and we shall accordingly add a few words on this subject.

Most zoologists have agreed in considering the toothed-whales to be nearer, the

[¹ In a large male specimen of the common fin-whale (*Physalus antiquorum*, Gray; *Pterobalæna communis*, Eschr.) stranded in Pevensy Bay, in November, 1865, the femur was represented by an oval cartilaginous nodule, an inch and a half in length, attached by a ligament to the pelvic bone. See 'Proceedings of the Zoological Society,' November 28th, 1865. W. H. F.]

whalebone-whales to be more removed, from the common type of a mammiferous animal, and accordingly the former to stand higher, the latter lower, in the systematic order of succession. This supposition is, of course, principally founded on the mouth being differently armed in the two groups, and in this respect the whalebone-whales must, no doubt, be said to be far removed from the common organization of a mammiferous animal, and it may further appear to be confirmed by some deviations from the common structure of mammalia, which occur together with the formation of whalebone, as, for instance, that the sternum only serves for the attachment for a single pair of ribs, and perhaps also that the sternal ribs, if they exist at all, are quite rudimentary. But it must not be forgotten that the opposite is the case in other and more essential respects; thus, especially, the brain of the whalebone-whales appears not a little superior to that of the toothed-whales, by the distinct development of the olfactory nerves; and it must further be considered as a proof of a higher organization that the two divisions of the digestive canal, the small intestine and the colon, are distinctly separated from each other, contrary to what is the case in the toothed-whales. Finally, as far as the osteology is concerned, we cannot agree in the common opinion that the cranium of the whalebone-whales is further removed than that of the toothed-whales from those of the rest of the mammalia; according to our opinion, exactly the reverse is the case. We may, perhaps, in the first place, seek some support for the correctness of our view in the fact that we do not find in the whalebone-whales that want of symmetry, or distortion of the head from the right to the left, which is so characteristic of the toothed-whales, and which (as it appears among these) is something perfectly unknown in the rest of the mammiferous class. But our opinion may also further be strengthened when we consider the form and relative position of the individual bones, notwithstanding the enormous superiority of the jaws, and, perhaps, we need only in this respect allude to the lower jaw, the zygomatic and lachrymal bones, the last mentioned of which has not even been pointed out in any toothed-whale with the exception of *Delphinorhynchus micropterus* and *Hyperoodon*. As to the rest of the skeleton, we shall here but slightly glance at the fact that we might also find reasons to support our opinion in the anterior extremities of the whalebone-whales; but we must lay greater stress on this circumstance, that it is only in them that we find, besides the rudimentary pelvis, remains of the other parts of the posterior extremities; and this discovery, in addition to the proofs derived also from other peculiarities in their organization, must surely be said to be sufficient to secure to the whalebone-whales a right to be placed at the head of the cetaceans, as the most perfect of this group of animals.

EXPLANATION OF THE PLATES.

PLATE I.

All the figures in this Plate are taken from the young whale sent from Greenland, in brine, by Major Fasting.

FIG.

1. The newborn Greenland whale (*Balæna mysticetus*, L.), one thirteenth of the natural size.
2. The head seen from above, same diminution.
3. The blow-holes, represented half their natural size.
4. The anterior part of the underlip, somewhat diminished, with the two groups of hair-knobs, out of which, however, the hairs themselves had already fallen when the specimen was received.
5. The muzzle, also somewhat diminished, with its hair-knobs.
6. The tail, with the caudal fin, one thirteenth of its natural size.
7. The anterior part of the cavity of the mouth, showing that the two baleen matrices do not meet anteriorly. Somewhat reduced from nature.

PLATE II.

1. The forty-seven and a half feet long Greenland whale skeleton, seen from the side, forty-eight times diminished. (The three anterior caudal vertebræ, the carpus, and the posterior extremities, are represented from the forty-four and a half feet long skeleton; the caudal vertebræ have been brought somewhat nearer to one another than in their fresh state by the drying up of the intervertebral cartilages; the tail is, therefore, on the whole, somewhat too short.)

In the cranium, the letters have the following significations :

- b.* The left parietal.
f. „ frontal.
i. „ intermaxillary.

FIG.

- k.* The right condyle of the occipital.
- l.* The left lachrymal.
- m.* „ „ superior maxillary.
- o.* The squamous portion of the occipital.
- t.* The left temporal.
- z.* „ „ zygomatic.

2. The head of the same forty-seven and a half feet long Greenland whale skeleton, seen from behind, twenty times reduced.

The different letters have the following significations :

- a.* The posterior surface of the articular process of the temporal.
- f.* The posterior angle of the extremity of the orbital process of the frontal.
- g.* The tympanic.
- i.* Superiorly, that part of the free margin of the nasal opening which is formed by the intermaxillaries; inferiorly, the free pointed end of the upper jaw formed by the intermaxillaries alone.
- k.* The condyle of the occipital.
- m.* Superiorly, the part of the superior maxillary situated immediately around the nasal opening; inferiorly, the lateral surfaces of the palate, formed by the superior maxillaries and descending obliquely towards the mesial line.
- n.* The posterior wall of the nasal opening formed by the nasal bones.
- o.* The external free surface of the occipital.
- t'*. The part of the temporal meeting the zygomatic arch.
- u.* The pterygoid cavity situated outside the nasal canals.
- v.* The posterior end of the vomer.
- w.* The petrous bone.

3. The cervical region and the anterior part of the dorsal region, with the two foremost pairs of ribs, and the sternum of the twenty-two and one third feet long skeleton, all still remaining in their natural connection. From a photograph, about ten times reduced.

1, 2, 3, 4, 5, 6, 7. The bodies of the seven ankylosed cervical vertebræ.

2. The right inferior transverse process of the second cervical vertebræ.

6. „ „ „ „ sixth „

2'. The left „ „ „ „ second „

3. „ „ „ „ third „

1'. „ „ superior „ „ first „

2'. „ „ „ „ second „

1, 2, 3, 4. The bodies of the four anterior dorsal vertebræ.

2, 3, 4. The right transverse processes of the second, third, and fourth dorsal vertebræ.

1', 2', 3', 5'. The left transverse processes of the first, second, third, and fifth dorsal vertebræ.

c and *c'*. The angle of the two anterior left ribs (*angulus costæ*).

t. The place in the second rib corresponding with its tubercle, being that to which the ligaments are affixed which connect it with the transverse process of the second dorsal vertebræ.

4. The left posterior limb of the forty-four and a half feet long Greenland whale skeleton, six times diminished.

a—d'. The pelvic bone.

b. The first subsidiary bone, corresponding with the femur.

e. The second and smaller subsidiary bone.

PLATE III.

FIG.

1. The skull of the thirteen feet long newborn Greenland whale, six times diminished.
2. „ „ forty-three feet long hump-back (*Megaptera boops*, Fbr.), twenty times diminished.
3. „ „ fifty-three and two thirds feet long fin-whale (*Balaenoptera musculus*, J. Müll., *Rorqual de la Méditerranée*, Cuv.), twenty times diminished.

All three seen from above. The letters have the following significations in all the figures :

- b.* That part of the parietal which covers the superior surface of the orbital process of the frontal.
- f.* The orbital process of the frontal.
- y.* The middle piece „
- i.* The intermaxillary.
- k.* The condyle of the occipital.
- l.* The lachrymal.
- m.* The portion of the superior maxillary belonging to the superior surface of the upper jaw.
- m'.* The posterior process of the superior maxillary.
- m^o.* The external „ „
- n.* The nasal bone.
- o.* The squamous portion of the occipital.
- o'.* The articular „ „
- q.* The condyle of the lower jaw.
- r.* The rami „ „
- t.* The lateral process of the temporal.
- v.* The internal surface of the vomer, exposed by the removal of the primordial vomer.
- x* (in fig. 1). Ligaments between the lateral processes of the frontal and the temporal.
- z* (in fig. 2). The zygomatic.

PLATE IV.

1. The posterior part of the head of the forty-seven and a half feet long Greenland whale skeleton, seen from above, twenty times diminished.
 - a.* The articular process of the temporal.
 - b.* The process of the parietal, covering the groove of the optic nerve.
 - f.* The frontal.
 - i.* The intermaxillary.
 - k.* The condyle of the occipital.
 - m.* The superior maxillary.
 - n.* The nasal bone.
 - n'.* The anterior part of the same bone which here happened to be of a more brittle structure, and a darker colour.

FIG.

- o.* The occipital.
 - q.* The *processus jugularis* of the occipital.
 - r.* The *processus mastoideus* of the temporal.
 - t.* The middle piece of the temporal.
 - t'.* The *processus zygomaticus* of the temporal.
 - v.* The superior concave surface of the vomer.
 - z.* The zygomatic.
 - x.* Ligaments between the orbital process of the frontal and the zygomatic process of the temporal.
2. The posterior part of the cranium of the forty-seven and a half feet long skeleton, seen from below, twenty times diminished.
- a.* The articular process of the temporal.
 - b—b.* The parietal, and its process covering the groove in the orbital process of the frontal for the optic nerve.
 - f—f.* The orbital process of the frontal.
 - g.* *Bulla tympani.*
 - h.* The portion of the pterygoid entering into the formation of the palate.
 - k.* The condyle of the occipital.
 - l.* The lachrymal.
 - m—m.* The palatine surface and lateral process of the superior maxillary.
 - o.* The very small portion of the basi-occipital which is still visible here between the pterygoid bones.
 - p.* The portion of the palatine entering into the formation of the palate.
 - u—u—u.* The pterygoid wedged in between the palatine and the superior maxillary, the temporal, and the parietal, and its external process under the prolongation of the parietal, covering the groove for the optic nerve.
 - v.* The posterior extremity of the vertical plate of the vomer, visible between the palatine bones.
 - w—w.* The petrous bone.
 - z.* The zygomatic.
3. The anterior pointed end of the superior maxillary of the forty-seven and a half feet long skeleton, seen from below, twenty times diminished.
- c.* The interval between the two intermaxillaries, in which the anterior pointed end of the primordial vomer is situated freely prominent in the mesial line of the palate.
 - i.* The foremost end of the intermaxillaries, here not covered by the superior maxillaries.
 - m.* The foremost end of the palatine surface of the superior maxillaries.

PLATE V.

FIG.

1. The right half of the head of the forty-seven and a half feet long Greenland whale skeleton, showing a section sawn vertically through the mesial line, twenty times diminished. The explanation of the letters in this figure is given at p. 96.
2. The right ramus of the lower jaw of the same head, seen from within, diminished to the same amount.
3. The posterior part of the same ramus of the lower jaw, seen from above, diminished to the same amount.

The letters have the following significations in both these figures :

- b.* The condyle (*processus condyloideus*).
 - c.* The coronoid process.
 - d.* The great opening for the vessels and nerves of the lower jaw.
 - e—e.* The groove formed by a row of foramina for the exit of vessels and nerves along the upper edge.
 - m.* The inner surface of the ramus of the lower jaw.
 - n.* The outer " " "
 - o.* The angle of the ramus of the lower jaw turned downwards and inwards (*angulus maxillæ inferioris*).
 - x.* The groove for the primordial inferior maxillary, or Meckel's cartilage.
4. The left petrous bone of the forty-seven and a half feet long Greenland whale skeleton, seen from below and in front, in its natural connection, with the adjoining bones and fibrous tissue, four times and a half diminished. The signification of the letters is given at p. 93.
 5. The internal nasal passage of the right half of the head of the forty-seven and a half feet long skeleton, represented in the first figure of this Plate, ten times diminished. The letters are explained at p. 95.

PLATE VI.

All the figures in this Plate are taken from the hyoids and the larynx of the forty-seven and a half feet long Greenland whale skeleton, six times diminished.

1. Shows the hyoids and the larynx in their natural connection from behind, or, more properly speaking, from the dorsal surface.
 - a.* The body of the hyoid.
 - a'—a'* The still cartilaginous obtuse points of its two lateral cornua.
 - b—b.* The two stylo-hyoid bones.
 - c—c.* The ligament by which the latter are attached to the anterior cornua of the hyoid.
 - d—d.* The ligaments by which they are attached to the petrous bones.

FIG.

- f-f.* The anterior cornua of the thyroid.
g-g. The posterior " "
h-h. The ligaments by which the anterior cornua of the thyroid are attached to the hyoid.
i-i. The ligaments by which the posterior cornua of the thyroid are attached to the cricoid cartilage.
k. The epiglottis.
l. The ligament by which the latter is attached to the internal surface of the cricoid.
m-n. The middle piece, or body, of the arytaenoid cartilages.
n-n. The anterior, or ascending, cornua of the arytaenoid cartilages.
p. The transverse ligament between the anterior cornua of the arytaenoid cartilages.
r. The dorsal surface of the cricoid cartilages.
2. The cricoid and the arytaenoid cartilages, and the epiglottis from the left side.
- k, m, and n.* As in the first figure.
o-o. The posterior, or descending, cornua of the arytaenoid cartilages.
q. The transverse ligament between these cornua.
s. The internal surface of the cricoid cartilage.
3. The epiglottis and the ascending cornua of the arytaenoid cartilages seen from the dorsal surface, the respiratory canals being closed.
- k, l, n, p.* As in the first figure.
4. The whole larynx from the ventral surface.
- e.* The ventral surface of the thyroid.
f, g, h, i, k, l, n. As in the first figure.
5. The whole larynx from the left side.
- e.* The ventral surface of the thyroid.
f, g, h, i, k, l, n. As in the first figure.
o. The descending cornua of the left thyroid cartilage.
r. The left lateral edge of the cricoid cartilage.
t. The ligamentous membrane between the lateral edge of the cricoid and the descending cornua of the arytaenoid cartilages.
u. The anterior part of the tracheal sac.



A P P E N D I X.

BY THE EDITOR.

It may be useful to add to the foregoing valuable monograph some observations upon the skeleton of an adult female Greenland right-whale, lately set up in the museum of the Royal College of Surgeons of England. This appeared to me especially important, as the materials, otherwise so rich, upon which the memoir was founded, were, as the authors themselves regretted, deficient in a full-grown specimen of this sex.

The skeleton was obtained from the same locality as all of those previously described, viz., Holsteinsborg, in South Greenland. It was sent, in 1863, to the Royal Zoological Museum at Copenhagen, and, through the kind mediation of Professor Reinhardt, was purchased from that institution by the Council of the Royal College of Surgeons. Of the sex of the animal from which it was obtained there can be no doubt, as a fetus taken from it, and the characteristic soft parts, were forwarded with the skeleton to Copenhagen.

The bones were but roughly cleaned, and the vertebræ, in groups of four or five or more, were attached together by their intervertebral substance. Although this was somewhat dried, after soaking for a few days in water it appeared to gain its natural consistence and bulk, and thus afforded a tolerably close approximation to the distances at which the different vertebræ should be placed, and consequently of the length of the whole vertebral column. I find that this amounts to twenty-nine feet, while the cranium, in a straight line, is seventeen feet long. The animal must have been very nearly, if not quite, full grown; the epiphyses of the humerus are firmly united to the shaft, without a trace of their original separation remaining; in the dorsal and lumbar regions of the spinal column they are still separable from the ends of the bodies of the vertebræ; in the caudal region they are ankylosed. It is, therefore, much in the same stage of growth as, or perhaps slightly younger than, the largest skeleton mentioned in the memoir, now in the Royal Museum of Natural History at Brussels, and which measures, as at present articulated, fifty feet three inches in length.

The evidence afforded by this new specimen gives no corroboration to the theory that the female Greenland whale exceeds the male in size; indeed, as far as one specimen can prove any-

thing, it shows that there is in this respect no marked sexual difference. Now, if we inquire more closely into the nature of the evidence upon which this supposition of the distinguished authors of the memoir rests, it appears to me that it amounts only to this, that *some* Greenland whales are said to be larger than the male whose skeleton passed under their examination, which larger animals they assume to be females, to avoid the difficulty of supposing that a mature animal can vary in the same sex to such an extent as from forty-six (English) feet (the length of the skeleton of their small adult male) to fifty-eight feet (the greatest length given by Scoresby, for a whale in the flesh, the sex not being stated). But, in the first place, this length, even according to Scoresby's account, appears to be quite exceptional; and further, as we are not told whether it was taken along the curve of the body, or in a straight line, as in the skeleton, and whether it was measured to the bottom of the notch in the middle of the tail, or, as was probably the case, to the most projecting part of the flukes, and as, moreover, without casting any imputation upon Scoresby's general faithfulness as an observer, we must allow for the great difficulties attending the measurement of a whale's carcass lashed alongside a vessel; taking all these circumstances into consideration, I am inclined to attach little weight to this particular case. The real evidence at present before us, so far as it goes, points to about fifty feet as the average length of the adult Greenland whale of either sex, allowing a margin of variation of a very few feet on either side of this.

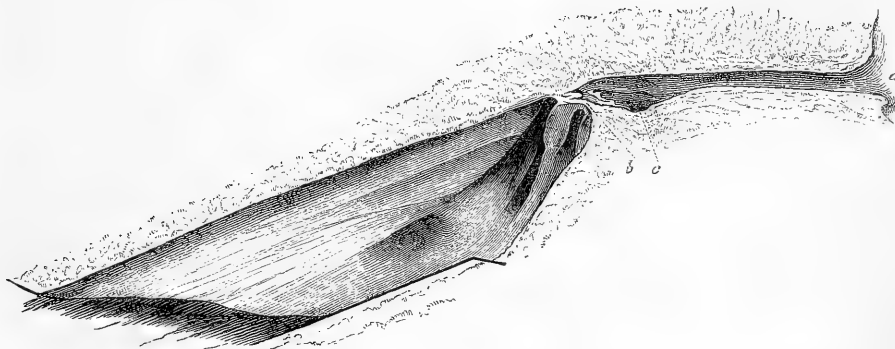
The next point upon which the examination of the new skeleton gives results, not quite coinciding with those of Professors Eschricht and Reinhardt, is with reference to the comparative size of the head in the male and female Greenland whale. As before said, the cranium is seventeen feet long, and the whole length of the skeleton forty-six feet, the former being to the latter as 1 to 0·3695. In the larger male skeleton at Brussels the proportion, according to my measurements as the skeleton is now articulated, is as 1 to 0·3731, or, according to Eschricht and Reinhardt, as 1 to 0·3895; while in the smaller adult male skeleton at Copenhagen it is as 1 to 0·3959. Such difference as exists is certainly in favour of the males; but it must be recollected that these are both somewhat older than the female, and there can be no question that age leads to important modifications, especially to a great increase of development of this part of the body. It is possible that the arch of the upper jaw, and, consequently, the length of the baleen, is generally greater in the male than the female. Indeed, on comparing the figure of the section of the large male skull (Plate V) with the female in the museum of the Royal College of Surgeons, the difference in this respect is well marked.

In order to obtain an idea of the relative size of the different portions of the skeleton, before the bones were articulated I had them weighed, with the following results. It will be observed that the skull considerably exceeds in weight the remaining parts of the osseous framework.

	Tons.	cwt.	lbs.
Cranium	0	18	40
Lower jaw-bones	0	9	18
Skull	1	7	58
Vertebral column	0	10	51
Ribs	0	7	60
Two scapula	0	0	108
Arm- and hand-bones	0	1	94
Sternum	0	0	23
Hyoid bones	0	0	13
Pelvic bones	0	0	2
Total	2	8	73

With reference to the cranium, the only point which requires notice, on its external aspect, is the absence of distinct lachrymal bones. If the parts around the orbit were not still covered with their thick periosteum, it might have been supposed that these thin, wedge-shaped bones had been lost, as so often happens in macerated skulls; but in reality they appear to have become firmly ankylosed to the frontals, slight traces of their original separation still remaining. This is remarkable, as I have met with no other instance of such a union in any whalebone-bone.

A section through the long axis of the cranium, rather to the right of the middle line, brought into view a very interesting region, of which, as it is not described in the memoir, I have here given a figure one fourth the size of nature.



The woodcut shows the bony walls of the chambers containing the olfactory organ of the right side, seen from within. In common with the region of the cranium in which they are lodged, they are drawn out to a remarkable length, and although possessing all the essential characters of the same parts in the ordinary mammalia, they are reduced to a state of extreme simplicity and insignificance compared with the proportions of the rest of the skeleton.

Near the lower part of the anterior wall of the cerebral cavity (*a*) in the middle line is a

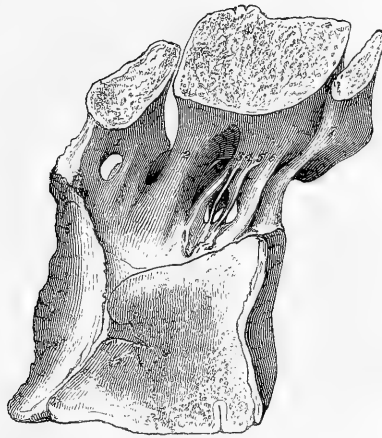
transversely elongated aperture, one and a half inch wide and one inch high. A prominent transverse ridge projects backwards into the cerebral cavity from the lower margin of this opening, representing the *processus olivaris* of anthropotomy; below this is the concavity of the *sella turcica*. The opening leads into a canal which runs directly forwards in the mass of cancellous bone formed by the union of the frontal, ethmoid, and presphenoid, for a distance of eight and a half inches. In the middle of its course it retains its original width, but is contracted in vertical diameter to about half an inch, and has a longitudinal eminence in the median line of the floor. Between five and six inches from the brain cavity it divides laterally to form the two somewhat dilated chambers for the lodgment of the olfactory bulbs. Two inches behind the anterior wall of each chamber a large oval canal (*c*), half an inch in its greatest diameter, passes off in an outward, backward, or downward direction. This canal, probably for the transmission of a blood-vessel, joins that which lodges the optic nerve at about ten inches from the cerebral cavity. The floor of the front part of the rhinencephalic chamber slightly ascends, and with its small concave anterior wall forms the cribriform plate of the ethmoid bone (*b*). This is little more than an inch in extent in either direction, and the foramina in it are both smaller and less numerous than in the corresponding part of the small fin-whale (*Balaenoptera rostrata*), preserved in the Hunterian collection. The foramina, pretty closely scattered over the anterior wall, extend backwards along the floor of the cavity in three lines, one in the middle and one near each side.

In front of, or rather below, the cribriform plate is a large chamber, of an irregularly triangular shape. The base, or longest side of the triangle (fourteen inches), is nearly horizontal, and forms the roof of the chamber. The floor, five inches long, and also closed, runs forwards and downwards, and the anterior side forms an open, narrow slit, twelve inches in length, slightly curved, with the concavity outwards, and opening into the roof of the great nasal passage, close to the side of the vomer. This olfactory chamber is extremely narrow from side to side, though its breadth varies in different parts, on account of the irregular disposition of its outer wall. In the middle part, in front, where this is very prominent and convex, the space between the two sides of the cavity is not more than a quarter of an inch. Posteriorly the outer wall is raised into several longitudinally placed elevations of a very simple character, representing the ethmoid turbinal bones. Of these the principal one is connected with the anterior or under surface of the cribriform plate. The upper and lower recess formed by this are each subdivided by small ridges, resembling in general disposition, but altogether smaller, and of more simple form, than those of *Balaenoptera rostrata*.

The entire number of vertebræ is fifty-five, of which, adopting the division between the lumbar and caudal regions used by Eschricht and Reinhardt, seven are cervical, twelve dorsal, fourteen lumbar, and twenty-two caudal. The latter appear to be quite complete.

The adjoining woodcut, showing a section through the middle line of the ankylosed mass of the cervical vertebræ, well illustrates some points in the structure of these singularly modified bones. The union of the seven bodies into one is very complete; even the layer of cartilage between the sixth and seventh, described by the authors of the memoir, does not exist in this specimen. Indeed, the separation of the last two bones is only slightly indicated near the lower surface of the united bodies. The upper part of the arch will be seen to consist of three pieces, the first composed only of the atlas, the second common to the axis and the four succeeding vertebræ, the last formed of the seventh by itself.

The ligaments usually attached to the odontoid process are inserted into a deep pit, situated in the middle line, between the articular surfaces of the condyles. The first dorsal vertebra has not, in this instance, contracted any union with the seventh cervical.



There are but eleven chevron bones, and certainly no more existed in an ossified condition; the first and the last three have the two lateral parts of which they are composed not united in the mesial line; the eleventh pair are disk-like bones, about an inch and a half in diameter, situated in the interspace between the twelfth and thirteenth vertebræ from the termination of the tail.

The ribs are but twelve in number, the last well developed. From the great care with which the skeleton was prepared it seems unlikely that any more can have existed and been overlooked; but the extremities of the transverse processes of the vertebra, following that which bears the twelfth rib, are certainly somewhat enlarged, and present an imperfect articular surface; this may be, however, for a second attachment of the twelfth rib.

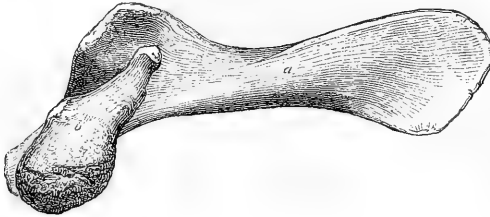
The sternum is heart-shaped, but with the anterior border very slightly excavated, and the posterior end much narrowed. It is twenty-two inches in length and twenty in breadth.

The bones of the anterior extremities resemble, in their general arrangement, form, and number, those figured at p. 129; there are some differences, however, in the carpal bones. Between the bone (or rather cartilage) placed on the radial border of the carpus and the cartilaginous upper extremity of the pollex no trace of a division could be found, even on making a section through them. There is no ossification in this cartilage; while, on the other hand, the cartilage representing the single bone of the distal row has a considerable osseous nucleus, though extending only to the dorsal surface of the wrist. The projecting cartilage on the ulnar side, representing the pisiform, has no osseous nucleus developed in it; the other two nuclei shown in the figure are well developed, and attain both external surfaces of the carpus. The bones of the digits precisely resemble, in number and arrangement, those shown in the figure.

As an individual peculiarity may be mentioned a curious difference in the two humeri, the upper or inner border of the right being two inches shorter than that of the left, while the outer

or lower border is of the same length; this causes the distal articular surface to have a different direction in the two bones.

The pelvic bones have each a single accessory bone (femur). If a third bone existed it must have been removed on both sides in preparing the skeleton. The main bone of the right side was thirteen and a quarter inches long, the accessory bone being six and a half; the left principal bone (*a*) was fourteen inches long, the smaller one (*b*) five and a half. As these interesting bones differ somewhat in appearance from those figured in the memoir (Plate II, fig. 4), I insert, for comparison, a woodcut of the outer surface of the bones of the left side in their natural relative position.



ON THE
SPECIES OF THE GENUS
ORCA.

INHABITING THE
NORTHERN SEAS.

BY
D. F. ESCHRICHT.

(Read before the Royal Danish Society of Sciences, May 9th, 1862.)

TRANSLATED FROM THE

'OVERSIGT OVER DET KONGELIGE DANSKE VIDENSKABERNES SELSKABS FORHANDLINGER,' 1862.

ON THE

NORTHERN SPECIES OF ORCA.

I.

ON Wednesday, the 24th of July, 1861, I received a telegram from Mr. Ernst Benzon, hereditary lord of the manor of Benzon, in the vicinity of the town of Randers, in Jutland, in which he informed me that, while sailing in his pleasure yacht in the Kattegat, he had found the carcass of a Cetacean about eleven ells long, which he had towed to Gjerrild strand belonging to his estate, where he would order it to remain untouched for my free examination, if I should set off for Grenaa by the steamer on that very day. I could not but accept such a kind invitation, affording a chance of a valuable acquisition to the museums of the university, as well as to science in general. I therefore set off at five o'clock in the afternoon, accompanied by Mr. Iversen, the assistant in the Zootomical-physiological Museum, and arrived at Grenaa early the next morning, where I found Mr. Benzon's carriage waiting to bring us to the manor-house and, a couple of hours afterwards, to the shore.

That it was only a carcass far advanced in putrefaction that awaited me here, might already have been concluded from the circumstance of its having been found floating; for all smaller Cetaceans sink immediately after death, and their dead bodies, like those of other animals generally, do not rise to the surface, until lifted by the various kinds of gas developed during putrefaction; but, for the last minutes of our drive, the stench meeting us, gave us every reason to fear that an anatomical examination, properly so called, would be intolerable, if not impossible. On our arrival, however, we saw that not only the outward form of the whole animal, but even the different colours of its skin had been extremely well preserved, and however disagreeable the task might be in the heat of summer, yet I could not omit to examine and measure the body as exactly as possible, and then begin immediately to work out the skeleton with the bones in their natural connection.

It was a killer, *Delphinus orca*, L., that lay before me with the belly and part of the left

lateral surface turned upwards, a male of medium size (twenty-one and one third feet long). The coloration so peculiar to the killers, always distinguished by a white mark above and behind the eye, and by a large white symmetrical figure on the side above and behind the navel, being a continuation of the white colour of the belly, had already struck me at a distance of several hundred paces, and the contrast of the two colours seemed rather to have grown stronger, than weaker, by putrefaction, most probably only because the external layer of the epidermis had come off, thus exhibiting the deeper and more strongly coloured layers.

The coloration agreed very well in the main with that of the well-known and excellent figure given by Dr. Schlegel, from a specimen stranded in November, 1841, on the coast of Holland.¹ But no traces were discovered of the purple longitudinal stripe, which in that specimen ran along the base of the back-fin,² nor of the little white spot at the posterior corners of both the pectoral fins. So far therefore, it agreed better with another very carefully executed drawing, for which I am indebted to the kindness of Professor Steenstrup. Mr. Thomsen, a teacher at the grammar-school at Randers, caused this figure to be executed from a specimen stranded on the eastern coast of Jutland, in the middle of February, 1855, being like Dr. Schlegel's specimen, a female, only thirteen feet long, and eight in circumference. We are unable to decide how far the spot beneath the pectoral fins may have been present on this specimen, but we are sure that the purple stripe under the back fin was also here completely

¹ 'Abhandlungen aus dem Gebiete der Zoologie und vergleichenden Anatomie,' 2nd part, plates vii and viii.

² [A few words relative to this stripe may, perhaps, find a place here. Dr. Schlegel we know, in his description of the Orca stranded at Wyk aan Zee, states expressly that no earlier observer had either perceived or represented such a stripe in this species; and it seems that my lamented friend Professor Eschricht was of the same opinion. The assertion is, notwithstanding, unfounded, for the killer caught in Lynn Harbour, November 19th, 1830, twelve years before the essay quoted above was published by Dr. Schlegel, was distinguished by a similar stripe.]

I have not, indeed, been able to examine the original communication about this animal in the fourth volume of 'London's Magazine of Natural History,' written by an anonymous author, for this periodical seems not to be found in our libraries; but fortunately we have perfectly satisfactory information on the point in two authors of later date, Th. Bell and Dewhurst, both having made use of the communication referred to in their respective works ('History of British Quadrupeds,' pp. 479-80, and the 'Natural History of the Order Cetacea,' pp. 179-80), in both of which this peculiar stripe on the back is particularly mentioned. Dewhurst's description is, moreover, illustrated by a figure of the animal, which Loudon himself had placed at his disposal; and in this woodcut the dorsal stripe is represented with the very same peculiar outline that it had in Dr. Schlegel's Orca, according to the latter author's description and figure. The only point as to which the dorsal mark of the Orca from Lynn Harbour may have been different from that of the one from Wyk aan Zee might, perhaps, be the colour; for in the latter specimen it was, according to Schlegel, "schmutzig bläulich purpurfarben, und hat gegen die Mitte des Rückens hin ein schieferartiges Ansehen;" whereas that of the former is described by Bell as "gray," and by Dewhurst as "silverish-gray." We need hardly add that no particular importance ought to be ascribed to such a difference, even if it really existed; but it is of great consequence not to overlook this second instance of an Orca with gray or purple-gray dorsal stripe, as the Orca from Lynn Harbour was a male with a high dorsal fin. The dorsal stripe may therefore appear in high-finned males as well as in low-finned females.—J. REINHARDT, 1865.]

wanting. Nor does it seem, that in the killer, described in 1851, by Professor Nilsson,¹ which I shall presently have to examine more particularly, either the longitudinal stripe, or the light spot at the root of the pectoral fins were present, but on the other hand this specimen shows another white spot on the back of the head which is not known ever to have been discovered before. During a short stay at Lund, I examined the two figures drawn by the Rev. Mr. Lundberg from Professor Nilsson's specimen, differing from each other only in a few unessential particulars, and then I found this anomaly, also, that the large white spot behind the eye had still another, but smaller one before it. Thus we see, that much as all the killers of the northern seas resemble each other as to their colours generally speaking, yet several smaller differences may occur in them, especially relative to some white spots on the dark ground. How far these differences must be considered, either as merely individual, or as the characters of different ages, sexes, or species, we cannot at present stop to examine.

It was a specimen considerably larger and fatter than that from which Schlegel's illustration had been drawn. For this, Dr. Schlegel inform us, was only sixteen and a quarter feet long, yielding scarcely forty guldens' worth (thirty Danish dollars) of oil, whereas the subject of the present dissertation was twenty-one feet four inches long, and its blubber yielded 210 "potter" (about forty-five English gallons) of oil, to the value of eighty-seven dollars. Besides, our specimen being a male, while Dr. Schlegel's was a female, I was not surprised that the extremely powerful bodily frame, peculiar to this genus of Cetaceans, was still more conspicuous in this instance than in Dr. Schlegel's figure, as not only the head was larger and more massive, and the body less tapering behind, but all the fins were far more powerfully developed. This might even be said of the pectoral fins, which showed already, in Dr. Schlegel's figure, a very characteristic breadth in proportion to the pectoral fins of all the rest of the toothed-whales; but still more, it might be said of the caudal fin, and especially of the back fin, which had not, indeed, the slightest resemblance to that of Dr. Schlegel's specimen, but, on the contrary, immediately reminded us of the description given by Bishop Gunnerus, of the back fin of the so-called "Stourvang."² In Dr. Schlegel's illustration, the back fin has its point inclined in a backward direction, the anterior margin being convex and the posterior concave, but in our specimen it arose quite vertically, especially in its anterior margin; the posterior edge was, indeed, slightly concave at its base, but afterwards it arose almost vertically, meeting the anterior margin in an obtuse extremity pointing straight upwards, and instead of its height being, as in Dr. Schlegel's figure, only between one eighth and one ninth of the total length of the animal,³ it was almost one fifth. In these respects, the individual before us not only differed from Dr. Schlegel's figure, but also from two other later illustrations, both of females, namely, the one mentioned above, by Mr. Thomsen, and an outline drawn by Mr. Bloch, formerly a physician in South Greenland, from a killer stranded there in 1844, copies of which have been left to Professor Nilsson, as well as myself, by the late Dr. Pingel. Both these figures, Mr. Thomsen's as well as Mr. Bloch's, seem to agree in all their measurements with Dr. Schlegel's. The only point in which this cannot be said to be the case is the form of the head, and I cannot help believing that Schlegel's figure has not been very successful in this respect, the snout having been represented too pointed, and the upper jaw too low.

¹ 'Förhandlingar vid de Skandinaviske Naturforskarnes, 6te Möte,' i, 1851, p. 56.

² 'Det Kongelige Norske Videnskabers Selskabs Skrifter,' 4de. Deel. Kbhvn., 1768, p. 102.

³ One foot eleven inches in sixteen feet three inches, or $\frac{23}{195}$.

The celebrated Swedish zoologist, Professor Nilsson, was already, fifteen years ago, surprised at the inferior height of the back fin in Schlegel's and Bloch's illustrations, having himself observed in those "Stourvang," which he had seen several times in the sea near the coasts of Helgeland, how it arose like a pole, two or three ells high, every time the animals raised their backs above the surface of the sea, and as it is also stated by Thomas Bell,¹ that the height of the back fin was four feet in a killer, caught in Lynn Harbour, nineteen feet long, or more than one fifth of the total length of the animal. Nor had it escaped Professor Nilsson's attention, that both those drawings represent females, whereas the specimen described by Mr. Bell was a male, and thus he was led to ask the question, "Has not the male a higher back fin than the female?"² But it must be admitted, that the small number of examples at his disposal might as well have justified the question; Might not the specimens of Schlegel and Bloch have belonged to a species of killer different from the "Stourvang" of the Norwegians, and from the specimen mentioned by Bell? The reason why the supposition of the illustrious Swedish zoologist has hitherto remained, as far as I know, perfectly unnoticed may, perhaps, partly be found in the circumstance, that many have considered the other supposition mentioned above, to be far more probable, as the Norwegian fishermen have always among the killers opposed a "Lille-Vang" (Little-Vang) to a "Stour-Vang" (Great-Vang). A very marked distinction had been made even by Fabricius, between the Ardluk of the Greenlanders (his *Physeter microps*), evidently a killer, and the Ardluksoak (his *Delphinus orca*, *pinnæ dorsi altissima*), and accordingly it was hardly thought advisable to reject unconditionally the distinction of Lacépède between a *Delphinus gladiator*, about which it is stated expressly,³ that its back fin may be more than one fifth of the animal, and a *Delphinus orca*. It seems to me, however, that the question must remain unanswered, as long as we have not observed a *male* killer with a low back fin, or a *female* with a high one. At all events it was further confirmed by the specimen under examination, that not every coloured spot, however symmetrical it may be, is to be considered as a distinguishing character of either species or sexes; for as Mr. Thomsen's specimen had already afforded an instance of a female with the low back fin (namely, one and a half feet in a thirteen feet long individual, accordingly a little more than one ninth), in which the purple mark on the back found in Dr. Schlegel's specimen did not exist, thus we had here a male with a very high back fin, but without traces of the white spot on the back part of the head, by which Professor Nilsson's specimen was distinguished. The question, however, whether there are one or more species of killers in our northern seas, is still to be examined by a comparison of the skeletons, I shall therefore revert to this subject presently.⁴

¹ 'British Quadrupeds,' London, 1837, p. 481.

² 'Skandinavisk Fauna,' 1st Deel, 2nd Udg., p. 606, note.

³ Lacépède, 'Histoire Naturelle des Cétacées,' Paris, l'an xii, p. 301.

⁴ After having written the above remarks I obtained a notice of a stranding of a killer on the coast of Jutland, nearly 200 years back, which I cannot help adding here, as it affords another instance of a female killer with a low back-fin. Mr. Benzon had informed me that at the manor-house of Steenalt, near Randers, there exists an oil-painting representing a killer stranded in the seventeenth century, on the neighbouring coast. I applied to the present owner of the estate, Mr. C. Brun, expressing a wish to have the picture copied, and had the pleasure, some time afterwards, of receiving a copy, fifty-three inches wide by thirty-eight high, very carefully executed in water-colours, with the following superscription:—"Anno 1679, d. 27de December, Da Kom denne Fisk

I shall now return to the examination of the external appearance of the killer before us. As already stated, not only the back fin, but all the fins, generally speaking, proved to be very large and powerful. All three female killers known to me through drawings have comparatively small caudal fins; in Schlegel's specimen its breadth is $\frac{1}{33}$ ths of the total length of the body = 0.282; in Thomsen's, $3\frac{1}{2} : 13 = 0.27$; and still smaller in Bloch's; in our specimen, on the contrary, $6\frac{1}{2} : 21\frac{1}{2} = 0.31$; and, according to Thomas Bell, its breadth may even be upwards of $\frac{1}{3}$ rd, or 0.333 of the length of the body.

The pectoral fins are very large in all killers, and especially very broad and ovate; in Dr. Schlegel's specimen, however, their length was only 0.123 of the length of the animal, their breadth 0.087; in our specimen, on the other hand, the length was 0.183, the breadth 0.15; accordingly, when compared with those of the former specimen, its length was almost as 3 to 2, its breadth nearly double; the circumference, therefore, almost three times as large. In the specimen described by Bell they were comparatively smaller, namely, their length 0.149, their breadth 0.125 of the total length of the animal.

Generally speaking these facts seem, no doubt, to speak in favour of Nilsson's supposition, as if the superior power and strength always prevalent in the males of all species of fierce beasts of prey, when compared with the females, were also here showing itself, and more especially so in the fins in general, and the back fin in particular; and that the killers are, indeed, most carnivorous animals will be evident from the following statements.

I had been told that the Cetacean I was going to see had most probably been choked by trying to swallow a seal, half of which was still fixed in its mouth; and, sure enough, a pair of swimming-paws of a seal were seen hanging out. It proved, however, when examined more attentively, to be a torn and dried seal-skin, the greater part of which was sticking fast within its jaws. From the portion hanging out it could be ascertained that it had been turned inside out, the paws, however, excepted, which, accordingly, were still placed on the hairy surface of the skin now turned inwards, but hanging out thence through a great rent. At length, the whole piece coming out, it appeared that the crushed head, too, had been excepted from the turning inside out, being placed, therefore, within the flayed skin.

While we were thus examining the external appearance of the animal, the measurement had also been commenced, which gave the following results:

Herudi fjoren ved voer Fergested: Hvor den blef Shut af Velbürdig Christen Seefeldt til Steenalt först med en Musquette Kuule Gjennem Hovedet oc dereffter med 9 store, rende Kuuler udi Livet ved nagelen, inden Den kunde, doe oc, Bergis—Dens Lengde Vaar $9\frac{1}{2}$ Sellandtz alne—oc dens brede um Kring, $6\frac{1}{2}$ Sellandtz alne." (In the year 1679, December 27th, this fish came into the firth near our ferry-place, where it was shot by the Honourable Christen Seefeldt, of Steenalt, first by a musket-bullet through the head, and afterwards with nine large slugs into the body, at the navel, before it could die and be secured; its length was nine and a half Sealandish ells, and its breadth around the body six and a half Sealandish ells.)

The drawing contains, as might be expected, several palpable errors from a zoological point of view; the posture of the animal is quite distorted, but fortunately so that both the female genitals and the low back-fin are visible; and, at the same time, its colouring shows distinctly enough that it is a killer; the peculiar distribution of the black and the white colour on the sides of the body and the large white spot behind the eye, which characterize these large dolphins, being represented.

¹ L. c., p. 481.

ESCHRICHT ON THE

	Feet.	Inches
Total length	21	4
Circumference of the body (at the back fin)	13	0
„ „ „ head (at the blow-holes)	9	8
Length of the opening of the mouth	1	7
From the corner of the mouth to the eye	0	6
Length of the fissure between the eyelids	0	1½
From the eye to the ear.	0	11
(The orifice of the ear four inches lower than the eye.)		
From the point of the snout to the pectoral fin	3	7
Base of the pectoral fin	1	4
Breadth „ „	3	2½
Length „ „	3	11
From the point of the snout to the blow-hole	2	7
„ „ „ dorsal fin	7	10
Base of the dorsal fin	2	10
Height „ „	4	0
From the point of the snout to the umbilicus	8	9
„ „ „ pudendum	11	6
Length of the fissure of the pudendum	1	5
From the pudendum to the vent	1	3
Length of the vent	0	2
From the vent to the notch of the tail	7	1
Height of the root of the tail	1	11
Length of the root of the caudal lobes	2	0
Breadth of the caudal fin	6	3
Length of the penis	3	2
Circumference of the same at the root	2	2½

The measuring having been finished, all the fins were cut off, whereupon the flensing was commenced, along with the laborious task of removing the greater masses of flesh, and cleaning the skeleton so far, that it might be transported by the steamer to Copenhagen. The blubber was six inches thick on the dorsal, only two inches on the ventral surface. No parasitic animal was discovered upon or within it. Assisted by six or eight men, I spent the greater portion of the day in flensing and cutting away the flesh, two men continually bringing cut-off pieces of blubber to the casks destined for them, two more dragging the great pieces of flesh to the beach by means of hooks and ropes, in order to throw them into the sea. In the mean time I was myself busy in examining the parts cut off, especially the head and the reproductive organs. The whole labour with these parts, so strongly affected by putrefaction, was not only in itself very fatiguing, but, besides, by the terrible stench, far surpassing anything I ever experienced of that kind, it was rendered so loathsome, that indeed a very determined earnestness of purpose was required to make us go through it. Nevertheless it lasted almost incessantly the whole day till after sunset, when we at length proceeded to open the abdomen.

Scarcely had this been done when our whole attention was attracted by the surprising size of the stomach (the foremost one lined with the epidermis of the œsophagus) thus exposed, in which, before it was opened, we thought that four large and entire seals might conveniently find

a place, as in the specimen examined by Professor Nilsson.¹ It was immediately opened. I am sorry to say that I forgot to measure it before; but as far as I can judge, estimating it by the eye, it had a length of about six feet and a breadth of four and a half feet; and prepared as I was to find something extraordinary in it, yet it was a most surprising sight to discover immediately five or six seals, some large, others small, all flayed, and, besides, entwined with one another to that degree, that it was necessary to pull them out one by one, in order to count them accurately. But during this process the general surprise was continually more and more increased—for rather a large number of eye-witnesses were present—as it for some time seemed as if the pulling out of every single body would disclose several new ones more deeply concealed; a couple of them seemed to be fresh flayed, most of them half digested, or already fallen to pieces, some only remaining in the shape of loose parts of the skeleton. The interest of the labourers who assisted us seemed to be particularly awakened by an extraordinary number of disk-like bodies, resembling coins, but proving soon to be the epiphyses of the vertebral bodies of young common porpoises; for gradually porpoises were also disclosed, though but one almost entire, most of them half decomposed, and only to be recognised by the fragments of the skeletons. Thus it became necessary, in order to ascertain the number of the animals swallowed, to arrange them in rows; but as far as the porpoises were concerned I satisfied myself by only collecting the heads. The result was, that in this stomach were found, in a more or less digested state, thirteen common porpoises and thirteen seals, to which, however, a fourteenth, a very small one, must be added, which, in its entire state, though much decomposed by digestion, had slipped into the second stomach, perhaps not till after death. If to this we were still to add the seal-skin which, as we have stated already, we found sticking between the teeth of the animal, then the number of the seals swallowed would be fifteen. But, everything being well considered, it is clear that this empty skin in the mouth of the animal must have belonged to one of the flayed bodies found in the stomach, and, therefore, ought not to be counted separately; for though a crushed cranium was still found in this skin, yet I dare not deny but that this head may have been wanting in one of the seals found half digested in the stomach, for these were not counted by the craniums like the porpoises. In the killer examined by Professor Nilsson the four seals were still found provided with the hairy skins; but all “had been cut across in the same manner transversely from the back of the head to the lowest part of the chest,” whence my distinguished friend makes the conclusion “that the seals were seized, not from behind, but from the side, having tried to move in curves (*Krimbugter*) in order to escape.”² The bodies of all the seals were skinned in my specimen, as I have stated already; and in order to judge of the manner in which they were seized I have only the skin sticking in the gape to guide me. This had also been cut across in the middle; but I confess that I believed I could explain the cut, as having been made by the animals having been caught by the teeth of the killer just across the middle of the body, therefore from behind. The fact that John Hunter found a single, cut-off porpoise-tail in the stomach of the individual examined by him³ seems to prove, at all events, that the porpoises, at least, are caught from behind. But it seems to me more important to point out that it is proved by the flayed condition of the seal-bodies found in the stomach of the killer, that these animals, after having been swallowed, are

¹ ‘Förhandlingar vid de Skandinaviske Naturforskarnes sjette Möte,’ Stockholm, 1855, p. 55.

² L. c., p. 58.

³ ‘Philosophical Transactions,’ vol. lxxvii (for the year 1787), p. 411.

stripped of their skins during digestion; it is also not less distinctly demonstrated that the skins are disgorged,¹ even pretty soon after the swallowing, by the circumstance that only slight traces of flayed skins were to be found in the stomach itself, whereas a whole skin, still partly covered with hairs, was hanging out between the teeth of the animal. That the greater part, by far, of the bones are digested in the stomach of the killer, as is the case in most other beasts of prey, is fully confirmed by the great quantity of cleaned porpoise-bones found in it, in a more or less decomposed state; the skin remaining in the throat served also pretty well, in more than one respect, to show when and how the animals swallowed, are flayed in the stomach. By the great number of hairs still fixed in their places it might be inferred that the flaying takes place shortly after the skin has become loose during dissolution, and by the manner in which it was turned inside out, it will be perceived that the flayed bodies are pushed out of the skin by the well-known, very powerful motions of the walls of the stomach during digestion, through the rent produced at the capture of the animal, by which means, however, the head and the paws may sometimes be torn off, and remain in it. No fish-bones were found in this instance, a case, we suppose, of rare occurrence, for not only did Professor Nilsson find very many salmon-bones in his specimen, but Professor Mulder² discovered also a number of bones of *Raia clavata* in a specimen stranded on the coast of Holland, April 15th, 1832. That, generally speaking, the killers, to a very great extent, live on the larger kind of fish has for a long time been generally acknowledged.

While the examination of the contents of the stomach was thus going on, and as it was already beginning to get dark, the whole length of the intestines had also been cut out; they were now stretched out on the beach, and found to measure 177 feet 8 inches, thus having more than eight times the length of the animal, which is even longer than what is generally found in Cetaceans.

Mr. Benzon's men watched the whole night the parts laid aside and the skeleton, now tolerably well cleaned, though still requiring a couple of days' work from my assistant, whom I had brought with me, before we could hope that it would be received on board the Copenhagen steamer.

It had been a most fatiguing day to all of us; and having spent so many hours in the immediate neighbourhood of the putrid carcass of the Cetacean, it cannot be denied but that both I and my assistant felt very ill; we soon, however, got the better of this indisposition through the rare hospitality which we were allowed to enjoy for the two following days on the estate of Mr. Benzon.

It has, from times of old, been the common assertion of sailors and inhabitants of shores,

¹ That the empty skins are disgorged by the killers seems to have been observed, once at least, in ancient times, though the fact was not correctly interpreted. For when we are told by Pliny (lib. ix, caps. 5 and 6) that the *Orca*, which in his time was shut up in the harbour of Ostia, where it was attacked and killed by the Emperor Claudius, had been tempted into that part of the sea by the wrecking of a ship laden with hides, on which it had been feeding for several days, we can hardly explain this singular opinion of his in any better way than by the conjecture that the animal had been seen to vomit empty skins during its incarceration in the harbour. On this supposition all doubt of its having really been an orca, and not a cachalot, would be removed, as the latter is not known to feed on warm-blooded animals, swallowing them skins and all.

² 'Leeuwarder Courant,' 1832, Nos. 31, 32, 43, 45, and 47.

in all quarters of the world, that the killers, which in their outward appearance may always be easily distinguished from all other toothed-whales by the extremely powerful structure of their body, the large teeth in both jaws, and the high dorsal fin, not only feed on large fishes, but also on warm-blooded animals, especially seals and porpoises, nay, that they even flock together in order to attack the largest whales, tearing off their blubber and flesh with their teeth until they die from loss of blood.

Pliny seems to have received his information from the shores of the Atlantic, when he first tells us (liber ix, cap. 15) that the whales (*Balenæ*) are not seen before the arrival of winter (ante brumam), "in gaditano oceano," where they seek shelter in bays, in which they prefer to bring forth their young ones, adding then that the Orcas know of these wanderings, being a species of animal inimical to the whales, and only to be compared with an immense quantity of flesh, horrible on account of its teeth. The whales, he tells us, try to save themselves by flight, but the Orcas oppose them, killing them in the narrow seas, or chasing them up on the shore. The author of the 'Kongespeil' (Mirror of Royalty) gives us a picture of their characters, perfectly faithful to nature, in his description of the *Vognhvaler* :—"In their cruelty against other Cetaceans," he says, "they are like dogs against other animals, herding together and attacking great whales; and where there is only one great whale they bite and weary it out until it gets its death thereof."

A strictly scientific account of these rapacious Cetaceans did not appear until Sibbald's excellent work, 'Phalainologia Nova,' was published in 1692. The year before, seven or eight of these animals had been stranded in the Firth of Forth; they seem to have been well-known visitors to the Scotch fishermen, and the accounts which Sibbald received from them about the rapacious nature of these Cetaceans agreed in the main with those of the ancient authors. But on this occasion Sibbald also received accurate descriptions of their exterior from several eye-witnesses. According to one of these descriptions one of two individuals had a length of eighteen feet, the other of twenty-two feet, and both of them had, in either jaw, thirty teeth of different form and size. A figure of one of the teeth is found in Sibbald's work, at the top of the second plate. It is the very hindmost and smallest in one of the dental rows, apparently that of the upper jaw. The colour of the body was said to be like that of a piebald horse (*equi maculis variegati*). In another of these descriptions sent to Sibbald, the animal is expressly stated to have been a male twenty-four feet long, the dorsal fin to have been more than three feet high, the belly snowy white, the rest of the body jet-black, with a large white spot over either shoulder (*humerus*). Both these descriptions must certainly be called very good, considering that they were given not by Sibbald, but by laymen at the end of the seventeenth century. Sibbald expressed himself still more distinctly in another place about the colour of the Orcas, using the following words :—"The back is black, the belly white, the sides in the middle between these two colours sometimes parti-coloured (*versicolor*), and divided extremely prettily into white and black spots." With regard to their general size he says that it is between the lengths of fifteen and twenty-five feet, and as to the number of the teeth he adds to the statement given above of thirty teeth in either jaw, that some have only twenty in either.

After such a clear description of the manner of living, size, number of teeth, and highly characteristic colour of the Orcas, it would hardly be supposed that they could in any case be mistaken for any other Cetaceans. Such is, however, the case, and, strange enough, it will

scarcely be difficult to show that it happened because people were in general too unconditionally guided by the statements found in Sibbald's work.

For under the name *Balæna* Sibbald comprehended all large Cetaceans, and in his 'Phalainologia' he only treats of those which he knew were found near the coasts of Scotland, namely, 1st, the killers; 2ndly, a shoal of Cetaceans stranded at the Orkneys, 102 in all, the largest twenty-four feet long, the smallest only twelve feet, with teeth in the lower jaw, but only with holes in the upper jaw, into which the latter fit, having on the back a protuberance (*asperitas*), which could not, properly speaking, be called a fin—evidently a herd of small cachalots, one of the schools, so called; 3rdly, a flock of toothed-whales, twenty-five in all, stranded in the Firth of Forth, most of them twelve feet long, some only nine or ten—we suppose a herd of ca'ing-whales (*Globiocephalus*). All these Cetaceans are treated of in the first section of 'Phalainologia.'

In the second section of the same work the *Balæna majores in inferiore maxilla tantum dentata* are described. These are also called *macrocephala*, as their head is said to make at least one fourth, often one third, or more, of the whole animal. He adds that this great head always contains spermaceti, having besides a peculiar form, especially by being provided with a large protuberant part on the upper surface of the cranium, and an upper jaw much broader and more prominent than the lower one. Science, in its present state of development, would tell us clearly enough that the animals in question can only have been cachalots; but that form was only known to Sibbald from the descriptions and figures of others, and these were all taken from individuals stranded on the European shores, and having their bellies turned upwards. The small and indistinctly defined dorsal fin (the hump) of the cachalots had in no case been observed, and Sibbald was of opinion that the cachalots, properly so called, had not any dorsal fin. He treats of them, in the first chapter of the second section, by the name of *Balæna macrocephala, quæ binas tantum pinnas laterales habet*. Now, it happened twice in his time that a cachalot was stranded on the coast of Scotland; one in the Firth of Forth, in February, 1689, and the other in the Orkneys, 1687, and in both cases it was stated by eye-witnesses that the animals had a dorsal fin. Accordingly he did not suppose them to be cachalots, properly speaking. Some of the teeth of both individuals were further sent to him, and these were very different from each other; that is to say, as we see by the figures in the second plate of the 'Phalainologia,' just as different as young and still unworn teeth of cachalots generally are from old and worn ones. But these characters of differences of age were supposed by Sibbald to be characters of species; and thus he was induced to form two new species in opposition to the cachalots properly so called, and characterised as wanting the dorsal fin, namely, 1st, a *Balæna macrocephala, quæ tertiam in dorso pinnam sive spinam habet et dentes in maxilla inferiore arcuatos falciformes*; and, 2ndly, a *Balæna macrocephala tripinnis, quæ in mandibula inferiore dentes habet minus inflexos et in planum desinentes*. Of the former of these, the younger individual from the Firth of Forth, it was told that it had been impossible to measure it, as in its last agony it had forced part of its body down into the sand. Nevertheless they brought him a figure of it, which was thought by Sibbald, to be, on the whole, most similar to the figure of a cachalot in the forty-second plate of Johnstone's 'Historia Naturalis,' and, as to the head, to the figure in the plate of Cetaceans in Willoughby's 'Historia Piscium,' most probably because the teeth are there represented as being pointed. To judge, however, by the print given by Sibbald, as copied from the same picture, in the first plate of his 'Phalainologia,' it must be confessed, that

its similarity with these two very good figures of cachalots is very small indeed. It is, singular enough, the very low dorsal fin that especially reminds one of a cachalot, and the best evidence of its having really been one is the tooth examined and figured by Sibbald himself.

The same remarks may be made with regard to the whale stranded in the Orkneys, for Sibbald had not seen anything of this either, but some few teeth four or five inches long, and the one of which he has given a figure is evidently an old and much worn cachalot tooth. Those, who brought him the news of the stranding, and gave him the teeth, told him, that it was a very large (*prægrandis*) female whale, having the blow-hole on the forehead; its head was eight or nine feet high, containing great quantities of spermaceti, and it had only teeth in the lower jaw. One told him, that there was a fin on its back, which he compared with a mizen-mast, and the same man stated that a male of the same kind had also been observed, which was thought to have had a length of twenty-four fathoms (*orgyia*). Now this last statement is most certainly exaggerated, but then it was only founded on an estimate of the size of an animal moving freely about; all boats approaching it had been crushed by it. But as to the stranded specimen, his statements will not, on the whole, be found to contradict the evidence of the teeth which prove it to have been a large old cachalot. It is highly creditable to this man's power of observation, that he should have laid particular stress on the considerable height of the head, and the place of the blow-hole on the forehead; for up to that time the highly characteristic square form of the head of the cachalot, and the peculiar place of the blow-hole on the forehead, seem quite to have escaped the attention of learned naturalists.

The comparison of the low dorsal fin with a mizen-mast has seemed to many, directly to contradict the idea that the animal was a cachalot; but most probably, however, only because a mizen-mast was considered (for instance, by Artedi), to be an extremely high mast. But in seamen's language it is not the highest mast that is called by that name, but the mast standing nearest to the helm; whether it be great or small; and the small dorsal fin of the cachalots (denominated by the South Sea whalers, the "hump"), is in reality, removed very far backwards, that is, just above the vent, while a more insignificant protuberance in the mesial line of the back (which they call the "bunch"), is to be found more forwards, just above the angle of the mouth. Only one of the statements, we believe, must be called perfectly wrong, viz., that the animal was a female; for the tooth of which he has given a figure, not only proves that the animal was a cachalot, but also that it was a very large specimen, and we know that female cachalots never grow to more than one third of the size of the males. But in the Cetaceans, no error is more frequently committed by inexperienced persons, than that of mistaking a male, whose penis has not been drawn out of its sheath, for a female.

However that may be, so much is certain, that when Sibbald considered this Cetacean which had only teeth in the lower jaw, and whose very great head contained a large quantity of spermaceti, to be a species different from the common cachalots, as well as from the one stranded in the Firth of Forth, he did so because there was a dorsal fin present, and by no means on account of its supposed great height.

On the foundation of the Linnean system, Artedi, to whom, we know, the arrangement of Fishes and Cetaceans had been intrusted, adopted blindly, all kinds of *Balæna* pointed out by Sibbald as different species. Those with teeth only in the lower jaw he divided into two

genera: *Catodon* and *Physeter*, the former wanting, the latter having, a dorsal fin, according to the statement of Sibbald; but in the tenth edition of his 'Systema Naturæ,' these two genera were combined by Linnaeus into one, denoted by the common name of *Physeter*. Thus, the following species were comprehended in this genus:

1. *Ph. catodon*, founded on the account received by Sibbald, of a shoal of 102 small cachalots stranded in the Orkneys. According to this account its character was the following: *Ph. dorso impenni, fistula in rostro*.

2. *Ph. macrocephalus*. By this name the common cachalot was understood, such as it was imagined to be according to the then existing descriptions and figures, especially the one by Clusius, who had stated expressly,¹ that its blow-hole was found on the head towards the back, and had not mentioned any dorsal fin. Accordingly its character was to the following effect: *Ph. dorso impenni, fistula in cervice*.

3. *Ph. microps*. Its character was: *Ph. dorso spina longa, maxilla superiore longiore*, in which it is not easy to recognise Sibbald's "*Balæna macrocephala quæ tertiam in dorso pinnam sive spinam habet, et dentes in maxilla inferiore arcuatos falciformes,*" or, in other words, his young cachalot from the Firth of Forth, though it appears from the common name, that the species was founded on this individual.

4. *Ph. tursio*. *Dorso pinna altissima, apicè dentium plano*: Sibbald's old cachalot with worn teeth, whose dorsal fin had been compared with the mast standing nearest to the helm.

This very unfortunate division of the species of cachalots, specimens of which still appeared rather frequently in the eighteenth century, was singularly bewildering in the Linnean period. Whenever a rather large Cetacean, about whose teeth nothing was known, but which was provided with a high or very high dorsal fin, was spoken of, it was not immediately thought proper to refer to the genus *Orca*, among the characters of which the superior height of the dorsal fin was not even mentioned, being only characterised in the following way: "*Delphinus rostro sursum repando dentibus latis serratis*" (a special character derived from Ray, which might rather be applied to a shark than to an *Orca*). In any such case it was, on the contrary, necessary, first to think of the two Linnean species of cachalot, *Physeter microps* and *Physeter tursio*, the more so as the efforts of the zoologist in this period were almost exclusively directed to refer the animals observed to the species set down in Linnaeus's 'Systema Naturæ.'

We have already seen in the above-mentioned quotation from the 'Kongespeil,' that the killers from ancient times have been known in the north, in reference to their rapacious nature, by the name of "Vognhvaler." By the same appellation (*i. e.* Vagn) they were known to the Norwegian fishermen through all the succeeding centuries. Nay, it was quite common to distinguish the "Vagn" with lower dorsal fins, from the "Vagn" with higher dorsal fins, by the names of "Lille-Vagn" (little killers), and "Stour-Vagn" (great killers), or "Staurhynning;" but hardly any one would be able to recognise them by the above-quoted Linnean character of *D. orca*. When in the year 1762, a drawing and description together with some teeth of a "Stour-Vagn" came into the possession of the learned Bishop Gunnerus, he was perfectly right in stating that no systematic author had treated properly of

¹ 'Exoticorum,' lib. vi, cap. 17.

this animal, and in putting it into the system as a new species, with the character: *Delphinus orca, dorsi pinna altissima, dentibus subconicis, parum incurvis*.¹

This new species of Orca (*pinna dorsi altissima*), is introduced into the system by O. F. Müller in his work, 'Prodomus Zoologiæ Danicæ' (1776), and placed by the side of the Linnean Orca, and at the same time the Linnean *Physeter tursio*, which had previously been characterised by a very high dorsal fin, was omitted by this author, as if he supposed that Sibbald's specimen, on which this *Physeter pinna dorsi altissima* had been founded, was an Orca with a high dorsal fin. But singularly enough (following Ström's example), he also referred the Norwegian "Staurhynning" (synonymous with the "Stour-Vang,"), to the Linnean *Physeter microps*, as if he supposed that "Staurhynnings" with toothless upper jaws also existed. In Greenland O. Fabricius became acquainted both with high-finned and low-finned killers, the former by the name of Ardlurk-soak, the latter by the name of Ardluk. In the former, he recognised the *D. orca pinna dorsi altissima, dentibus subconicis, parum incurvis*, described by Gunnerus; but in endeavouring to keep up all the Linnean species, he transferred this character to the *D. orca* of Linnæus, which was thus made to comprehend all killers with high dorsal fins. But then he did not find any special name in the Linnean genus *Delphinus* for the killers with low dorsal fins, but after having quite arbitrarily transferred the Linnean specific name *Ph. catodon* (the small cachalots from the Orkneys: *dorso impenni, fistula in rostro*), to the Greenland Pernak, with the character, *dorso pinnato, apice dentum plano*, he still found the specific name *Ph. microps* (*Ph. dorso spina longa, maxilla superiore longiore*), which he thought might be applied to the killers with low dorsal fins. O. F. Müller had already, as we have just stated, partly referred the Staurhynning to this species; so also did Fabricius, but he further added the "Lille-Vagn" of the Norwegians, which was then quite naturally followed by the Ardluk. It now followed that the low-finned killers were supposed to be toothless in the upper jaw. The Greenlanders, indeed, told Fabricius, that the Ardluk had teeth in the upper jaw, and he had himself never had an opportunity of examining any part of them but the lower jaw. He was also aware, even better than any other naturalist, that these Ardluk were fierce beasts of prey, in the same sense of the word as the Ardlurksoak; he states himself that the former and the latter live in common, and nobody has described better than he the manner in which the Ardluk hunt the seals. But at that time it was a very common supposition that the cachalots were even fiercer animals than the killers. Fabricius moreover had no certain proof that these Ardluk might not after all be toothless in the upper jaw, and by supposing them to be so, he contrived to have all these different toothed-whales arranged within the Linnean system, which at that time people were inclined to consider as infallible. Thus the low-finned killers were referred to the cachalots, among which they received the name of *Ph. microps*.

The consequence of this great error was that the whole excellent description which Fabricius had given of the manner in which the seals are hunted by the killers, was now applied to a species of cachalot. Thus, the already very common notion about the cachalots, that they feed on warm-blooded animals—though we now know, that they live almost exclusively on cephalopods, as is proved even by the position of their teeth, which are only used by the males as weapons of attack when in a state of irritation—was still further confirmed, nay all those

¹ 'Det Kongl. Norske Videnskabers Selskabs Skrifter,' 4de Deel, Kbhvn., 1768, p. 110.

well-known statements of sailors and inhabitants of coasts about ravenous whales were, without further comment, also ascribed to this supposed *Physeter microps*. This was especially done by Lacépède, who in the beginning of this century was looked upon as the arbitrator of Cetology. It must, however, be confessed, that the error had scarcely any influence in determining the species of any rapacious Cetacean examined. For no such animal was ever seen to want teeth in the upper jaw. It was always a *Delphinus* with large teeth in both jaws, and a more or less high dorsal fin. Nay, perhaps, the high-finned individuals were also everywhere distinguished from those with low dorsal fins; thus, especially by Lacépède himself, only that he called the high-finned ones (*D. orca*, Fabricii), by a new name *Delphinus gladiator*, and the low-finned ones (*Physeter microps*, Fabricii), he named *Delphinus orca*.

At length Cuvier undertook the great task of clearing the system from the numerous species of Cetaceans resting on a perfectly uncertain foundation. Of the four Linnean species of cachalots only one was retained, and also only one species of Orca. Among the more modern cetologists, Schlegel is absolutely guided by Cuvier, and J. E. Gray, though he does not follow Cuvier as far as the cachalots are concerned, retaining on the contrary Sibbald's two large cachalots as forming each a species, yet agrees with Cuvier with respect to the Orcas, as far as he does not believe in any difference of species between the high-finned and low-finned specimens. On the other hand, he separates from the others, and no doubt with perfect right, the killers from beyond the equator, and some fossil species. The same distinguished English cetologist has further, with no less justice, set the killers aside as a genus by themselves, and more especially, he has separated them not only from the ca'ing-whales, but also from certain more closely allied species, of which he has formed the genus *Grampus*. It seems to me, indeed, that the killers ought to be separated not only as a peculiar genus, but as a peculiar group or family among the toothed-whales, because, in opposition to all the other Cetaceans, they subsist, though not exclusively, yet to a very great extent, on warm-blooded animals.

It has already been related, that they have always been considered as very fierce carnivorous animals among the inhabitants of coasts and seafaring people of all parts of the world. Of late, the ancient accounts, a tolerably complete compilation of which is to be found in Bishop Gunnerus's essay just quoted, have been considered very much exaggerated, if not almost fabulous. In mentioning the enemies of the Greenland whale, and among them the thrasher of the English sailors, a Cetacean which attacks large animals of its own order, the celebrated whaler Captain Scoresby adds in a parenthesis:¹ "If such an animal there be," with the remark, that he at least has never witnessed a struggle between such an animal and a whale. Mr. Frederick Debell Bennet, an English surgeon of great experience in the more recent South Sea cachalot fishery, states,² that small shoals of killers, as they are also called by seamen, an appellation perfectly synonymous with the name thrasher just mentioned, have, indeed, occasionally been observed by him, but that he has never been able to witness the least trace of anything which would confirm the prevalent opinion about their blood-thirsty way of living; he adds, indeed, that the same traditions about their fierce temper are preserved by the southern as by the northern whalers, but that they are as little founded on their own observa-

¹ 'Account of the Arctic Regions,' vol. i, (1820) p. 474.

² 'Narrative of a Whaling Voyage round the Globe,' vol. ii, (London, 1840) p. 239.

tions. In a note he says, that the strongest proof that a cannibal disposition exists at all in this order of Cetaceans, rests upon the fact, that the tail of a common porpoise was found by John Hunter in the stomach of a killer examined by him, but he adds, that this circumstance when properly considered will appear to be more mysterious than decisive. Now this respected author would hardly have thought it proper to express such strong doubts, if he had known the description of the seal-hunting of the killers by Otto Fabricius, an author perfectly trustworthy in his statement of facts: how the seals take flight, as soon as they observe a shoal of Ardluk, and when overtaken by them have recourse to the shore, sometimes to the ice; but how that then they are disappointed, the Ardluks waiting below to attack them again when they descend, as they are sometimes forced to do, the killers with united force upsetting the floes, even though of considerable size. Only one thing could still be doubted after such a description, how far the killers were able to swallow the large seals whole, and this doubt was completely removed by Professor Nilsson's observation. By the account given above, it has also been proved that they do not spare mammalia of their own, more than those of other orders. It is true, that the three specimens, in whose stomachs warm-blooded animals have hitherto been found, namely, Hunter's, Nilsson's, and Benzon's, were all males with high dorsal fins, and that the only low-finned killer, as far as I know, the contents of whose stomach has hitherto been examined, viz., Mulder's specimen, was only found to have swallowed a great thornback; but even if the low-finned ones should really form a species by themselves (a question we shall presently have to consider more minutely), yet their fierceness can hardly be thought to be much inferior than that of the high-finned ones, as Fabricius's description of the seal-hunting of the killers is found in his description of the Ardluk, and not in that of the Ardlurksoak.

It now only remains to ascertain, whether the killers also really attack and tear great Cetaceans, to satisfy their hunger on their blubber and flesh. On this point, doubts have been still more prevalent in this century. And yet the evidence of eye-witnesses has not been wanting in modern literature to prove that the killers make such attacks. Thus, especially the celebrated traveller Tilesius, has given the following description of the killers in the sea near Kamtschatka: "They swim," says he,¹ "in ranks five abreast, the heads and tails turned downwards, elevating all at the same time their backs with the sabre-formed fins above the water. When they have wounded a whale, they never lose sight of it during the pursuit, but follow it everywhere attacking it from all sides like bull dogs, and harassing it until it dies, or runs ashore." This statement will be found to agree perfectly well with two accounts sent to me in 1840, from Greenland, one from Mr. Motzfeldt, a merchant of Julianehaab, who died soon after, and another from my particular friend, Captain Holböll,² now also deceased. The former gives the following account: "The killer attacks also the Greenland whale. Such an instance was observed at Holsteinsborg, from the boats engaged in whale-fishing. A shoal of killers pursuing a large Greenland whale northwards passed close by the boats. Some of them had caught hold of its tail and fins with their teeth, while others jumped over it at the blow holes, seeking to hinder it from breathing, and others again thumped it on the sides. The boats followed to see how the contest would end. The whale directed its course

¹ 'Isis,' 1835, pp. 725-26.

² See Eschricht 'Untersuchungen über die nordischen Wallthiere,' Leipzig, 1849, pp. 194 and 198

into a bay near Rivertshavn, where, breaking loose, it gave one of its antagonists such a blow directly on its head with the edge of its tail, that he sank to the bottom very slowly, most probably mortally wounded. Then the whale went into the inner part of the bay, where its head struck on the shore, and in this position it became an easy prey to the Greenlanders."

The same gentleman, so very well acquainted with everything relating to Greenland, asserts, however, at the same time, that the killers, that are so much feared by the seals, are themselves afraid of the walrus. His account of a case that happened at Norsuak, in the north of Greenland, is to the following effect: "Some Greenlanders were just going to attack a walrus at rest, when a shoal of killers came to attack it from the opposite side, but the walrus went to meet them, and the whole shoal, it was told, dispersed immediately in every direction. The Greenlanders saw at some distance the largest of the killers emerging again with the walrus, by whose teeth it had been transfixed." (Furthermore, Motzfeldt does not make any distinction between the high-finned and low-finned killers as different species: "It is surprising," he says, "that Fabricius should have made two different species of Ardluk and Ardlurksoak, as it is only the size which is expressed by the difference of these two names. In this manner, the number of the species might be increased at will by similar inflections of the words, as Ardlurujuksoak, Ardlukulorsuak," &c.)

Captain Holböll's own account of the manner of living of the killers, is to the following effect: "In the year 1827, I was myself an eye-witness of a great slaughter performed by these rapacious animals. A shoal of Belugas had been pursued by these blood-thirsty animals into a bay in the neighbourhood of Godhavn, and were there literally torn to pieces by them. Many more of the Belugas were killed than eaten, so that the Greenlanders besides their own booty, got a good share of that of the killers. In the year 1830, a large krepokak (*Megaptera longimana*) was overpowered by an Orca, in the neighbourhood of Narparsok, according to the statements of the Greenlanders, and torn to pieces after it was dead. Almost fifteen barrels of the blubber floating about at the place where the struggle had taken place, fell to the share of the Greenlanders. It is principally the blubber that is the most coveted food of the killers, not the tongue as I have seen stated in several places. In this krepokak especially, the tongue was found untouched, and was afterwards flensed by the Greenlanders."

As the result of these researches and new statements, we believe that we are now able to declare—

1. That all statements about some species of cachalots subsisting on warm-blooded animals (more especially a *Physeter microps*) are only founded on misconceptions.

2. The assertions made from times of old, about the fierce nature of the Orcas are, on the other hand, perfectly true, though, indeed, they partly subsist on large fishes. They are able to swallow whole porpoises, as well as seals, even very large individuals, four at least immediately after one another (according to Nilsson's observation), and in the course of a few days as many as twenty-seven individuals, nor do they fear to attack and tear to pieces even the very largest whalebone-whales, in order to satisfy their hunger on their blubber.

II.¹

AFTER this more recent information, the doubts expressed by Scoresby and Bennet, as to whether the Orcas really persecute marine mammalia or not, must be considered as completely removed. The killers must be called carnivorous animals, in the strictest sense of the word, and as such they stand so isolated in the order of Cetaceans that they deserve, if only for that very reason, to form not only a genus by themselves, but a peculiar group or family among the toothed-whales.

Nor will it be difficult to point out the characters of this peculiar group in the form of their bodies, nay even to fix them so distinctly, that it can hardly be doubted in any case, whether a Cetacean, be it swimming in the sea, or only presenting single portions of its body for examination, does belong to this group or not.

When swimming about in the sea, every Orca may always easily be recognised by its high dorsal fin, for even in the low-finned ones this is still one tenth of the entire length of the animal, and it is hardly ever found so high in any other Cetacean. The killers never move about in great shoals like those of the ca'ing-whales (*Globiocephalus*) or the species of *Grampus*, but only twelve or sixteen individuals together, and these are said to be regularly arranged in several rows during their wanderings. As soon as the whole body of a killer appears, it may be known at the first glance, by its parti-coloured appearance, which seems to be common to all the species, for not only does the white or cream-coloured tint of the belly form a striking contrast to the jet black colour of the back, but the sides are also marked with large symmetrical figures in these two colours.

These characters, however well they may serve as leading hints in identifying an individual, may, nevertheless, be considered as not very essential; the same may be said about the considerable size, though in this respect, the killers surpass all other Cetaceans with teeth in both jaws, but not about the extremely powerful structure of their bodies, by which they are distinguished from all others, both as to the whole frame of the body, and as to every one of its separate parts. Although very fat animals, yet we do not find in them that peculiar adipose swelling on the head, by which the teutophagous Cetaceans (the cachalots, the bottleheads, and the ca'ing-whales) are characterised, and though large and powerfully made, they have nothing of the clumsiness of these. As to the fins, it is not only the high dorsal fin that distinguishes them from all other toothed-whales, but also the extraordinarily large pectoral fins. In the ca'ing-whales, the latter are, indeed, considerably longer, and this seems to be the case with certain species of the genus *Grampus*, but at the same time they are always very

¹ This second and last section of Professor Eschricht's memoir was not yet published, when death suddenly terminated his scientific labours. The manuscript found among his papers, but unfortunately still unfinished, was printed in the Proceedings of the Royal Danish Society of Sciences, for 1862 (pp. 234—264) under the superintendence of Professor Steenstrup.

narrow, and seem to be but slender and feeble when compared with those of the killers. That the former, as well as the latter, must be excellent swimmers is perfectly evident. Nevertheless, the killers seem, as to the ease and variety of their movements, to be inferior especially to the dolphins properly so called, whose activity is well known to voyagers who have seen them follow the fastest sailing vessels for miles, occasionally diving under them, or swimming in a circle around them with an agility sufficiently expressed in the lightness of their comparatively meager body, the slenderness of their limbs, and the great number of their vertebræ; but on the other hand these dolphins seem to be surpassed by the killers in the power of their movements. Their pectoral fins may still be called rather long in proportion to those of most of the other toothed-whales, but their special character is, properly speaking, in their being at the same time almost as broad as long (the proportion is nearly as 5 : 6). Such is also the case with their caudal fin, that is to say, its two lobes are not remarkable for their length but for their powerful structure. Their vertebræ are only few in number; fifty-two, fifty-three, or at most fifty-four, but, like the ribs, they are, comparatively speaking, extremely large and strong.

It is, however, especially by the organs of mastication, or rather of prehension, that the greater power of the killers is expressed, that is to say, by the jaws with the muscles by which they are moved, and in the jaws themselves, by the teeth. It is in these organs of prehension, and particularly in the teeth, that we must seek for the most essential character of this group of rapacious whales in the stricter sense of the word, standing so isolated in the order of the Cetaceans.

In the Cetaceans, as well as in all other mammalia, the power by which *the jaws* are pressed together, is indicated by the circumference and depth of the temporal fossæ. In the killers these are comparatively larger and deeper than in any other Cetaceans. An Orca cranium stands, in this respect, in almost the same relation to the cranium of many other cetaceous animals, for instance, to that of a Beluga, or of a dolphin properly so called, as the cranium of a lion to that of a horse or ruminating animal. The contrast appears, perhaps, least striking, when the cranium of a ca'ing-whale is compared with that of a killer, but in the former the muscular power operates under much greater disadvantages, the teeth being confined to the foremost third of the jaws, whereas in the killers the whole length of the dental margin of the jaws is furnished with teeth, the largest of which occupy the middle part. The upper jaw of the ca'ing-whale has also almost the same breadth as that of the killer; but this breadth is principally owing to the intermaxillaries, evidently in order to give a broader substratum for the adipose swelling on the head, as in the cachalots; in the killers, on the contrary, the considerable breadth of the upper jaw is principally produced by the superior maxillaries, and the breadth of the latter is again necessitated by the very large teeth fixed into it.

The *teeth* of the killers are, in several respects, distinguished from those of all other Cetaceans. Their free portion resembles that of the cachalot's teeth, representing, as in these, a curved cone with an obtuse point and a comparatively broad base, only that it is most commonly somewhat compressed having two indistinct margins, an exterior one convex, and an interior one concave; but more minutely examined, especially when cut through transversely, it is observed to have quite a different structure, for whereas the cachalot's teeth only consist of dentine covered with cement, but without any enamel, at all events, except at the extreme tip, from which it is soon worn off, the teeth of the Orcas are on the contrary provided with

a complete covering of enamel to their free portion. Thus, it is, properly speaking, only a very small piece, soon worn off, that deserves the name of crown in the part of the cachalot's tooth standing out of the gum, and all the rest of it may be called a projecting part of the fang; but such is not the case with the teeth of the Orcas. In these a constricted part, the neck, encompassed by the gum may be perceived between the crown and the fang, at least, in the teeth of young individuals; the crown is gradually worn off as the animal gets older, but the fang, though in the full-grown tooth, at least one and a half time longer than the crown, never grows out to repair the loss, which may be supposed to take place in the cachalots, as we know from our own observation that it happens in the beluga even to an extraordinary degree.

The killers have thirteen to fourteen teeth on either side of both jaws; the foremost of those in the upper jaw is placed in the intermaxillary bone, and, as is the corresponding one in the lower jaw, very near to the mesial line; both are very small (3''' long, 1''' thick) and soon closed at the point of the root. In my two youngest skeletons (that of Mr. Thomsen, and the one from the Farøe Islands), they were still hidden in the gum; in all the old ones they had, on the contrary, fallen out. The foremost tooth in the maxillary bone is also comparatively small (scarcely 1'' long, 4'' broad towards the point of the root), and the three hindmost ones are so short that they hardly meet the opposite ones, when the mouth is closed; but the eight middle maxillary teeth are almost equally long and strong. They are somewhat more curved in the upper than in the lower jaw. Beneath the neck the root is perceptibly enlarged, so that the thickest portion of the whole tooth is the superior half of the root, and its conical form does not appear till in its inferior half towards the point of the root. In the teeth of these two younger Orca skeletons, as well as in those of one of the separate crania from the Farøe Islands, this conical portion of the root, however, has not yet been formed, and, accordingly, all these teeth have still the form of a single cone, with all the modifications mentioned above; bent as a hook towards the point, a little compressed, and with traces of a constriction in the middle most perceptible in the convex margin.

But while having this their earliest form of a single cone almost an inch and a half high, half an inch or one inch broad, the Orca teeth are not only still open teeth, but filled with the pulp to such a degree that their solid walls, though consisting of two layers of different kinds—in the crown of dentine and enamel, in the root of dentine and cement—have scarcely anywhere a thickness of more than half a line, not even at the very top of the crown, while the diameter of the hollow of the pulp is about an inch. Like teeth in general, they present, at a very early period, when removed from their natural places, a certain resemblance to small caps of paper, and are, of course, extremely brittle. Such I have found them, not only in the two younger Orca crania of the museum (that of Mr. Thomsen, and the smallest from the Farøe Islands, which is thirty-two inches long), but also in the second from the same locality that is three inches longer. It is not till in the third from the Farøe Islands whose length is forty inches, that the formation of the dentine is almost finished in all the teeth, the two or three hindmost excepted. When sawn through, a narrow elongated cavity alone remains for the pulp, whereas the remainder of the tooth consists interiorly of dentine arranged in several concentric layers.

In the teeth of the cachalots the formation of the dentine proceeds so very fast, that even when quite small they have already very thick walls, presenting only a very small cavity for the pulp at the point of the root in the shape of a very low cone. But, as we have seen, the contrary is the case with the teeth of the Orcas, characterised by a surprisingly slow ossification, a

circumstance which often produces in them a peculiar morbid condition, excited by friction. For the conical teeth in the upper and lower jaws of the killers are very regularly fitted in between each other, so that in general they are not easily exposed to any friction at the points, at least not at the beginning. But having such a considerable breadth, and being placed close to one another, the inevitable consequence is that they become worn on the lateral surfaces. Even in very young teeth, we find an elongated concave friction mark on one of the sides; in the upper jaw most commonly on the anterior and external sides of the teeth, but on the lower jaw in the posterior and internal sides. The more excavated this worn surface becomes, the deeper of course the teeth of the two jaws will be wedged in between each other. Soon, most of the teeth are worn by both of the opposite ones. The worn surfaces meet each other at the point, which is completely worn off, and the originally conical teeth, with their decidedly pointed, if not very sharp, ends, are now changed into real flat and obtuse teeth. As in all other real, that is to say, enamelled crowns of teeth, the portion once worn off is not compensated for by a growing out of the root of the tooth, and in old killers all the crowns of the teeth may be found worn down to the very gums. This was the case with the specimen of Mr. Benzon. This wearing off does not generally take place until the formation of the dentine in the crowns has been completed, or until the crowns of the teeth are perfectly ossified. But not unfrequently it happens otherwise, and then the wear penetrates both the enamel and the still thin layer of the dentine, so that the pulp is exposed and dies away, and the formation of the dentine is not only stopped in the crown, but also in the root which is never closed, and the whole tooth remains hollow from the worn surface down to the point of the root. Nevertheless, such decayed teeth do not fall out.

According to what we have stated above, the teeth of the Orcas are of a quite different kind from those of the cachalots, which have only spurious or not enamelled dental crowns, like those of the belugas, except in their earliest age. They belong, on the contrary, to the canine kind as those of the true dolphins, the common porpoises and the ca'ing-whales, as far as the teeth of all these animals have also real or enamelled crowns. By its form, and more especially by its superior thickness, an Orca tooth is, nevertheless, even more easily distinguishable from any of the teeth of the latter Cetaceans, than by its structure from those of the cachalots.

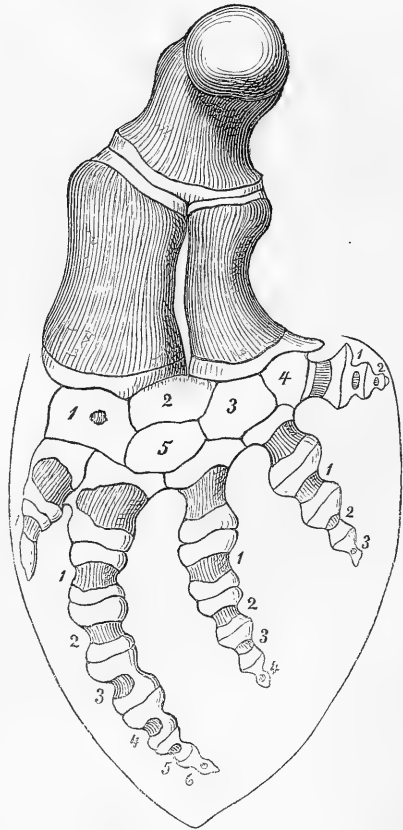
It has already been remarked in the description of the exterior of the rapacious whales, that they may as easily be distinguished from all other toothed Cetaceans by the form and size of the *pectoral fins*, as by the height and shape of the dorsal fin. The same remark may be applied to each of the bones of the pectoral fins. As to the scapula it need only be said, that it is easily distinguished from that of the ca'ing-whale and all other large toothed whales, by its strong marks and ridges for the insertion of the muscles, and especially by its having its spine with the acromion placed sufficiently far behind the anterior edge as not to hide the part of the external surface (*Fossa supraspinata*) which is placed before it, whereas this part of the scapula of other great toothed Cetaceans is not easily visible, except from the anterior edge; evidently a proof of the greater development of the muscles, and especially of the muscle (*M. supraspinatus*) attached to this hollow.

As an illustration of the peculiar structure of the arm and the *manus* of the killers, we have inserted a woodcut representing at a scale four times reduced, the left pectoral fin of the thirteen feet long individual of Mr. Thomsen (captured at Aarhus, 1855), as it appeared six days after the preparation of the skeleton. The whole length of the arm was $22\frac{1}{2}$ ". Of this length the

humerus occupied 5" 2"', the fore-arm 5", the carpus 2", the metacarpus also 2", the longest finger 6" 10"', and the skin on the point 1" 6"'. The greatest breadth is at the root of the thumb, namely, at a distance of 10" 4"', from the extreme point of the *manus*, and 12" 2"' from the most anterior point of the humerus. The greatest breadth of the humerus was at its posterior extremity, where it measured 4" 4"'. The bones of the fore-arm had a breadth of 5" 8"' at their anterior extremities (the radius 3" 2"', the ulna 2" 4"'), in the middle a breadth of 4" 10"' (the former 3", the latter 1" 8"'), and posteriorly a breadth of 7" 6"' (the radius 2", the ulna 5" 4"'). The carpus consisted of five bones, four of which (No. 1, 2, 3, 4, in the woodcut) formed an anterior row; the radius was in contact with No. 1 and 2, the ulna with 2, 3 and 4. Of the metacarpal bones, that of the thumb was contiguous with No. 1; that of the second finger with Nos. 1 and 5; that of the third with Nos. 5 and 3; that of the fourth with Nos. 3 and 4; and that of the fifth with No. 4 alone. The thumb is placed close up to the radial margin of the *manus*, has only one phalanx (besides the metacarpal bone) and reaches only to the middle of the first phalanx of the second finger. This is considerably longer than any of the others, and composed of six phalanges; besides, it is very much curved, being parallel with the radial edge. The third finger has only four phalanges, the fourth three, both pointing towards the ulnar edge of the *manus*; but the fifth finger, having only two phalanges, and placed on a level with the first row of bones of the carpus, has a perfectly transverse direction, meeting the projecting corner on the ulnar edge of the *manus*.

That the pectoral fins of the killers differ from those of all other toothed-whales by being very large, generally speaking, and besides by being almost equally long and broad (the proportion of the length to the breadth is as 6 : 5), may to a very great extent be ascribed to this transverse position of the fifth finger and the strong curvature of the second and longest; but this peculiarity is also produced by the form of the phalanges, as they are all very broad in proportion to their length, by which means any single phalanx may in general easily be distinguished from the phalanges of all other toothed-whales. Their superior breadth is, however, principally to be found in their extremities, so that the hour-glass form, so common in these bones of the Cetaceans, is here very conspicuous.

We know that in the Cetaceans all the bones of the *manus* are in general only incompletely



ossified, and that especially all the extremities of the phalanges usually remain cartilaginous throughout the animal's life, by which means the whole fin must needs preserve a high degree of flexibility, united with elasticity. In the individual whose pectoral fin forms the subject of this description, the ossification had proceeded only very little even in the centre part of the phalanges, as it will be seen in the woodcut above, and that this must partly be ascribed to the young age of the individual, may be concluded at once from the facts that of the five bones of the carpus, it is only the one marked by 1, that showed traces of an osseous nucleus, and that the epiphyses of the long bones of the arm were still entirely cartilaginous. But even in old and full-grown small killers, of which the three brachial bones were already completely ossified, for instance, in Mr. Benzon's twenty-one feet long specimen, the ossification in the five carpal bones appears only in as many osseous nuclei, irregular in their circumferences, which were so far from being placed in immediate contact with one another, that the cartilage had still a decided superiority in this part of the hand. In the phalanges, the ossification appeared to be almost as incomplete. It is true, that even in the young individual, an osseous nucleus was visible in the centre of every one of them; in most of them it occupied about half their length, in a few of them even two thirds; but especially in the most external phalanx of each finger and in both phalanges of the fifth finger, it appeared outwardly only in about the same way as in the carpal bone marked by 1, that is, as a very small osseous flake in the very centre; and in two of the metacarpal bones, it had only reached the ulnar and not the radial margin; in the third, fourth, and fifth phalanges of the second finger, it had, on the contrary, only reached the radial, and not the ulnar margin. This peculiarity we might also feel inclined to ascribe to the youth of the individual, but it is still to be found in very old individuals, especially in Mr. Benzon's, and must accordingly be considered as a character of the species; in the third, fourth, and fifth phalanges of the second finger of the latter individual's pectoral fin, the ossification, always beginning in the centres of the phalanges, had still only reached the radial margins of the bones. This state of imperfect ossification is evidently closely connected with the peculiar breadth of these bones in the killers, and may, accordingly, be reckoned among the characters derived from the pectoral fins.

On account of the imperfect ossification of the bones of the *manus* of the killers, their pectoral fins are liable to shrink very much in drying, so that they become still far shorter in proportion to their breadth than they are in their fresh state; some allowance must, therefore, always be made in measuring old skeletons. The pectoral fin of Mr. Thomsen's thirteen feet long specimen was found between the 13th of June, 1855, when it was measured and drawn, and the 4th of April, 1862, when it was measured again, to have shrunk to such an extent, that the humerus and the fore-arm, from being 10" 2", had become only 9" long; the carpus and manus had shrunk from a length of 12½" to 7½"; and the manus from a breadth of 11" to 7" 11". In order to preserve the immense pectoral fins of Mr. Benzon's specimen in their original form, they were, when prepared, fastened to an iron frame by strong nails; but they were torn by the nails while drying, and the whole arm was found to have lost a couple of inches in length, and one inch in breadth, after which they were again nailed to the frame to prevent as far as possible their further shrinking.

By their powerful and broad pectoral fins, the killers are most directly opposed to the ca'ing-whales, whose pectoral fins are remarkably long and narrow; but these two genera of Delphinoids are, on the contrary, tolerably similar to each other in the form of the *vertebræ* and that of the

head. This resemblance is especially produced by the neural spines being in general singularly small in both species, especially from the middle of the lumbar region, and by the neurapophyses themselves being comparatively high and narrow, so that the articular processes appear to have advanced upwards in an uncommon degree and to be placed close to each other. Nevertheless, any of the vertebræ of an Orca may easily be distinguished from the nearest corresponding one of a ca'ing-whale by its greater circumference, especially as far as the body is concerned, and that not only because the killers, generally speaking, are far larger animals, but also because they are, at the same time, comparatively far more powerfully built. In every single part of the vertebral column peculiar distinguishing marks may, of course, also be pointed out, at least when we have the objects themselves before us. Particularly, the well-known circumstance ought to be remembered, that all the cervical vertebræ of the ca'ing-whales are ankylosed,¹ or rather forming one single bone, as they originally have formed one single cartilage; whereas, the seventh cervical of the killers is always completely free, and the fifth and sixth, at least as far as their vertebral bodies are concerned. In dried skeletons of young individuals, it would often seem as if only the atlas and the axis made one piece, but this is only in consequence of the not yet ossified cartilaginous portions uniting the rest of the cervical vertebræ having become dry and fallen out. As regards the dorsal vertebræ, we may, perhaps, be permitted to mention still another distinguishing mark from the ca'ing-whales, though indeed only a negative one. For though in the latter genus the seventh pair of ribs, like the succeeding pairs, are only attached to the transverse process of the corresponding vertebra, yet they seem originally, like the six preceding pairs, to have been furnished with necks, only that these necks during the process of ossification, have been separated from the ribs themselves and ankylosed with the vertebra. In many cases, however, we only find slight traces of these strange osseous appendages to the seventh dorsal of the ca'ing whale, but in the killer we find no traces of them at all.

The killers have either twelve or only eleven *pairs of ribs*; sometimes (as in Mr. Thomsen's specimen) twelve on one, eleven on the other side, a difference that seems to denote that the number is not quite constant. The ribs are, on the whole, comparatively long, massive, and much curved. The six foremost pairs are attached to the sternum by means of their sternal portions which form separate bones, as is always the case in the toothed-whales. The ossification of the sternum originates in four nuclei. In Mr. Thomsen's thirteen feet long specimen, the three foremost of these nuclei are already very large, only separated from one another by cartilaginous transverse interspaces; but in the hindmost and more narrow part of the sternum the osseous nucleus has not yet appeared. The foremost pair of ribs is attached to the sternum on a level with the foremost osseous nucleus, that is, to the perceptibly broader part of the sternum called the manubrium, the second, third, and fourth on a level with the cartilaginous transverse portions between the osseous nuclei; the fifth and sixth finally, to the posterior and more narrow part, that was found entirely cartilaginous in the sternum of Mr. Thomsen's specimen.

A pair of bones that deserves our particular attention in the skeleton of the Cetaceans are *the pelvic bones*, for not only will they in general serve to determine the genus, if not the species of the animal, fully as well as any other bone in the skeleton, the head alone

¹ [This statement is scarcely to be relied on; compare what I have said on this point in the following paper on *Pseudorca*: J. REINHARDT.]

excepted, but they are usually the only parts of the skeleton by which the sex may also be decided.

In the toothed-whales the pelvic bones of the male are generally somewhat differently formed, and, at least in some species, considerably larger in all dimensions, than those of the female. This seems in a high degree to be the case with the killers, but it must at the same time be admitted that their form is subject to many, even very surprising deviations, as is clearly proved by their being often unsymmetrical with each other in the same individual.

They appear in all cases as a pair of bones much extended in length, having their posterior extremities close upon the anus, and here approaching nearer to each other, but diverging from each other in a forward direction, so as to have their anterior extremities twice as far removed from each other as the posterior ones. They are more or less curved, with a concave often rather sharp interior edge, and a convex and perfectly obtuse exterior margin. This general description of the pelvic bones of the killers will especially hold true with respect to their hindmost two thirds. In the foremost third they usually become much thinner, often almost cylindrical, and end quite in front in an enlargement; and it is principally in this part that differences of form appear frequently even between the two bones of the same pair.

I found these bones extraordinarily large and strong in Mr. Benzon's twenty-one and one third feet long specimen, which was a male. They were $11\frac{1}{2}$ " long, and in the anterior third but little more than 1" broad, in the two posterior thirds as broad as 2", besides very thick everywhere. They were almost quite symmetrical with each other; the distance between them in front was $10\frac{1}{2}$ ", but in their most posterior and broader parts they are bent towards each other in a uniform and slightly curved arch, so as to approach each other to a distance of 4". The woodcut represents the outline of the left one seen from above.¹ The transition to the anterior more narrow third had the shape of a slight constriction; there was another and more considerable narrowing near the foremost extremity, which consequently had a certain resemblance to the head of a rib.



By examining the Orca skeleton of Nilsson at Lund, I found that its pelvic bones in nearly all particulars resembled those of Mr. Benzon's specimen here described, only that they were 1" shorter, and considerably more narrow, being in the very broadest place only $1\frac{5}{8}$ ".

As a contrast to the very large pelvic bones of these specimens, we shall now describe those of Mr. Thomsén's thirteen feet long individual, which was a female. They were only $4\frac{1}{2}$ " long, in their hindmost two thirds 5" broad, and not perceptibly curved, but in their foremost only 3" broad and almost cylindrical third they were bent slightly inwards so as to form a knee in

¹ All the pelvic bones represented here are given one fourth the natural size.

their outer margin, and, finally, they were dilated at their anterior extremities, forming a knob (*capitulum*), which, however, was still only cartilaginous, and about the form of which nothing certain can be stated, on account of their altered state at the time of the examination. It is, however, certain, that this pair of pelvic bones



was almost perfectly symmetrical. But such was not the case with the pair of pelvic bones belonging to the skeleton of Mr. Bloch's old female specimen. These two bones are of the same length, namely, 8", and the same breadth, namely 8''' behind, and $2\frac{1}{2}$ ''' in front close to the knob. Their posterior and broader two thirds being only very slightly curved, might, perhaps, be also called symmetrical, but their anterior third is so differently formed, and twisted in opposite directions, that it will be found impossible to place the two bones so that they seem symmetrical in their whole length.



Nevertheless, these two pelvic bones of the full-grown female Orca, have in themselves an indisputable resemblance to those of the young female just mentioned, especially in their slenderness and scarcely perceptible curve of their broader extremities; whereas they are exceedingly different from the massive pelvic bones of the males, with their strong incurvation behind, and their perfectly simple form in front, and we can hardly help considering the difference to be a character of sex.

No pelvic bones were found attached to the little Farøe skeleton of the museum when it was unpacked, but among the many loose bones which, as we have already stated, besides three crania, accompanied the whole lot sent from the same locality, we found four pairs of pelvic bones, each carefully tied together, and it can hardly be doubted but that they all belonged to individuals of the shoal stranded there.

Among these pelvic bones, one pair is perfectly different from all the others, especially by its considerable thickness, and resembles those of Benzon's and Nilsson's specimens in an extraordinary degree. It belongs, therefore, without doubt, to a large male. The length of the bones is $10\frac{1}{2}$ ", that is, as in Nilsson's specimen, 1" shorter than the pelvic bones of Benzon's specimen.

The three remaining pairs belonging to this lot are comparatively slender, and may, we should say, on this account alone be supposed to have belonged to females. The smallest among them is only 6" long, and it is extremely probable that it belongs to the small 11' 9" long skeleton, as all the other loose bones are those of larger individuals.

Since the recent progress of Cetology it cannot be doubted but that the genus Orca, inhabiting all the large seas of the globe, must contain more than one species, and we have certainly every reason to refer to it every Cetacean known to subsist on warm-blooded animals as well as on fishes.

That more especially the killers or, as they have sometimes been called, thrashers beyond the equator must be specifically distinct from the northern ones might, perhaps, in itself be considered as a matter of course, even if J. E. Gray had not given us the different

measurements of their crania. But there is another question that still deserves to be particularly examined, namely, whether several species of this genus or family of Cetaceans, so peculiar in its manner of living, may not also be found in the northern seas. It has already been stated that not only the Norwegian fisherman distinguish the high-finned and low-finned Orcas by the names of "Stour-Vang," and "Lille-Vang," but that also the zoologists before Cuvier's time have very generally supposed them to be two different species. After Cuvier's time this difference between the high-finned and low-finned killers had not been particularly attended to until it was again pointed out by Professor Nilsson, with a question which seemed to imply that it might be a character of sex. But lately, Professor Lilljeborg of Upsala,¹ has again supported the earlier supposition and, what is more important, by comparing skeletons of both species, he believes he has found several characters by which it would seem to be pretty easy to distinguish the two species in osteological museums.

Professor Lilljeborg has, however, only had an opportunity of examining one skeleton of a high-finned specimen, namely, Professor Nilsson's at Lund; of the low-finned ones, on the contrary, five, namely, three in the University Museum under my superintendence, and two in the Museum of Bergen. With the outward forms and colours belonging to the former skeleton, he became acquainted by the coloured figures preserved at Lund, and executed by Pastor Lundberg, copies of which were also forwarded to me through the kindness of Professor Wahlgren. The white spot on the neck of this individual is set down, though with some hesitation, as a special character of the high-finned species, for which he retains Lacépède's name of *Delphinus gladiator*. Professor Lilljeborg has been obliged to make use of Schlegel's description in order to determine the outward appearance of the low-finned species. He has, however, also expressed some doubts as to the invariable existence of the purple stripe along the base of the dorsal fin, and it has been pointed out above that this doubt has been as fully confirmed by the figure given by Mr. Thomsen of the thirteen feet long specimen from the eastern coast of Jutland (1855), as his doubts about the invariable existence of the white spot on the necks of the high-finned specimens has proved to be well founded by my examination of Mr. Benzon's specimen. We must therefore suppose, as has already been said above, that we can hardly succeed at present in deriving characters for the two supposed species from the colours of the skin. The different height of the dorsal fin will, however, compensate for all other characters in the outward appearance of the animals. It is more important to derive certain characters from the skeletons. This has been the principal object of my much respected friend, and I shall endeavour to assist him in this with all the means at my disposal.

I have thought it expedient to arrange Professor Lilljeborg's characters of the two species of Orca, the types of which are Professor Nilsson's specimen on the one hand, and the specimens from Bergen on the other, in a tabular form, and in the following manner:

¹ 'Ofversigt af Skandinaviens Hvaldjur,' Upsala, 1862, 8vo, pp. 15—23.

	The High-finned Killers.	The Low-finned Killers.
1. Size	Up to about 23' (24 Swedish) ft.	Up to about 15'4" (16½ Swedish) ft.
2. Number of ribs	12	11
3. Form of the head	Breadth to length about as 8 : 12	Breadth to length as 7 : 12
4. Protuberance formed by the frontal and the nasal bones	More elevated.	Less elevated and pointing more backward
5. Ankylosis of the cervical vertebræ	3 foremost by the bodies 6 foremost by the spinous processes	2 foremost by the bodies 3 or 4 foremost by the spinous processes
6. Attrition of the teeth	All worn off at the points	Only the foremost worn off at the points
7. Number of the carpal bones	5	2
8. Number of the phalanges in the thumb	1	1
" " second finger	6	5 or 4
" " third " 	4	3
" " fourth " 	3	2
" " fifth " 	2	2

The author remarks himself, that some of the osteological characters here mentioned, may, indeed, have originated in differences of age, and this remark is so true, that it seems to me we had better immediately strike out of the list all those with which this is more particularly the case. Among these we reckon, in the first instance, the wear of the teeth; for that the crowns of the teeth may be worn quite off in a low-finned Orca has been proved especially by Mr. Bloch's specimen in the museum of the University (for the dorsal fin was in this, about seventeen and a half feet long individual, only 1' 8½" high), and that the teeth of an Orca, said to have been four fathoms long, with a dorsal fin three ells high, may even be perfectly uninjured at the points, we have an equally decisive proof in the account given by Bishop Gunnerus compared with the two figures accompanying it of two of the teeth.¹

Then the character derived from the number of the carpal bones, supposed to have been five in Professor Nilsson's (as well as in Mr. Benzon's specimen), but only two in those from Bergen, must evidently be struck out of the list, for we believe it to be quite certain that all killers have five bones in this part of the manus, as represented in the woodcut, p. 173, only that in dried

¹ 'Del Kgl. Norske Vidensk. Selsk. Skrifter,' 4 Deel., tab. xii, fig. 2 og 3.

skeletons they cannot be distinguished, unless their ossification has reached the surface, and as yet this was only the case with one of the bones of the very young specimen depicted.

It has also been already indicated, that the ankylosis of the cervical vertebræ may appear more or less extensive according to the animal's age, at least, after the cartilaginous portions have been removed from their places, and I do not hesitate to express a similar opinion about the height of the protuberance formed by the frontal and the nasal bones, as well as about the proportion between the length and the breadth of the head; for the greatest breadth of the head, namely, between the temporal arches, is always inferior in less muscular individuals, whether this inferiority must be ascribed to age or sex. The number of the phalanges is, indeed, independent of age, but not quite constant; not unfrequently it is not even quite the same in the two pectoral fins of the same individual. The same remark may also be applied to the number of the ribs, for Mr. Thomsen's specimen has twelve ribs on the left, eleven on the right side. But yet it cannot be denied that in addition to other and more certain characters, such uncertain or inconstant ones as the number of the ribs and the phalanges may also deserve to be considered.

Thus, of the author's eight osteological characters, there is only one left to be considered, we mean the one placed at the top of the list: the size of the individuals. It is true, that the remark made by the author himself, that many of his characters may be explained as differences of age or sex, may be fully as well applied to this character, as to any of the others; and the author has, undoubtedly, as I shall have occasion to show immediately, been very unsuccessful in bestowing this character on the skeletons in the museum under my care, but he was perfectly right in using it in the comparison of Professor Nilsson's specimen with the two from Bergen; for here it is expressly stated, that the skeletons compared both belonged to full-grown males. It is true, that a full-grown animal's teeth are continually wearing off to a considerable degree, and that the animal itself may become far more muscular after having attained its full length, by which means the different protuberances in the cranium may also increase in circumference, and the head itself become broader; but when the animal is really full-grown, that is to say, when the epiphyses are ankylosed to their respective vertebral bodies, then it cannot increase in length. And though we may find full-grown individuals of rather different sizes within the same species, yet in individuals of the same sex, especially among the Cetaceans, we find these differences confined within so narrow limits, that we may suppose, with considerable certainty, that two full-grown males, the skeleton of one of which is 20' 4½" (21½ Swedish feet) long, and that of the other only 14' 10" (15' 8½" Swedish measure), can scarcely belong to the same species. When this point has been settled, then, as has already been granted, we may also pay some regard to the less constant characters, as the number of the ribs and phalanges.

But before we enter on all the inferences implied by such a supposition, we ought first to procure all the information that can possibly be obtained, in order to ascertain its correctness. One of the most certain signs that a toothed-whale has attained its full growth, is, in my opinion, its having its teeth closed at the roots, and the only part of the skeleton, by which the sex of the individual may with any certainty be ascertained is, according to what we have just stated, the pelvic bones. I have, therefore, applied to the excellent director of the Bergen Museum, Dr. Koren, by whom these two skeletons were put up, and by whom Professor Lilljeborg's attention, was in the first instance directed to the probability of the *Stourhymning* being a different species from the *Delphinus orca* described by Schlegel. Dr.

Koren immediately informed me, that, indeed, all the teeth of the two skeletons are closed at the roots, and the foremost worn off even in a considerable degree, but that he regretted to be unable to tell me with certainty, whether these two skeletons belonged to males, as he had not seen the sexual organs himself. "The fishermen who brought the skeletons," he writes, "told me that they were those of males; but I am sorry to say that experience has proved that their statements are not always to be relied upon."

After having received this information, I had almost come back to my former doubts; for the examination of the Bergen skeletons seemed scarcely to have given any result than this, that a female killer can be full-grown, when its skeleton is scarcely fifteen feet long, as I already knew from the skeleton of Mr. Bloch's specimen that it may be, when it is sixteen and a half feet long. But, fortunately, Dr. Koren also received from the fishermen along with the two skeletons one of the pelvic bones, of which he has been kind enough to send me a figure of the natural size. Like those represented above, it is here given at a quarter of its natural size, and thus we leave it to the reader's judgment, how far I am right in considering it as a decisive proof in favour of the statement of the fishermen. It is true that it is not so thick by far as the pelvic bones of Mr. Benzon's or Professor Nilsson's specimens, nor does it quite resemble them, especially in the anterior third; but being of an individual so much smaller, it could not well be expected to be fully



as massive, nor as belonging to another species to have the same form, and yet, on the other hand, it has still far less resemblance to all the pelvic bones of *female* killers known to me, especially in the hindmost two thirds, where it is far thicker and more strongly curved. This will be seen when it is compared with the three pairs of slender pelvic bones among those sent from the Farøe Islands, and with those of Mr. Thomsen's specimen; and what seems to me to settle the question, the same is also seen when it is compared with the pelvic bones of Bloch's skeleton (woodcut p. 177). It is not only very unlike the latter in form, but, at the same time, both larger and thicker, although this skeleton is that of a still larger low-finned female killer. So let us give honour to the words of the fishermen, this time, at least! These two Orca skeletons, only fifteen or sixteen feet long, and yet full-grown, must, therefore, really be supposed to be those of males, and it is now proved, that a species of killer exists in the northern seas, the males of which are full-grown, at a length of about fifteen or sixteen feet. It must be different from the "Stour-vang," the male of which is represented in the Museums of Copenhagen and Lund, and whose skeletons have a length of nineteen and a quarter, or twenty and a half feet. So far, I must declare myself to be of the same opinion as Dr. Koren and Professor Lilljeborg. The correctness of that opinion is undoubtedly also confirmed by the circumstances already pointed out by Professor Lilljeborg, that the type of the larger species (Professor Nilsson's specimen) has twelve pair of ribs and six phalanges in the second finger, whereas, both the types of the smaller species have only eleven pairs of ribs, and one or two phalanges less in that longest finger.

Granted, then, that Professor Nilsson's specimen, on the one hand, and the two Bergen specimens on the other, are types of two different species of northern killers, it now remains to determine, as far as possible, in the instance of any other known specimen, whether it belongs to the one or the other of these species.

To begin with the specimen, with the description of whose natural appearance we have commenced our present account, we mean Mr. Benzon's, it can hardly be doubted but that it belongs to the same species as that of Professor Nilsson. Though not only a full-grown male, like the latter specimen, but even a very old individual with its teeth worn down to the very gums, and with the roots of the teeth perfectly closed, and besides, covered with a very thick layer of cement, and though provided with an equally high dorsal fin (four feet), and still broader pectoral fins, yet it was one foot shorter, and wanted the white spot on the back of the head; but these differences may, we suppose, be considered to be individual, as the whole osteology of the two specimens presents almost exactly the same character,¹ having both twelve pairs of ribs; and, as ought to be particularly noticed, fifty-four vertebræ, whereas both the types of the smaller species have only fifty-two vertebræ. As to the number of the phalanges, the left pectoral fin of my specimen agrees even better with those of Professor Nilsson's specimen, than with the right pectoral fin of the same individual; the fourth and fifth fingers of the latter having each one phalanx less than the former, for the fourth has only two phalanges and the fifth only one.

Of a few unessential differences, I need only mention here that the first part of the sternum (the *manubrium*), contrary to what is the case in the specimen of Professor Nilsson, is completely ankylosed with the second, and has not any hole in the middle.

It may, perhaps, be more difficult to point out the females belonging to either of these species. This part of the task has only been very slightly treated of by Professor Lilljeborg, because while he was staying at Copenhagen, where three skeletons of females were before him, namely, the 16' 4" long one from Greenland (Mr. Bloch's specimen), the 11' 11" long one from the eastern coast of Jutland (Mr. Thomsen's specimen), and the 11' 9" long one from the Farøe Islands, he had not yet thought of treating the matter so accurately as he afterwards determined to do during his ensuing visit to Bergen. It is in this part of the task that I especially believe myself able to assist my respected friend, having, of course, on account of my position, had a much better opportunity of examining these objects belonging to the museum.

The Orca skeleton longest in my possession is that of an Ardluk from Greenland caught in 1844, in the neighbourhood of Godthaab, which Professor Nilsson in his "Scandinavian Fauna" has mentioned as the Bloch specimen, because he was acquainted with it from a drawing executed by Mr. Bloch, then the physician of the settlement, and sent home the very same year, while the skeleton itself was sent to me the following year by Captain Holböll, together with paper patterns of its dorsal, caudal, and pectoral fins. The dried skeleton is 16' 4", in its fresh state the animal must, therefore, be supposed to have been about seventeen and a half feet long. It was a female, its pelvic bones are described and represented above. The osteology, on the whole, corresponds to that of the Bergen specimens, as described by Professor Lilljeborg. It has fifty-two vertebræ, eleven pair of ribs, and the foremost hæmapophysis is placed between the thirty-first and thirty-second vertebræ. The three foremost cervical vertebræ are ankylosed by the bodies, the four foremost by the spinous processes; the digits of the left pectoral fin have one, six, three, two, one phalanges respectively; in the right, there are two phalanges less in the longest finger. We must therefore with Professor Lilljeborg refer it to the smaller species. But it was besides

¹ In order to ascertain this point I made a journey to Lund, where I met with the greatest possible kindness at the hands of Professor Naumann and Professor Wahlgren.

a perfectly full-grown, even an old individual, for the ossification of the vertebræ was not only quite complete, but the teeth, of which there were thirteen on either side of the upper jaw, and eleven in the lower jaw, were quite closed at the points of the roots, except four which were quite hollow, and all the crowns of the teeth were worn down to the very gums. We believe, therefore, we may set up this specimen as a type of the female of the smaller species, just as the two Bergen specimens have already been set up as types of the male. But then we come to two rather important results, relative to the sexual differences in this species: 1, that the female of this species, as of the Cetaceans in general, is somewhat (one or two feet) larger than the male; 2, that the dorsal fin is somewhat smaller. In one of the specimens, of which the skeletons are preserved in the Museum at Bergen, and whose fins bore a very close resemblance to those of Schlegel's specimen, the length of the dorsal fin along its anterior edge was 2' 3" Norwegian (Danish) measure, according to the statements of Professor Lilljeborg, by which measurement, however, it seems difficult to find out the real height of the fin. But the dorsal fin of the Greenland skeleton, which is one foot longer than the longest of those from Bergen, is only 1' 8½" long; and Dr. Koren has had the kindness to send me a paper pattern of the dorsal fin of one of these Bergen killers, adding expressly that it was of about the same size in both of them, and this pattern is really only 1' 10½" high. The pectoral fin which in the Bergen males, according to Dr. Koren's statement, were 2' 9½" long, were 1' 11" long and 1' ¾" broad, in the Greenland specimen; the breadth of the caudal fin was 3' 3". Thus, the superior power in the fins of the males seems at any rate to prevail, though to a far inferior degree than we had reason to presume, before the separation of the two species.

The distribution of colours in the Greenland specimen, as far as it can be seen from the figure drawn by Mr. Bloch, did not differ from the common colours of the northern killers.

The other two Orca skeletons, already for some time belonging to the museum, are much smaller; the one (Mr. Thomsen's) 11' 11" long, the other (the one from the Farøe Islands) 11' 9". At first it seemed to be very likely, that both these belonged also to the small species. But a more minute consideration of them has led to an opposite result.

To begin with Mr. Thomsen's from the eastern coast of Jutland, it is indeed only 11' 11" long, but at the same time it is so young, that by the experience I have obtained in judging about skeletons of Cetaceans at different periods of age, I cannot suppose it to have advanced much beyond the sucking age, nor, indeed, to have attained to half its full length. All the teeth (it had thirteen teeth in either side of both jaws, and besides one intermaxillary tooth in the upper, and a corresponding small foremost tooth in the lower jaw) are occupied by the cavity of the dental pulp to that degree that they are thin as paper up to the very point of the crown; in the carpus there is only one slight trace of ossification; all the extremities of the long bones are perfectly cartilaginous (see the woodcut, p. 173, which was taken from this specimen), the three foremost osseous portions of the sternum are separated by rather broad cartilaginous interspaces, and the fourth is entirely cartilaginous; all the vertebral processes are only about half ossified, and the ossified portions are still very brittle.

Now, it is a matter of course, that when size is to be employed as a character of species, it is only in full-grown individuals, as the two Bergen skeletons, and those of Nilsson, Benzon, and Bloch, that it can be used without making allowances, and that in all other cases we must try to conjecture from the more or less advanced state of development of the individual how much larger it would have grown if it had lived. By following this principle, I suppose that the

normal size of this scarcely twelve feet long skeleton (the fresh specimen was 13' long), would be twenty-four feet at least, and that it ought, therefore, not to be reckoned as belonging to the smaller, but, on the contrary, to the larger species.

The correctness of this opinion is also confirmed by several other less essential circumstances. It is the only female Orca skeleton in the museum having fifty-four vertebræ like Nilsson's and Benzon's specimens, and at one side, at least, twelve ribs. Finally, the phalanges appear in the largest numbers: one, six, four, three, two, as will be seen in the woodcut.

Another evidence that this only thirteen feet long Orca belongs to the same species as the twenty-one and one third feet long specimen of Mr. Benzon may, perhaps, be found in the vomer appearing rather extensively on the palate of both these individuals between the five hindmost teeth, a character not generally met with in the killers.

But if these conclusions are correct, if this little killer is really to be considered as a very young female of the larger species, then we come to the very important result, that at least the young females have also here a comparatively much lower dorsal fin than the older males. According to Mr. Thomsen's measurements and drawing, the dorsal fin of the 13' long female was 1' 6" high, or in the proportion of 18 : 156 (0.115 of the length); but in both the full-grown males, one of which (Nilsson's) was 22½', the other (Benzon's) 21⅓', it was four feet, or 0.178—0.187 of the length of the body. Nevertheless, it seems in the females also to be comparatively higher in the larger species than in the smaller one; for, whereas its proportion to the length of the body in the Thomsen specimen was still 0.123, it was only as 20½" to 210" = 0.098 in the 17½' long Greenland specimen, just described. But, at all events, it must be considered as very uncertain whether the Norwegian fishermen by the name of Lille-Vang only understand males and females of the smaller species, or also use the same appellation for the females of the larger species.

The smallest of the Orca skeletons in the museum under my care is that belonging to one of the animals stranded in 1855 in the Farøe Islands. It might readily be inferred that this skeleton could not belong to the smaller species of Orca, as the crania and the other parts of the skeletons belonging to the animals stranded at the same time proved to be those of large, some even of very large animals; several of the vertebræ, for instance, were about twice as large in all dimensions as the corresponding ones in this skeleton; but this was also evident from the condition of the skeleton itself, especially as its teeth appeared to be in a still less developed state than those of the Thomsen specimen.

Nevertheless, a more minute examination of this skeleton must soon lead to the admission that it could not belong to the same larger species as the other little skeleton, that one, namely, of which the Nilsson and the Benzon specimens have been considered as types. It had not fifty-four, but only fifty-three vertebræ; not twelve, but only eleven pair of ribs. The vomer was not visible in the palate, and though the hands were so much dried up, that the number of the phalanges could hardly be ascertained, yet there seemed to be one or two less in most of the fingers. And what will probably be thought to be still more essential, in almost all its parts the measurements gave very different results.

Professor Lilljeborg had already become partially acquainted with these differences, but he thought that they might possibly be explained as sexual characters. That this is not the case was obvious to me, when I had an opportunity of finding them again on those three or four other skeletons, of which the crania and other bones had been sent to me as belonging to animals stranded at the same time. One of these crania, 35" long, had come to the Royal Museum, and by examining this Professor Reinhardt had already by himself, and quite independently, arrived at the same conclusion as I had, namely, that we had before us a new species of this genus.

Professor Lilljeborg has already stated that the cranium is two inches broader, it is besides an inch longer, though the whole skeleton is 2" shorter. The same author has also stated quite correctly, that the scapula is somewhat broader, the ribs both longer and broader, and the foremost ones more strongly curved, to which may still be added that the bones of the arm are perceptibly thicker; but when he says that these differences might possibly be explained as characters of sex, he can hardly have observed to what an extraordinary extent they attain in the foremost pair of ribs; for the length of these ribs is really $12\frac{1}{2}$ ", or one eleventh of the length of the whole skeleton, whereas, in the Thomsen specimen, it was only $8\frac{1}{2}$ ", or one eighteenth. This surprising length of the first rib of the Orca skeleton, only $11\frac{3}{4}$ " long, from the Farøe Islands, will appear the more extraordinary when compared with the length of that of the $19\frac{1}{4}$ " long skeleton of the Benzon specimen, which was also only $12\frac{1}{2}$ ", or but little more than one eighteenth of the total length of animal, and, comparatively speaking, just the same as in the Thomsen specimen (which again may serve as an additional proof that the latter skeleton belongs to the same species). But I have had the great advantage over Professor Lilljeborg, in having been able to examine three other skeletons of the same shoal, more or less incomplete indeed, but still affording sufficient proofs that all these and other differences in the small skeleton, so far from being differences of sex, or age, or individuals, must, on the contrary, be considered as evidences of its belonging to a new species of Orca in the northern seas.

The loose bones that followed with the skeleton belong, as we have stated, to three skeletons two of which are much larger, the third only a little larger than the complete skeleton. Among these bones we found, as we have said, altogether four pair of pelvic bones, and the smallest of them evidently belonged to the skeleton (see p. 177), the smallest but one to the other very young individual, and these have, therefore, without doubt, been females. One of the two longest skeletons was a male, to judge by its pelvic bones already described, the other a female; and we confidently conjecture that this whole little shoal consisted of a pair of killers with one young one all but new born, and another one year older, both females. But it seems to be more uncertain whether the largest individual was the male or the female. I regret particularly that the cranium of the larger skeleton has not come into my possession.

After having arranged the bones of these three defective skeletons, as far as circumstances made it possible, I now give the following statements as the result of my examination of them.

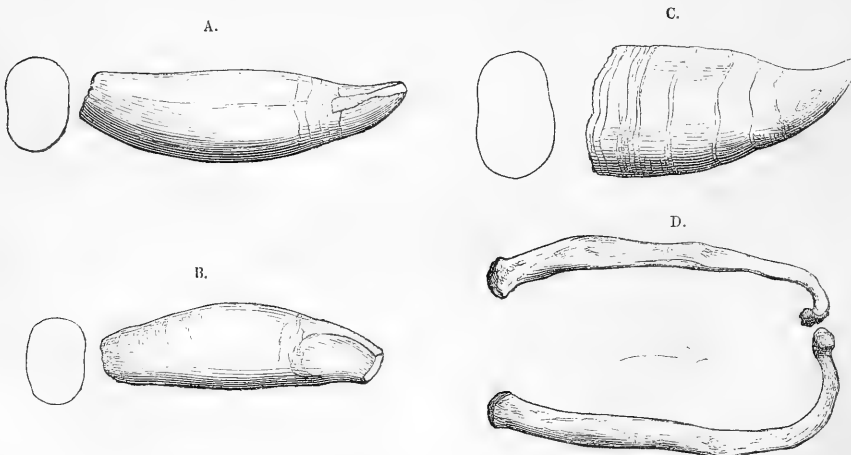
1. Every possible doubt of their belonging to one and the same species has been removed. The differences pointed out above in the small but complete skeleton have all been found again in the larger ones, as far as this was possible, the bones being incomplete and separated from one another. Thus, perhaps, the superior length of the anterior pair of ribs ought first to be particularly noticed. It is 2' long in the largest specimen, whereas, in the Benzon

specimen, it has only a length of $12\frac{1}{2}$ " ; the former is, therefore, almost twice as long as the latter, though the whole skeleton can hardly be supposed to have been more than one sixth longer. The bones of the arms are much thicker, though not perceptibly longer, the cranium both longer and broader; the vomer does not appear on the palate; the teeth are compressed from the sides and not worn at all at the points; even in the largest of these crania having a length of 40", and a breadth of 26", in which the midmost teeth are long and almost entirely closed at the roots, they only present a lengthened worn surface on either side.

2. The length of the largest of the skeletons must be estimated at about twenty-three feet. Of this specimen, six vertebræ of the dorsal and lumbar regions and the last ten caudal vertebræ are wanting besides the cranium, supposing that the total number of the vertebræ was exactly fifty-three, as in the small skeleton. The estimate has been made by comparing the vertebræ and continuous portions of the spine, as we found them, partly with the corresponding ones of the small skeleton, by which comparison they proved to be about twice as long as those of the latter, and partly with those of the Benzon specimen, than which they appeared about one sixth longer. The length of the largest skeleton but one I think I may estimate at¹ , that of the smallest but one at times longer than that of the very young one (11' 9"), the length of the former accordingly at , that of the latter at . But the crania do not increase in the same proportion.

The figures A, B, and C, represent the hindmost tooth but four of the left lower jaw of different specimens of Orca, with their transverse sections, at one half their natural size.

- A. Of the large cranium from the Farøe Islands.
- B. Of the Benzon specimen.
- C. Of the smallest specimen but one from the Farøe Islands.
- D. The pelvic bones of the largest specimen but one from the Farøe Islands.



P.S. Mr. Müller, who sent the skeletons and crania of this new species from the Farøe Islands, states that the animals from which they were taken belonged to a small shoal

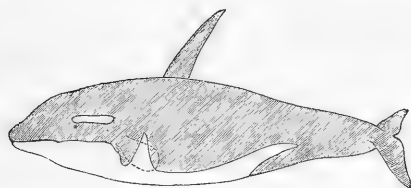
¹ [Left incomplete in the MS.]

which in January, 1858, in a *manner hitherto unknown*, and for some unknown reason, ran on the shore and perished in the Kollefjord in Strömö Island, and that on the same day another shoal consisting of nineteen killers was in the *same* way stranded in Qualvig in the same island.—J. STEENSTRUP.

ADDITIONAL NOTE.

[Sysselmand H. C. Müller, who sent from the Faröes the skeletons and crania on which Eschricht has founded this *third* northern species of Orca, informs us, that these remains were taken from a small flock of nine killers, which ran aground in an uncommon manner, and for some unknown reason, in the month of January, 1858, in the Kollefjord in Strömö, and perished there, while on the very same day, and in the same manner, a larger shoal of nineteen head were stranded in Qualvig (Firth of whales) in the same island, which events could not but attract the attention of the inhabitants, the more so as they are accustomed to see with what facility the common killers, when they happen to get aground, work themselves afloat again.

It is evident from Mr. Müller's written information, as well as from some small sketches made by him of three of the captured killers, that this new species possesses peculiarities, not only in the details of its osteology, but also in its outward appearance, and that more especially its colouring affords a constant and striking character, by which it is clearly distinguished from the two other northern species. For while it presents the general distribution of colour peculiar to the latter and, indeed, as it seems, to the whole genus, we find that, just behind the pectoral fin, the white colour of the belly is continued upwards into the black colour of the upper parts, in the shape of a regular triangle, as is shown in the adjoined copy of one of Mr. Müller's small sketches.¹



It cannot be doubted but that the white triangle in the black colour has occasioned the name of "Bovquitequalur" (in Danish, Bovhvidehval, the whale that is white in the region of the shoulder), by which the inhabitants of the Faröes denominate these killers, and thus the name is an additional guarantee for the correctness of the figure as to this important character, even though in other respects it might not be found to be of the strictest accuracy. Mr. Müller's little sketch, as will be seen, represents the animal with a very high,² almost straight, and comparatively narrow,

¹ The pectoral fin is indicated only by a dotted line.

² Its height in the largest individual was five feet three inches, Dan.

dorsal fin like that of the "Stourvang" (*Orca gladiator*), but as he states expressly in his letters that individuals were also found in the flock, with a lower and more curved dorsal fin, it would seem that in this species, too, the dorsal fin has a different height and form in the different sexes.

Mr. Müller opened and examined the stomach of one of the killers stranded in Kollefjord, and found in it the hairs and claws of seals as well as small white laminae of whalebone, which could scarcely have belonged to any other species of whale than the lesser Rorqual (*Balænoptera rostrata*, Fbr. or *B. minor*, Knox).

[Eschricht does not seem before his death to have chosen any name for the third northern killer, at all events nothing was mentioned about this point in his manuscript; but Professor Steenstrup, to whom the skeletons of the individuals stranded in Kollefjord had originally been sent by Mr. Müller, with the information he was enabled to impart about them, and from whom Eschricht received all these materials for his own use, has now designated the new species by the certainly very appropriate name of *Orca Eschrichtii*.

J. REINHARDT. 1865.]

PSEUDORCA CRASSIDENS,

A CETACEAN

HITHERTO UNKNOWN IN THE

DANISH FAUNA.

BY

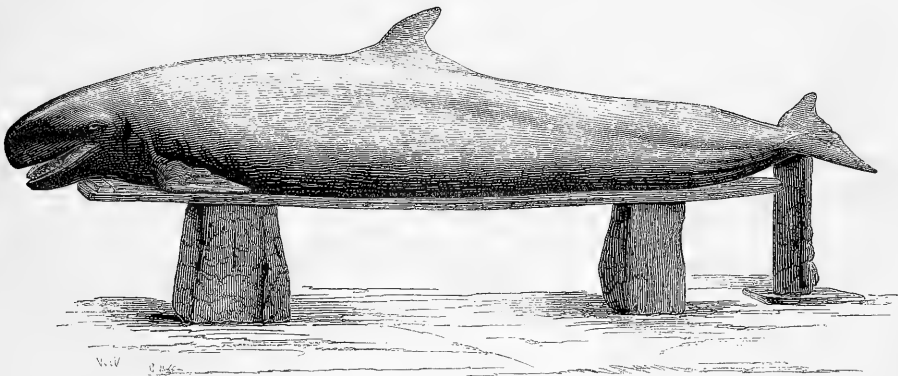
J. REINHARDT.

(Read before the Royal Danish Society of Sciences, the 7th of November, 1862.)

TRANSLATED FROM THE

'OVERSIGT OVER DET KONGELIGE DANSKE VIDENSKABERNES SELSKABS FORHANDLINGER,' 1862.

PSEUDORCA CRASSIDENS.



Female, sixteen feet in length ; killed in the Bay of Kiel, November 24th, 1861.¹

In the course of the summer of 1862, three specimens of a large and, in several respects, remarkable dolphin were thrown dead on the shores of the Danish islands of Sealand and Funen. As chance would have it, my first information was about the one that had last been drifted ashore ; and as the measures taken by me to endeavour to procure some parts of this animal for the Zoological Museum caused me to become acquainted with the individuals which were stranded at an earlier date, I shall begin my account with this specimen.

On the 14th of August, 1862, the local newspaper of Kallundborg, a town on the north-western coast of Sealand, contained the intelligence, which from thence found its way into several of the newspapers of Copenhagen, that a Cetacean said to have been eight or nine ells long had several days before been thrown up dead in the neighbourhood on the southern beach of Asnæs, a small tongue of land belonging to the estates of Count Lerche, of Lerchenborg. The short account contained nothing in reference to the colour or appearance of the animal ; but judging from the statement about its size, I supposed that it was most probably an *Orca* (a so-called "Sværdfisk" or "Spækhugger," or killer), an animal, therefore, tolerably well known ; and as, moreover, there was very little chance of my arriving in time to profit much by a journey to the place where it had been stranded, several days having already elapsed since the occurrence, I thought it not worth while to go. Some three weeks afterwards, however, a tooth was shown to me, which had been found lying beside the dead body, and was brought to Copen-

¹ [This figure (taken from a photograph) is not in the original memoir.—W. H. F.]

hagen by Mr. Rörbye, a medical student, who, while passing his vacation in the neighbourhood of Asnæs, had gone to see the dolphin a short time after it had been thrown up on the beach. The sight of the tooth immediately convinced me that the stranded Cetacean could not belong to any of our species of Orca, but that it must be an animal of which it was important to save even any fragments and detached pieces, and being told at the same time that Count Lerche had caused the carcass to be buried, I applied to him, with a request that the body might be disinterred, so that the bones might be put together to form a skeleton as complete as circumstances would admit of. On arriving at Lerchenborg, I was received most kindly by Count Lerche, who afforded me all the assistance I wanted; but the more accurate accounts I now received at the place itself, I regret to say, in no slight degree diminished the hopes on which my visit was founded. The dolphin had, indeed, been interred, but for the purpose of its being employed as manure, and on account of its considerable weight, and with a view of rendering the work easier, it had first been hewn into many pieces, which then had been spread over rather a large piece of ground, where it would be difficult to find them again. At the same time, however, it was some comfort to me to hear that (as I had rightly concluded) it would not have availed much if I had set out somewhat earlier, for the dolphin had been found on the 9th of August, and had already been cut to pieces on the 11th of the same month, several days before the news of its stranding had reached Copenhagen, and the chopping had been carried out so unsparingly, that the head itself had been divided in the middle, and many of the vertebræ had been split. It soon became evident to me that I must give up the hope of collecting fragments enough for forming a tolerably complete skeleton, but, thanks to the assistance given to me, I succeeded, nevertheless, in finding the most important parts, and among these more especially the fragments of the cranium, the cervical vertebræ, the scapulæ, the bones of the arms and some vertebræ. But as to the verbal information I tried to elicit from those who had seen the animal, as it lay upon the shore, I was not particularly successful; the only thing I could learn with tolerable certainty was, that it was a female nineteen feet long—a little longer, therefore, than it had originally been stated to be. But as to its appearance and colour, the statements were contradictory.

Thus, while the information about this individual remained in an unsatisfactory state, I received during my stay at Lerchenborg another valuable piece of intelligence—that some time before another great dolphin had been drifted dead on the shoal, close to the shore near the lighthouse of Refsnæs, some few miles from Asnæs; that it had been saved, and that the carcass had remained lying on the beach, the blubber having been cut off and melted into about ten gallons of oil. Circumstances did not permit me to go immediately from Asnæs to Refsnæs. I was obliged to return to town first; but having by renewed inquiries ascertained the trustworthiness of the intelligence, and obtained such information as rendered it not improbable that it might be a dolphin of the same species as the one stranded at Asnæs, I accepted the hospitable invitation of Mr. Barner, the owner of a farm in the neighbourhood, and early in October I went there accompanied by the conservator of the museum. I found the animal, of which by far the greater part of the flesh was still adhering to the bones, lying buried in the neighbourhood of the lighthouse at the foot of the sand-hills on the sea-shore, and covered with sand; to my satisfaction it really proved to be of the same species as the dolphin stranded at Asnæs, though indeed a smaller individual, being only about fourteen feet long; and although it had been found as early as the month of June (as I was told), or more than three months before, yet the putrefaction had

not proceeded so far as might have been expected. After two days' rather hard work, the skeleton, defective only in some comparatively unimportant parts,¹ was ready to be sent away, and with a readiness of which I wish to express my sincere acknowledgment, Mr. Barner added to all the other assistance he so liberally had afforded me still another kindness, in ordering the skeleton to be brought to Kallundborg by his own conveyance, thence to be sent by sea to Copenhagen. But as to the appearance and colour of the animal, as it was before the blubber had been cut off, the information obtained here at Refsnæs, was as defective as that formerly received at Asnæs. Not even the sex could be discovered. The people who had found the dolphin could say nothing about it, and in the buried carcass no distinguishable trace of external or internal sexual organs were to be found; in the flensing, the external sexual parts, as well as the pelvic bones, had been cut off, and the internal parts were so much decomposed that an examination of them gave no result. Lastly, the third carcass was thrown ashore some days before Whitsuntide, near the small town of Middelfart, in Funen. A physician of this town had, immediately after the stranding, informed Professor Eschricht of this event, and at his request sent him the nearly complete skeleton, which my illustrious friend had the great kindness to leave at my disposal, being informed that I had availed myself of the opportunity afforded me by the stranding of the two other individuals, to subject this remarkable Cetacean to a detailed examination. This third individual was almost full-grown, as was sufficiently proved by the skeleton, and the donor stated that it was a male, but we received no further particulars about it. Thus it is only by the skeleton that we have to decide which dolphin it is that in these three cases had been thrown up on our shores, but, fortunately, we need nothing more to settle the question.

That it is none of *the larger species hitherto described* from the North Sea and the northern part of the Atlantic cannot possibly be doubted; even a slight glance at the figures given in the following pages of the cranium and the pectoral fin will immediately be sufficient to prove that it cannot be any of the Northern species of *Orca*; no more can it be the *Globiocephalus incrassatus*,² a species founded lately on an incomplete cranium, still less the common ca'ing-whale, or pilot-whale, *Globiocephalus melas*, nor finally, the *Delphinus griseus* of Cuvier, hitherto observed in some few cases, the type of the genus *Grampus* of Gray. Another form, however, very peculiar and different from all these more or less well-known large, few-toothed species has lately been observed in our Northern seas; for on the 24th of November, 1861, a considerable shoal of very large dolphins arrived at dawn in the Bay of Kiel. Some fishermen and sailors in boats succeeded in separating about thirty head from the rest of the shoal, and in driving them up into the harbour itself, where one was killed, but the rest contrived to escape again in spite of all pains taken to drive them on shore. The dolphin killed, a female, sixteen feet long, was exhibited at Kiel, and other places in Holstein, and bought for the anatomical collection of the University of Kiel. No complete description of it has hitherto been published, and of its skeleton, especially, we have no account; but some information, scanty enough it is true, about the appearance and teeth of the captured dolphin, is to be found in a short account of the whole event, which Dr. Möbius has given in the periodical, 'Der Zoologische

¹ Besides the pelvic bones, only the three last caudal vertebræ and the right pectoral fin were wanting, the last had most probably been carried away by foxes, which had dug a way down to the carcass; the caudal vertebræ, with the greater part of the caudal fin, seem to have been absent even at the time when the dolphin was found drifting in the sea.

² 'Proceedings of the Zool. Soc. of London,' 1861, p. 309.

Garten,¹ and some additional and more satisfactory knowledge about its outward appearance has also been gained in another way, namely, by the assistance of some photographs, pretty well executed,² and a very fine plaster-of-Paris model, about seventeen inches long, which Professor Behn ordered to be made of the animal, just after it was killed. Here accordingly, we have another form that cannot be left unnoticed in deciding the question to what species the animals thrown ashore on Asnæs and Refsnæs belonged; and besides the size, there were, indeed, several other points in the latter specimens, for instance, the form and size of the pectoral fins, the number and appearance of the teeth, that could not but lead our researches to the Kiel dolphin, and raise a strong supposition in favour of its being really of the same species as the object of our present examination. To this it may be objected, that it would be strange if a dolphin, not known to have been observed previously in the North, had now suddenly appeared in the course of a few months, not only once but thrice; it may, however, on second thoughts, be considered still more extraordinary if, at short intervals, *two* great, hitherto unknown Cetaceans had made their appearance on our coasts, and the objection will lose all its weight, when we consider that it was not a single individual, but a great shoal, evidently astray,³ that entered the Bay of Kiel, and that, most probably, the Refsnæs and the Asnæs dolphins belonged to the same. For it is likely enough⁴ that such a shoal, having once strayed into strange and narrow seas, may continue to roam in them for a long time, without being able to find its way out again into the open ocean. However, as we know nothing essential about the Kiel dolphin, except as far as its external appearance is concerned, the skeleton being still perfectly unknown, and as, on the other hand, I did not know much about the outward appearance of my dolphins (the shape of the pectoral fins alone excepted, having found one of those of the individual buried at Refsnæs in a condition so little injured, that I was able to take an exact copy of its outline), I might, indeed, resting on the information before me, consider it to be very probable, that the latter two were of the same species as the former one, but as matters stood, a perfect certainty could only be obtained by a comparison of the skeletons, or at all events of their more characteristic parts. I wrote, accordingly, to Professor Behn, in order to get the question settled in this way, adding a sketch of the cranium of the individual stranded at Asnæs. That gentleman, formerly my fellow voyager, had the kindness not only to confirm my supposition, but at the same time to furnish me with such information about the cranium of the skeleton set

¹ III Jahrgang, No. 2 (Februar, 1862), p. 39.

² See figure at p. 191.

³ For we suppose that very few will believe that these colossal animals are natives of the Baltic, and the narrow sounds between our islands, or that they even appear rather frequently in these seas.

⁴ That these individuals really belonged to the shoal that entered the Bay of Kiel is rendered still more probable by the fact, already mentioned, that an individual of the same species was also found at Middelfart, shortly before Whitsuntide, 1862, that is just in the interval between the time when the shoal was first discovered in the Bay of Kiel and the stranding of the carcass found at Refsnæs. I should not be surprised if part of the shoal dispersed at Kiel were still, at the time when I am writing this, roaming about in our sounds and belts, and if the two large dolphins which, according to the statements of the newspapers, were thrown ashore at Naskov in the end of October, 1862, should also prove to have belonged to the same species. The size (a length of seven or nine ells, and a "circumference as that of a horse") would at all events favour such a supposition. It is to be regretted that the measures taken to endeavour to preserve some parts of these animals for our museums, have been, as far as I know, unsuccessful.

up at Kiel, that I became convinced that some few trifling particulars in which the crania may, perhaps, differ from each other, are at most only individual differences.

Thus, as it may be considered as an indisputable fact, that in all the different cases mentioned here, we have only to do with one and the same species, the next question will be, whether this species has already been described or not; for though it is not one of the dolphins generally known in the Northern seas, it does not of course follow that it is an entirely unknown form, generally speaking; nor, as we shall see, is this the case. It is true that it may be sought for in vain among the remaining more or less well-known species now in existence; even that one among the latter to which it has, perhaps, the greatest resemblance, the *Delphinus ferus*, from the Mediterranean, described by Bonnaterre,¹ but never found again since his time, must, if the description is in any way to be trusted, be quite a different animal, though it agrees with ours, as far as the length of the body and the number and size of the teeth are concerned. But the case is different when we extend our researches to the fossil, or so-called fossil species, for among these there is one, viz., Owen's *Phocæna crassidens*² (*Orca crassidens*, Gray),³ to which at all events it has a most striking resemblance, if, indeed, it is not quite identical with it. This species is founded on a cranium and some other parts of a skeleton, which some twenty years ago were dug up from beneath the layer of turf in the Great Fen in Lincolnshire, not far from the town of Stamford. Thus the circumstances under which these remains are found do not preclude the possibility of their belonging to a species still living, but hitherto unknown, and though their appearance caused the distinguished naturalist, to whom we are indebted for our information about them, to suppose that they were fossil, yet he has himself alluded to such a possibility, improbable as it might have seemed to him. Owen has described nothing but the cranium of his *Phocæna crassidens*, and his description is not detailed enough to admit of any minute comparison between his cranium and ours, being, indeed, especially intended to show the difference between the new species and the killer and the ca'ing-whale; in one particular, finally, the importance of which we shall examine more closely, it may, perhaps, be doubtful whether his description agrees altogether with the state of things as we have found them in our dolphin, but on the other hand, the short description is, on the whole, very appropriate, and the figures by which it is illustrated (viz., two figures of the cranium,⁴ and one of the five foremost cervical vertebræ),⁵ not only show a resemblance to our dolphin in the general outlines, but they present exactly those characters in particular by which it is distinguished from all the other more or less kindred forms. I therefore, believe, that we must really acknowledge this *Phocæna crassidens* of Owen, to be the dolphin stranded on our coasts, however strange it may seem, that our first knowledge of a Cetacean, of which great shoals are still, in our time, roaming about in our Northern sea, should have come to us through an individual which, thousands of years ago, found its resting place on a sea-

¹ "Tableau Encyclopédique et Méthodique des trois règnes de la Nature," "Cétologie," par M. l'Abbé Bonnaterre, Paris, 1789, p. 27.

² 'A History of British Fossil Mammals and Birds,' London, 1846, p. 516.

³ 'The Zoology of the Voyage of H.M.S. Erebus and Terror,' "Mammalia," London, 1846, p. 34. 'Catalogue of the Species of Mammalia in the collection of British Museum,' part i, Cetacea, London, 1850, p. 94.

⁴ L. c., fig. 213, p. 516 and fig. 216, p. 523.

⁵ L. c., fig. 214, p. 520.

bottom, now forming part of the soil of England. At all events we can hardly help believing in the identity until, either by a direct comparison, or by means of a more accurate description, and more detailed figures of Mr. Owen's fossil specimen, we should be able to point out possible differences, which cannot be derived from the information about this specimen at present before us. But whether our dolphin be the same as Owen's *Phocæna crassidens*, or not, it has a peculiar interest; for though related both with the Orcas, with the *Globiocephali*, and with the genus *Grampus* of Gray, yet it cannot (except by forcing their natural limits), be put down as belonging to any of those genera, either according to its external characters, or according to the peculiarities of its skeleton. The outward appearance of our dolphin is (as we have already said) pretty satisfactorily known from the photographs and the model taken from the Kiel specimen, copies of which are added to this paper, and I shall not stop to give a minute description of it, being unable to add anything to what is already shown by these representations. The hitherto unknown osteology, however, I shall try to detail by means of the more or less complete skeletons of the three individuals which have been at my disposal. Of these individuals, the female stranded at Asnæs is not only (as might be supposed, on account of its more considerable size) an older animal than either of the others, but, judging by the appearance of the bones, even an extremely old individual; the specimen stranded at Refsnæs is, indeed, only very slightly smaller than the male thrown ashore at Middelfart; but the sternum, still consisting of separate pieces, and the cervical vertebræ, less completely ankylosed, make it nevertheless clear that it is the youngest of the three; but even this individual is by no means a very young animal.

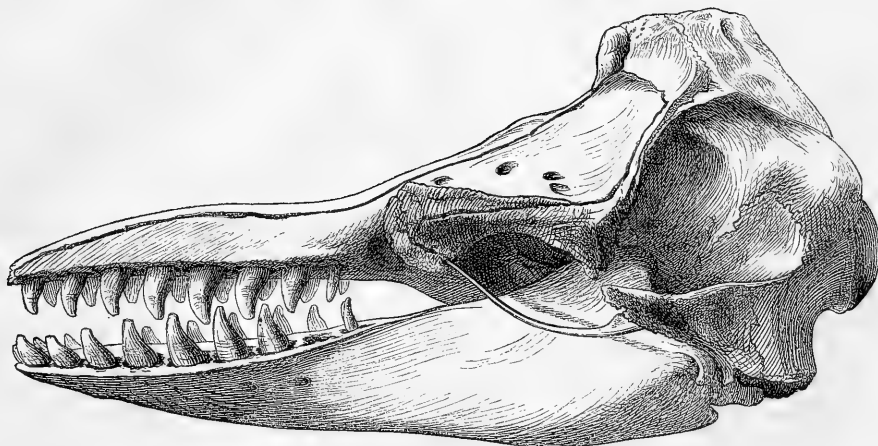
Though all parts of the skeleton of this dolphin may, generally speaking, be called rather powerful in proportion to its size, yet this may more especially be said about the skull, distinguished by its heavy, almost clumsy form, and making nearly one sixth (more exactly two thirteenthths) of the full length of the dried skeleton.

Of the dolphins which must be considered as most nearly related to ours, viz., the ca'ing-whales, the grampuses, and the killers, the last-mentioned may, perhaps, be said to resemble it most, as far as the general outline of the skull is concerned; in this respect, we should say that our dolphin differs more from the grampuses, and most, no doubt, from the ca'ing-whales. If we examine the two woodcuts (pages 197 and 198), representing the skull of the individual stranded at Refsnæs at one fourth of its natural size, as seen from the side (fig. 1), and from above (fig. 2), and compare them with the head of an Orca, it will be seen at once that the resemblance between them appears principally in the cranium, properly so called, and is especially produced by the great development of the occipital ridge, and its direction, as well as by the considerable circumference of the temporal fossæ, which again is in relation to the powerful set of teeth, and the corresponding weight and massiveness of the lower jaw. In the details, however, we shall find deviations enough. Thus, the back of the head or the occiput does not slope so obliquely behind, nor is it concave as in the Orcas; but, on the other hand, it is not so abruptly raised, and, at the same time, hardly so much vaulted as in *Grampus* or *Globiocephalus*.

The temporal fossæ are further very deeply excavated in the Orcas, and that part of them which is formed by the frontals is rather larger than smaller than their hindmost part, bounded by the parietal and temporal bones. In our *crassidens*, on the contrary, that part of the tem-

poral fossa which is formed by the frontal bones does not even make one half of the whole fossæ, and that part of its wall that is formed by the parietal and temporal bones is not con-

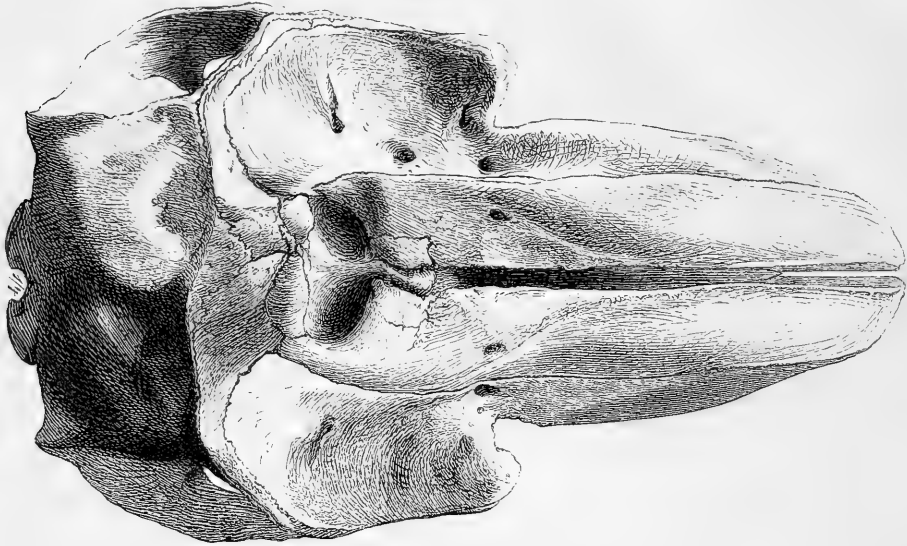
FIG. 1.



cave but convex. Thus, the temporal fossa is, no doubt, less spacious than in the killers, but this diminution in depth is partly compensated for by its being extended farther backwards, than in the latter Cetaceans, as the continuation of the occipital ridge by which it is limited behind, describes a parabolic curve, and not a simple arc of a circle, as in the Orcas (at any rate in the Northern species of this genus). In the grampuses and the ca'ing-whales, the temporal fossæ are much smaller, and the share which the frontal bone has in forming them is of very slight importance, especially in the latter. It is further peculiar to our dolphin, that it is not the nasal bones, but, on the contrary, a projecting knob on the interparietal bone, ankylosed with the occipital bone, behind the occipital ridge, which forms the uppermost point of the skull; for just the contrary is the case in all the three kindred forms. It must further be added that the nasal bones do not approach the occipital ridge so nearly as in the latter forms, but are placed some distance (about three inches) before it; the reason of this is, of course, that that extremity of the interparietal bone jutting out before this ridge, and that strip of the frontal bones which is not covered with the superior maxillaries is broader here than in the other three species. It may, perhaps, seem unsafe to derive a character from such a peculiarity, as in the Cetaceans, the bones of the cranium are frequently modified even considerably in their relative position during the growth of the animal; and, in truth, we cannot do so even in the allied species of the ca'ing-whales, for, when these are young, their nasal bones are almost as far removed from the occipital ridge, as in the form here described, whereas, we know that they come very near to it when the animal has increased in age. But in our *crassidens* we need scarcely fear that age might produce a similar alteration. For the individuals in question, are not only old animals, one of them even unquestionably very old; but a comparison between the latter and the somewhat younger specimen from Middelfart, shows that the distance between the occipital ridge and the nasal bones become even rather greater than smaller, as the animal grows older.

In the facial part ("the beak"), the resemblance to the killers is, perhaps, somewhat less striking; for this part is shorter than the remaining part the skull, contrary to what is the case in

FIG. 2.



those crania of killers which I have examined; it is moreover very broad, and obtusely rounded in front, and is also distinguished by tapering very slightly and very uniformly in a forward direction, so that it is not much narrower even in the middle than in the place where it is broadest farther behind, and these characters seem to become continually more distinct as the animal advances in age; at least we have found that the cranium of the Asnæs dolphin, evidently an extremely old individual, was the one of the three having the shortest and broadest beak. One thing, however, produces a most conspicuous difference between our dolphin and the Orcas, we mean the different breadth of the intermaxillaries; for when we add the fissure between them filled with the cartilage of the primordial vomer, then these bones occupy about two thirds of the whole breadth of the beak in our *crassidens*, while in the Orcas they are much narrower than the superior maxillaries. In this respect we find unquestionably a likeness with the ca'ing-whales, in which the intermaxillaries, as is well known, are also, and even in a still higher degree, remarkable for their breadth; but beyond this no further resemblance is to be found with these in the structure of the beak. In the ca'ing-whales, far more than in our dolphins, the unusual size of the intermaxillaries is produced at the expense of the superior maxillaries, and it is not strange that the latter have a diminished share in the breadth of the beak, as the feeble set of teeth of these animals only requires small and shallow sockets. Behind the short row of teeth, the alveolar margin is further gradually twisted in such a way as to have an edge turned outwards, and this exterior margin of the superior maxillaries is not placed on a level with the intermaxillaries behind, but a little above them, by which means the surface of the beak becomes somewhat concave in this place. It is true that the intermaxillaries of Cuvier's *Delphinus*

griseus are not so broad as those of the ca'ing-whales, (nay not even so broad as those of our *crassidens*); but judging by the figures,¹ this dolphin seems, nevertheless, as far as the rest of the beak is concerned, to be much more similar to these Cetaceans, than to the type of any other species. But the case is somewhat different in the species which we are here describing, the surface of the beak is from its origin somewhat convex, the dental row occupies almost the whole length of the beak, the superior maxillaries have still a considerable thickness, in order to leave room for the very deep sockets of the teeth, and are, generally speaking, much more like the same bones of an Orca than those of the ca'ing-whale or the Grampus.

The asymmetry pervading the whole cranium also affects the intermaxillaries, and especially the hindmost part of these bones. The right one is perceptibly broader than the left, and is quite contiguous with the corresponding nasal bone, its posterior extremity inserting itself between the latter and the superior maxillary; the left, on the contrary, does not extend quite so far backwards, and more especially does not quite reach the nasal bone, which is also influenced by the general asymmetry, being considerably smaller than the right one. Just before the nostrils there is a notch in the inner edge of both of the intermaxillaries, and in the space thus left a portion of the superior maxillaries become visible. In conformity with the general obliquity of the head the visible part of the right superior maxillary is always somewhat larger than that of the left; but the portion of these bones, laid bare in this manner, may, in different individuals, be sometimes a little larger, sometimes a little smaller. Something very similar also takes place in the common ca'ing-whale, and (though in a smaller degree) in the northern killers, and various other dolphins, amongst others in the common porpoise. On the contrary, it does not seem to be the case with *Grampus griseus*, to judge by Cuvier's figures, and from this Cetacean the dolphin here described also differs in another and more important respect, as far as this part of the skull is concerned. The intermaxillaries of *Grampus griseus* are dilated in front of the nostrils, according to the statements of both Cuvier² and J. E. Gray,³ so as to cause a convexity in this place; but no trace of anything of the kind is to be found in our species, in which the intermaxillaries are, on the contrary, somewhat depressed at some distance before the nostrils, and the distinctly defined three-cornered region in this place, denominated by Gray the "triangle," here forms a slight depression, as in most other dolphins.

As far as may be inferred from Owen's short description and small figures of his *Phocaena crassidens*, it must be quite similar to our dolphin, as to all the details of the characters of the cranium which have been examined above; it has, therefore, hitherto been unnecessary to refer particularly to the fossil form, and compare it with our specimens. We shall now mention the only point, as to which the resemblance may at first glance seem doubtful, and which accordingly must be considered more minutely. We know that in the dolphins the vomer is sometimes visible on the inferior surface of the beak (sometimes even in two different places), and thus it may have some share in forming the palatine surface; sometimes on the contrary, it does not appear there at all. Now Owen states that the vomer appears on the

¹ 'Recherches s. l. Oss. Foss.,' 4me ed. Atlas, tome deuxième, pl. 223, figs. 1 and 2.

² Ibid., 4me ed. tome 8, 2me partie, p. 125.

³ 'The Zoology of the Voyage of H.M.S. Erebus and Terror,' "Mammalia," p. 30. Catalogue of the Mamm. in the Coll. of the Brit. Mus., P. 1, Cetacea, p. 82.

osseous palate of *Phocæna crassidens* in the same place, and to the same extent as in the common porpoise.¹ If this statement is to be interpreted according to the strictest sense of the words, it would, perhaps, point out a difference between the fossil form and the dolphins from our shores, for the vomer does not exactly resemble that of the common porpoise in any of the crania. In the common porpoise the visible piece of the vomer is considerably broader, in proportion to its length, than in our specimens; and, besides, it is placed on a level with the bones between which it appears, whereas in our dolphin it is seen lying deeper than the latter, as it were, at the bottom of a fissure between them, when we look down from above upon the palatine surface. But we suppose that Owen's words are not to be explained quite literally. It must be remembered, that he does not compare his fossil form with the common porpoise; but with the great Northern dolphins, the killer, the ca'ing whale, the beluga, and the *Grampus griseus*, in all of which the vomer does not appear at all on the palatine surface. It was, therefore, of little importance to him to lay much stress on any slight possible difference between his fossil form and the common porpoise, relative to their vomers; but only, by a comparison taken from an animal generally known, to state briefly and generally, that the vomer is visible on the palatine surface in the fossil form, in opposition to what is the case in the other great Northern species, and this opinion of ours is corroborated by his own figure, which does not seem to represent the vomer as it appears in the common porpoise. When we take all this into consideration, we shall hardly find sufficient reason to derive, from what Owen states about the vomer of his *Phocæna crassidens*, a difference between it and the dolphin thrown ashore on our coasts, the less so, as individual peculiarities are to be found, at least in the latter, as to the appearance, of this bone, which must render it very unsafe to found any characters upon it. For it is only in the dolphins stranded at Middelfart and Refsnæs, that the vomer appears in the manner described above; not the slightest portion of this bone appears on the palate of the very old individual thrown ashore on the southern side of Asnæs.

The large powerful teeth with which our dolphin, as well as the killers, is provided have caused that the lower jaw, not less than in the latter, is distinguished by a massive thickness and weight, forming a striking contrast to its slender structure in the ca'ing-whales. The difference between our dolphin and the ca'ing-whale is so great in this respect, that the lower jaw of the individual stranded at Refsnæs weighs almost twice as much as the lower jaw, one inch longer, of a Farøe ca'ing-whale; the former being about four pounds, the latter only two pounds and one eighth. It is, however, not only by its great weight and thickness that the lower jaw reminds us of the lower jaw of an Orca, also in its shape it more resembles the latter, than the lower jaw of a ca'ing-whale. If we look at it from the side, we shall find that the inferior edges of its rami are almost straight, as in the Orcas; whereas the same edge of the lower jaw of the ca'ing-whale is very much curved, so as to describe an arc with the convexity turned upwards, the uppermost point of which is found nearly below the posterior extremity of the dental row, so that the jaw, when placed on a level surface, only rests on two points, that is to say, quite at the posterior extremity, and in front at the point where the symphysis commences. This same curvature is also found in the lower jaw of *Grampus griseus*, and further in that of the beluga (*Delphinapterus leucas*), and partly also in that of the narwhal (*Monodon monoceros*); thus, it seems to be characteristic of the

¹ 'Hist. of British Fossil Mamm. and Birds,' p. 518.

great broad-nosed dolphins having only a feeble, or defective set of teeth, whereas the form of the lower jaw of our *crassidens* and the killers is called forth and necessitated by powerful and large teeth. It is further a consequence of the size of the teeth, that the dental row, just as in the killers, occupies the larger half of the whole length of the jaw, although the teeth are hardly so numerous as in the ca'ing-whale, in which the dental row (even before a single tooth has as yet fallen out) does not occupy more than a third of the jaw; and finally, and partly for the same reason, the difference between the greatest height of the jaw behind and its smallest height close to the symphysis, is not so considerable as in the ca'ing-whale, and the symphysis itself is comparatively longer than in the latter species; but in these two respects also our dolphin bears a close resemblance to the killer. The considerable size of the teeth (comparatively speaking, scarcely smaller than those of the killers) has already been briefly alluded to, we must now give a more minute description of them. They are slightly curved in an inward direction, and placed in deep sockets, which both in the upper and in the lower jaw are completely separated from each other through their whole extent, whereas the sockets of the teeth of the killers are most frequently only imperfectly separated. Only between the two hindmost sockets the partition may sometimes disappear, and the cavities may thus become more or less completely coalesced. In the lower jaw, the foremost socket approaches the point of the jaw as much as possible; but such is not the case in the upper jaw, as the intermaxillaries project in front of it, though only very slightly. The roots of the teeth seem to close much faster than in the majority of the killers; at least the roots are still perfectly open in the teeth of several crania of a species of large killer from the seas round the Farøe Islands, which belonged to animals middle-aged, at least, rather than to young ones; whereas the teeth even of the Refsnæs individual of the species here described have their roots perfectly pointed, and it is only in the largest teeth that an insignificant aperture is left in the points of the roots leading into rather a narrow internal cavity. In the upper jaw, the teeth increase in size progressively backwards up to the last tooth, which becomes suddenly again considerably smaller than the preceding one; in the lower jaw, the foremost tooth is also very small, scarcely half as large as the second one; then the teeth uniformly increase in size up to the seventh or eighth, which are of about the same size; the ninth is again a little smaller, and the hindmost again less than half the size of this one. The teeth are almost of the same size in both jaws; the largest are two and a half inches in circumference just above the alveoli, and have a length of about three inches, of which the enamelled crown occupies about one third. The number of the teeth is subject to individual differences; Möbius¹ states that the number of the teeth of the individual caught in the harbour of Kiel, is twenty in either jaw, ten on either side, and Professor Behn has confirmed this statement in a letter to the author of this memoir. But this number we do not find repeated in any of the individuals stranded on the Danish coasts, nor do the latter quite agree with one another as to the number of their teeth. Thus, the individual stranded at Middelfart has nine teeth on either side of either jaw, the total number being smaller by four than in the Kiel dolphin, and there is not the slightest trace of its having had more teeth at an earlier period of its life. In the Asnæs specimen, the teeth had fallen out, and only one or two were found lying on the beach, where the body was landed; but by the quite uninjured sockets we may ascertain with perfect certainty, that this individual.

¹ l. c. page 3.

like the Kiel dolphin, had ten teeth on either side of the lower jaw, of which, however, the two hindmost ones were placed in a common socket, this, however, bearing traces not to be mistaken of having originally consisted of two, now united into one. In the upper jaw, on the contrary, there are only eight teeth on either side, or two fewer than the Middelfart specimen; in the Refsnæs dolphin, finally, of which all the teeth, except one or two, were present, and still fixed in their sockets, when it was disinterred from where it was buried, the number of the teeth, both in the upper and in the lower jaw, was quite the same as in the Asnæs dolphin, but the hindmost tooth in the upper jaw was lodged here in its own socket, perfectly well separated from the last but one. In the Refsnæs dolphin the teeth were but little worn,¹ and, more especially, the teeth of the left side were a little less worn than those of the right side; the teeth of the Asnæs dolphin must, to judge from those very few of which I obtained possession, have been worn a good deal more, especially the foremost ones in the jaw; yet the wear is not greater, than will show perfectly clearly, that this dolphin *keeps its teeth until the last period of its life*. We have hitherto only mentioned those teeth which are fixed into distinct sockets; but besides these, one or even two teeth are sometimes, at least, to be found quite anteriorly on either side of the upper jaw; for these no sockets are to be found, and they can therefore only be fixed in the gums. I have not seen these teeth myself (which have been observed neither in the Middelfart dolphin, nor in the Refsnæs specimen), but I am indebted for my knowledge of them to the kind information of Professor Behn, who told me in a letter that during the preparation of the cranium of the Kiel dolphin, two small teeth were found lodged in the gum; he did not see them himself, until after they had been taken out, but the preparer stated that he had found them in the upper jaw, and as to this point, at least, he can hardly have been mistaken; but whether they were placed one on either side, or both on the same side, Professor Behn found it impossible to ascertain. From the appearance of the teeth, however, he thinks himself enabled to conclude, that two such diminutive teeth must, originally, at least, have been found on either side; for though there is no great difference in their length, yet the one is so much thicker than the other, that it weighs three times as much as the latter (the greater one twelve, the smaller one four grains); thus, it does not seem very probable that they formed a pair, and if this supposition is correct, the original number of teeth in the upper jaw of the Kiel dolphin must have been twelve in either side; it may, however, be doubtful whether these teeth are always to be found, and I feel especially inclined to believe that they were not present in the Refsnæs dolphin.

In order to render my description of the cranium more complete, I shall here add several measurements of the three skulls at my disposal; to make the comparison with *Delphinus griseus* easier, I have chosen chiefly to give the same dimensions that Cuvier has given of the cranium of this animal in his 'Recherches sur les Ossemens Fossiles,' and finally, I have in a fourth column added those measurements which Owen has given of his *Phocæna crassidens*, reduced into Danish inches and lines.²

¹ All the crowns of the teeth of the Middelfart dolphin having been broken off, one or two excepted, before the skeleton arrived at this town, it cannot be ascertained, whether its teeth have been much worn or not; though judging from the few uninjured teeth, we should say that the wear has not been much greater in this specimen than it was in the one from Refsnæs.

² As to these measurements it must, however, be observed that they do not quite agree with those given by J. E. Gray, though it is the same cranium that has been measured by both the English

	The specimen from Asnæs (♀).	The specimen from Refsnæs.	The specimen from Middelfart (♂).	Owen's fossil <i>Phocæna crassidens.</i>
Length of the head measured from the occipital condyles to the tip of beak	—	24"	24"	25" 2"
Length of the head measured to the middle of the inferior margin of the occipital foramen	—	23" 2"	23" 2"	—
Length of the cranial portion measured from the occipital condyles to the posterior wall of the nasal canal	—	8" 9"	8" 6"	—
Length of the beak measured from its origin on a level with the anterior extremities of the zygomatic bones	10" 8"	11"	11"	11" 7"
Greatest breadth of the head (across the zygomatic processes of the temporal bones)	14" 8"	14" 10"	14" 1"	—
Breadth of the head across the postorbital processes of the frontals	—	14" 3"	14" 4"	14" 6"
Breadth across the occipital ridge at its union with the temporal ridges	8" 8"	9"	8" 3"	—
Breadth across the prominences formed by the frontals, the superior maxillaries and the zygomatic bones in front of the orbit	—	13"	12" 8"	—
Breadth of the beak at its origin	8" 3"	8" 3"	8" 1"	—
Breadth of the beak towards the middle, just before the most posterior tooth but two	8" 1"	7" 9"	7" 6"	—
Height of the occipital foramen	—	2" 3"	2" 8"	—
Breadth " "	—	2" 2"	2" 6"	—
Distance from the inferior margin of the occipital foramen to the posterior margin of the pterygoid bones	—	8" 2"	8"	—
Length of the dental row in the upper jaw	9" 8"	10" 2"	9" 9"	—
Length of the lower jaw measured from the condyle to its foremost extremity	18" 6"	19" 6"	18" 4"	19" 2 $\frac{1}{2}$ "
Length of the symphysis	3"	4"	3" 1"	—
Length of the dental row in the lower jaw	9" 1"	10" 2"	9" 5"	9" 2"

When compared with the greater majority of the other Cetaceans belonging to the dolphin family, the dolphins to which the one treated of here is most closely allied are all provided with rather a small number of vertebræ. The *Grampus griseus*, one of the forms in question having the greatest number, is stated by Cuvier¹ to have only sixty-one. In three skeletons of ca'ing-whales from the Farøe Islands, I find the number of the vertebræ to

naturalists; the discrepancies may perhaps be partly explained by the mutilated state of the skull, which may have rendered it difficult to give some measurements otherwise than approximatively; but, at all events, they show that we must not overrate the small differences found in some dimensions of Owen's cranium, when compared with those of the Danish crania. I may add in this place, that the reason why I have given fewer measurements of the cranium of the Asnæs dolphin than of the two other crania from Refsnæs and Middelfart, is the mutilated condition of the former.

¹ 'Rech. s. l. Oss. Foss.,' 4me ed., t. 8, 2me partie, p. 147.

vary between fifty-eight¹ and sixty, and with this number agree the greater part and the best authenticated of the earlier enumerations of the vertebræ of this species ; in some of our Northern Orcas, finally, we find fifty-two, in others fifty-four or fifty-five vertebræ. In this respect, also, our dolphin agrees with its kindred species ; nay, its vertebræ are even a little less numerous than those of the Orcas themselves ; for in the individual found at Middelfart, we count fifty-one vertebræ, the Refsnæs specimen had altogether fifty. So small a number of vertebræ as this is otherwise only found, within the group of the dolphins, in the beluga, and in the platanista,² which deviates in so many respects from the common type. There is some reason to suppose that of the numbers just mentioned, the latter (fifty) will most likely be the normal one, whereas the former seems only to be owing to a supernumerary vertebra, which in the Middelfart dolphin has accidentally increased the number of the dorsal vertebræ beyond the usual number. For in the skeleton of the individual found at Refsnæs, the caudal vertebræ are not, indeed, all present ; but if we compare this skeleton with the one from Middelfart, having all its caudal vertebræ, we may easily be satisfied that no more than the last three of them are wanting in the former skeleton, and that the caudal vertebræ have originally been present in both individuals in the same number, viz., twenty-three :³ in front of the caudal vertebræ, on the other hand, we find altogether twenty-eight vertebræ in the Middelfart dolphin, but only twenty-seven in the one from Refsnæs. A more minute examination will show that the number of the lumbar vertebræ is the same in both individuals, but that the Refsnæs dolphin has ten pairs of ribs, and accordingly as many dorsal vertebra, whereas in the Middelfart dolphin an eleventh dorsal vertebra is to be found behind the tenth, and to this additional vertebra an eleventh rib belongs, lying loose in the flesh on the right side, to which we find no corresponding rib in the left side, a defect which, according to Professor Eschricht's express assurance, is original. The question will therefore be, whether we are rather to suppose that one dorsal vertebra is wanting in the Refsnæs dolphin, or that a supernumerary one exists in the Middelfart specimen ; but as, generally speaking, it is certainly more frequently the case that supernumerary vertebræ are to be found in this part of the spine than that any should be wanting, and as the circumstance of the eleventh dorsal vertebra in the case treated of being only provided with one rib, seems further to speak in favour of the first supposition, and as, finally, I have been informed that no more than ten pairs of ribs are to be found in the skeleton of the

¹ In the skeleton, where this number of vertebræ is counted, the last caudal vertebra is evidently ankylosed with the penultimate into one bone, which has been reckoned here as two vertebræ ; if it is only counted as one, the whole number will, of course, be only fifty-seven.

² The *Hyperoodontes* or *Ziphioides* have, indeed, still fewer vertebræ ; but they do not, according to my opinion, belong to the dolphins at all, but, in analogy, with the cachalots (*Physeteres*) constitute a group by themselves, equally distinct from the latter, and from the dolphins properly so called, all within the great section or sub-order of the toothed-whales ; and when we leave these unnoticed, our statement, as expressed above, is correct.

³ I consider the hindmost of the two vertebræ to which the first chevron bone (hæmapophysis) is affixed, to be the first caudal vertebra, as is also done in the essay by Eschricht and myself on the Greenland whale, published by this Society. In his earlier essays upon the Cetaceans, and especially in the one on the Ganges dolphin, Professor Eschricht has included the foremost of the two said vertebræ among the caudal vertebræ, whereas, according to the mode of computation followed here, it must be called the hindmost lumbar vertebra.

Kiel specimen, ten dorsal vertebræ may certainly be considered to be the normal number in this species, which, accordingly in this manner, will be provided with seven cervical, ten dorsal, ten lumbar, and lastly, twenty-three caudal vertebræ. In consequence of this comparatively small number of the vertebræ, the single vertebræ, especially in the hindmost part of the dorsal region, in the lumbar region, and the greater part of the tail, are more extended in length than in the ca'ing-whales and the killers, and as moreover the spinous processes are somewhat lower than is the case, not only with the former, but also with the latter, the appearance of the spine, generally speaking, will be found to differ not a little from that of the spine of an Orca, and still more from that of the spine of a ca'ing-whale. It may further be inferred that our species is in this respect no less different from the *Delphinus griseus* also, both from the considerable difference between these two animals in the number of their vertebræ, and from Cuvier's words about this species, first described by him: "Les apophyses épineuses s'élèvent beaucoup sur le commencement des lombes," seeming also to denote that such is the case; but his description is so short, that we are not able from it alone to obtain an accurate idea of the peculiarities of the spine of this *Delphinus griseus*.¹

If we pass to the examination of the details of the vertebral column, and in the first place to that of the cervical vertebræ, we shall find that the ankylosis of these is farther advanced than either in the killers, or in the ca'ing-whales. For though in old animals of the former species, the four or five, or in rare instances, perhaps, even the six foremost cervical vertebræ may be ankylosed by means of their spinous processes,² yet it is only the two, or, at most, the three foremost of the vertebral bodies that are ankylosed; the rest of them always remain separate, and though the bodies of the six foremost cervical vertebræ may sometimes be ankylosed in the ca'ing-whales, yet both the sixth and the fifth may also, even in very large, and evidently very old individuals remain separate from each other, and from the preceding ones. But in the species of which we are now treating it is not only the six foremost, but in some individuals, even all seven cervical vertebræ that have their vertebral bodies ankylosed. Thus, the former is the case in the individual drifted ashore at Asnæs, the latter in the male stranded at Middelfart; it is true, that only the five foremost cervical vertebræ have their bodies ankylosed³ in the individual found at Refsnæs; but this must most probably only be considered as a consequence of the greater youth of this individual; for the thin posterior epiphysis of the fifth cervical vertebra is not united with the middle piece of the vertebral body, and both the epiphyses of the sixth are still free; and it is certainly probable that, just as the anterior osseous disk of the fifth vertebral body is already perfectly united, not only with the middle piece of the body, but further with the body

¹ 'Rech. s. l., Oss. Foss.,' 4me ed., tom. 8, 2, page 147.

² Of the cervical vertebræ of an Orca from the Skagerak preserved in the Royal Museum, the four foremost are perfectly ankylosed by means of their spines; the spine of the fifth cervical vertebra is, indeed, perfectly separated from these ankylosed spines of the preceding vertebræ, but, on the other hand, it is again ankylosed to the spine of the sixth cervical vertebra, and it is placed so closely up to the fourth one, and the irregularities in the contiguous surfaces fit so exactly together, that the thought strikes us quite naturally that these, too, are going to be ankylosed, and that if the animal had grown somewhat older, all the six foremost cervical vertebræ would have been united by their spinous processes, while only the three foremost are ankylosed also by their bodies.

³ The same was the case with the individual on which Owen founded his *Phocæna crassidens*, but we are not informed whether this was a young animal or not.

of the preceding fourth cervical vertebra, so the posterior epiphysis of the fifth vertebra would not only in time have become united with the middle piece, if the animal had grown older, but an ankylosis of the contiguous epiphyses of the fifth and sixth vertebral bodies would also have taken place during the process of ossification. But it may be doubted, whether the ankylosis of the body of the seventh cervical vertebra with the other six, is to be considered as a consequence of the increasing age of the animal, or whether an individual difference, independent of age, does not prevail in this particular; at all events, there is not any other reason to consider the individual thrown ashore at Middelfart to be older than the one from Asnæs; it must on the contrary, be supposed to be younger; for, in the Middelfart specimen, the epiphyses of the vertebral bodies are much farther from being united with the middle pieces in the remaining part of the spine, and especially in the dorsal region, than in the Asnæs dolphin, where the growth of the vertebræ is all but completed. In the five foremost cervical vertebræ, the arches are ankylosed partly by means of their *processus obliqui*, partly by the points of the spines, though not exactly in the same manner in all individuals; but the arches of the two posterior cervical vertebræ are not united with those of the preceding ones in any of the three individuals which I have been able to examine, and the ankylosis of the cervical vertebræ seems to be fully as much advanced in the bodies themselves, as in the arches, contrary to what is otherwise usually the case. There are also some peculiar characters in the transverse processes; in the atlas we find as usual a thick transverse process; but the axis, which in the killers and in the ca'ing-whales (at least in *G. melas*) is also furnished with a powerfully developed transverse process, not much inferior in size to that of the first cervical vertebra, presents in our dolphin only a slight trace of such a process in a projecting ridge; this, however, as well as the well-developed process itself of the allied forms of dolphins, must be supposed to correspond to both the superior and inferior transverse processes of the succeeding cervical vertebræ. Such double transverse processes are also found in our species, though only in quite a rudimentary condition in the third, fourth, fifth, and sixth cervical vertebræ; the superior ones appear like thin, vertically placed, osseous laminæ, subject to individual differences, that on the third cervical vertebra being the largest; the inferior ones are more knob- or knot-like, but about these, too, it holds true that they are hardly found quite similar in size and form in any two individuals, and one or another of them may even sometimes be entirely wanting. As to these last-mentioned processes, our dolphin may be said to have a middle place between the killers, in which they have also the form of irregular osseous knobs, but are, however, considerably larger than those of our dolphin, and the ca'ing-whale, in which they may almost be said to have totally disappeared. But in the structure of the seventh cervical vertebra a striking resemblance appears again between the ca'ing-whale and our species; for this vertebra, which has no inferior transverse process, is (like that of the ca'ing-whale) provided with a superior transverse process turned obliquely forwards, several times longer and thicker than the preceding ones, whereas, in the killers, the same process is as rudimentary as those immediately preceding it. Thus, generally speaking, and contrary to what appears to be the case in many other parts of the skeleton, the cervical vertebræ resemble those of the ca'ing whale much more than those of the killers, and the most essential and conspicuous difference between our dolphin and the ca'ing-whale in this portion of the vertebral column is, properly speaking, limited to the one already alluded to, which appears in the very different development of the transverse processes of the second cervical vertebra. It must be left undecided how far our dolphin and

the *Grampus griseus* resemble each other or not in their cervical vertebræ, so long as we, with respect to the latter, have only Cuvier's description to go by, which as to this point is quite insufficient. To judge by his words, we may, perhaps, surmise that his dolphin agrees with ours, at all events, insomuch that all seven cervical vertebræ grow together into one solid osseous mass; for his words are: "dans le *griseus*, les cervicales se soudent aussi promptement que dans le dauphin;"¹ but, at the same time, it must not be overlooked that he expresses himself in much the same manner about his *Delphinus globiceps*, generally considered as identical with the *Delphinus melas* of Traill, although, in this instance, the seventh cervical vertebra (at any rate according to my experience) remains separate throughout life.²

The body of the first dorsal vertebra is scarcely longer than that of the seventh cervical vertebra, but that of the second dorsal has already almost double the length, and the succeeding vertebræ uniformly increase in length. The distinction between two different elements in the anterior of the processes known by the name of *processus obliqui*, or *articulares*, in the dorsal and lumbar vertebræ, namely, partly the real articular process, partly the wartlike process—*processus mammillaris* as it is called, placed outside the former, a distinction which of late has been pointed out, especially by A. Retzius, must to a certain degree be acknowledged as justifiable in our dolphin, as in the Cetaceans generally; mammillary processes may, properly speaking, be distinguished already in the second dorsal, and even in the seventh we may still, though with difficulty, discern both one of these and an articular process placed inside it. But from thence these two sorts of processes are united in one, and as the mammillary processes are not particularly prominent, even where they are largest, but may very well be regarded as parts of the articular process, I prefer to take no further notice here of the distinction made by Retzius, and accordingly to use the denomination of *processus obliqui*, or *articulares*, in their earlier, and more common

'Rech. s. l. Oss. Foss.,' l. c., p. 147. As to the comparison used by Cuvier in this place, I may, perhaps, be permitted to observe, that while he assumes all seven cervical vertebræ to be ankylosed in the *Delphinus delphis* (l. c., p. 140), it is stated by Rapp ('die Cetaceen,' p. 62) that only the two foremost are ankylosed in this species. Dr. Jackson finally, who in 'Boston Journal of Nat. Hist.,' 1845, has described a dolphin from the coast of North America, which, according to his supposition and that of Gray, may, perhaps, be referred to *Delphinus delphis*, is (according to Gray's citation of the original essay, inaccessible to me) said to have "the first and second cervical scarcely moveable upon each other; and the other five smaller and rather more moveable" (Gray, 'Catal. of Cetacea,' p. 122). I must leave it undecided how far the discrepancies of these statements are caused by different species or individuals of different age having formed the objects of the different researches, or by what other manner they are to be explained. I shall only remark that, whether Jackson's seven feet long dolphin was the genuine *D. delphis* or not, his statement about a mobility, be it ever so slight, between the axis and the atlas, may, perhaps, be considered doubtful. Even in such forms as have only these two vertebræ ankylosed, but the rest of the cervical vertebræ free as *D. tursio*, the bodies of the two first-mentioned vertebræ are so completely ankylosed, that we cannot even point out any limits between them, and by examining fetuses of *Phocæna communis*, it will be seen that the coalescence is already to be found in these. We shall hardly in any dolphins find a mobility between the atlas and the axis, except in those few cases in which all the cervical vertebræ remain free throughout life; and such is only the case with forms that are generically widely different from the group to which *Delphinus delphis* belongs, namely, with the narwhal, the beluga, and the platanista.

² l. c., p. 146. "Dans le *globiceps* les cervicales se soudent assez vite."

sense. If we continue, then, to use this terminology, we shall find that the posterior articular processes have already disappeared in the sixth dorsal of the Refsnæs dolphin, and in the seventh dorsal of the Middelfart individual, whereas the anterior ones do not entirely disappear until quite posteriorly in the caudal vertebræ. But whereas these anterior articular processes in the different genera of dolphins still continue to clasp round the root of the preceding spinous process, in a shorter or longer portion of the dorsal and lumbar region, even after the articular surfaces have disappeared, and though they have advanced upwards themselves on the vertebral arch to the roots of the spinous processes, there is not one amongst them in our dolphin that reaches quite to the spinous process preceding it. This, we suppose, is partly owing to their not being particularly large themselves, but also to the considerable length of the vertebral bodies by which the intervals between the spinous processes are rendered uncommonly large. I know no other dolphin besides this where such is the case; in the nearly related species of the killers we still find some eight or nine vertebræ, the spines of which are thus clasped from behind by the articular processes of the succeeding vertebra, and even in the ca'ing-whales, though, perhaps, in this respect more similar to the one here treated of than any other dolphin, we always find some of the spinous processes of the posterior dorsal vertebræ enclaspd in this manner.

Ten pairs of ribs, which I have previously thought right to consider as the normal number in our *crassidens*, is a smaller number than is found in any other dolphin; even the kindred species of the killers and the ca'ing-whales have eleven or twelve pairs, and according to Cuvier, the last number is also found in *Delphinus griseus*. Of these ten pairs, the five foremost are true ribs; the six foremost attach themselves to the vertebral bodies, as well as to the transverse processes; the four posterior pair, on the contrary, are only affixed to the latter, and thus have neither neck or head. In the skeleton of the male stranded at Middelfart, however, we find, as it were, a trace indicating that the seventh pair of ribs was also intended to have fastened itself both to the vertebral body and the transverse process. For though in this pair of ribs there is not the slightest trace of any neck in the ribs themselves, yet the anterior margin of the transverse process of the seventh dorsal sends out a cylindrical process, pointing obliquely forwards and inwards towards the hindmost part of the body of the sixth dorsal, where again we find a projecting knob analogous to the similar one of the preceding vertebra to which the head of the sixth rib is attached. It is, however, only in the right side of the skeleton, that this interesting peculiarity is seen exactly as I have described it; for this little process that strives to form a bridge in an oblique direction from the transverse process of the seventh dorsal to the body of the sixth, is in the left side somewhat more slender than in the right side, nor has it on this side preserved its connection with the transverse process, but is, on the contrary, ankylosed with the body of the last-mentioned vertebra. In both cases, however, it cannot be doubted for an instant, but that it really is some trace, or rudiment of a costal neck, intended for the seventh pair of ribs, that we have before us, though having become entirely separated from the rib, and ankylosed with the vertebra, with which it was to have been attached. We sometimes find the same peculiarity in the seventh dorsal of the ca'ing whale, nor should we wonder if this similarity were considered as indicating some very close relationship between our dolphin and the latter species. Now, I shall not deny that some similarity may really be found to exist between them in this respect, as far as I have hitherto only found this peculiarity in these two species; but the importance we may ascribe to this similarity, is, at any rate, very

insignificant. The circumstance, that the process does not appear in exactly the same manner on both sides in the Middelfart dolphin, would in itself warrant any misgivings as to its being an important or constant feature, nor, indeed, do we find even a trace of it in the skeleton of the individual found at Refsnæs; and the ca'ing-whale is exactly in the same case, for this peculiarity is found in some individuals of this species, but is entirely wanting in others; and thus, we suppose, it can hardly be entitled to be considered other than a mere accidental, though, perhaps, frequent abnormality.

The sternum consists of four pieces; in the full-grown male from Middelfart the three foremost of these are united into one bone, in which, however, we may still discern the limits between the original parts tolerably well; the hindmost portion, on the contrary, though completely ossified, is only moveably joined with the preceding ones. The four pieces of the sternum of the individual found at Refsnæs are not yet ankylosed to one another, and the hindmost piece is still only cartilaginous; the sternum of the female drifted ashore at Asnæs had been broken when the animal was cut up, and I only succeeded in finding one of the fragments. I cannot, therefore, state with certainty, whether in the last period of life all four sternal bones become completely ankylosed, but it can hardly be doubted but that such is the case. In the foremost piece, or manubrium, the surface turned upwards is longitudinally concave, but transversely convex; the surface turned downwards is, on the contrary, longitudinally convex, and, especially in its foremost extremity, transversely concave, in its posterior portion it becomes gradually more flat in this direction. Behind the place where the first rib is attached to it, the margin of the sternum projects into a pointed angle which, however, does not assume the character of a special process, to such a degree as in the ca'ing-whale, and still more in the killers. Not far from its anterior edge, the manubrium is perforated in the mesial line by an oblong hole of somewhat different size in the different individuals, and, in the old individual from Asnæs we find, a couple of inches behind this, another much smaller hole, of which, however, nothing is to be seen in the two other individuals; both holes are of course indications of the original ossification of each of the sternal bones from two centres situated side by side. Of the most nearly allied forms, the ca'ing-whales are also provided with the foremost of these holes, but in *D. griseus* it is wanting, according to the statement of Cuvier, nor do I find any traces of it in the Orcas, but as may readily be supposed, this hole is not a character of particular importance; it may be found in forms which differ very much in other parts of their skeletons, and it may be wanting in one or the other of two nearly related forms. I find it in a *Lagenorhynchus*, and in the common porpoise; it is further to be found in *Delphinus delphis*; on the contrary, it is wanting in *D. tursio*, in the platanista, the narwhal, and the beluga. In the Refsnæs dolphin the individual pieces of the sternum are considerably narrower, and, especially the second one, comparatively longer, than is the case with the male found at Middelfart, and thus the sternum seems to change its form pretty much with age. I shall only add still that an asymmetry similar to that which appears in the skull, pervades the whole sternum; for this bone, but particularly its anterior portion, has like the skull, a slight but perceptible twisting from the right to the left. I do not, however, mention this asymmetry as something peculiar to this dolphin; the same appears more or less distinctly in other species also, and is, perhaps, even the rule, but this asymmetry in the dolphins, which may also appear in the ribs being a little longer on the right than on the left side, has commonly been completely overlooked, though, indeed, it is well deserving of attention.¹

¹ As far as the cachalots are concerned, Mr. William S. Wall has pointed out an obliquity also

If we return again to the vertebral column, we still find the size of the vertebræ uniformly increasing as we pass backwards in the lumbar region; we saw in the dorsal, the vertebral bodies becoming continually wider, and at the same time increasing in length, at least, as far as the two or three hindmost ones, and even these are by no means shorter than those nearest preceding them; therefore the lumbar region is considerably longer than the dorsal region, the proportion between them being about that of three to two, though the lumbar are not more numerous than the dorsal vertebræ. It is almost superfluous to remark that the vertebral arches become gradually smaller, and the spinal canal more narrow as the vertebral bodies increase in size. Besides the character which the vertebral bodies possess in the lumbar region in their long and massive form, they are in this species, as in many others, distinguished by still another, of which, however, we have found slight traces also in the posterior dorsal vertebræ; for a longitudinal keel is found along the under side, which is already distinguishable, though not very prominent, in the first lumbar vertebra, but very conspicuous in the third, and which then is continued in the same manner in all the following lumbar vertebræ, down to the very last, but again disappearing in the caudal vertebræ. It has already been mentioned that the species treated of here is distinguished by the inferior height of all the spines; though these are not so low as in the narwhal, not to speak of the beluga, yet there is at any rate a striking difference between the relative height of the spines of our species and those of the killers, and especially those of the ca'ing-whales, and this difference in addition to the considerable length of the vertebral bodies gives, especially to the lumbar vertebræ, a somewhat different appearance from that of the allied forms¹ just mentioned; a comparison of the measure-

in other parts of the skeleton besides the skull. For in his *Catodon Australis* he has discovered an asymmetry, not indeed in the sternum (where, however, it is also most probably to be found), but in the pectoral fins and the ribs, the right pectoral and the right ribs being larger than the pectoral and the ribs of the left side; and of his genus *Euphysetes* (*Kogia*, Gray), he states that the middle piece of the sternum (the foremost one had been lost), is asymmetrical. All the left ribs, one only excepted, being wanting in the only skeleton existing of this singular form, he has not been able to inform us whether the asymmetry here, as in his *Catodon*, also extended to the ribs; nor does he state whether the pectorals are of different sizes, probably in consequence of their being both more or less defective. (See 'Description of a new Sperm Whale, together with some Account of a new Genus of Sperm Whales, called Euphysetes,' Sydney, 1851, pp. 5, 25, and 52.) But as regards the dolphins, no one seems to have mentioned anything of the kind. The only statement that might contain any evidence of an earlier observation of such a deformity is, as far as I know, to be found in a passage of Eschricht's essay on the Ganges-dolphin (*Platanista*), in the 'Transactions of the Royal Danish Academy of Sciences' (Fifth series, 2nd volume). For here the "sternal body" properly so-called, of the skeleton described (a young female), is said to consist of two osseous lateral pieces, of which the left one "is only half as large as the right;" but Mr. Eschricht does not add anything to inform us, whether he considers this difference in size as normal or accidental, or whether, generally speaking, he considers it to be of any importance; and he has overlooked or, at least, not mentioned, the fact, that the manubrium, too, is somewhat, though not very much, deformed. [The description of the skeleton of *Catodon Australis* quoted above, though published under the name of Wall, was really written by the late Mr. W. S. McLeay. See Dr. G. Bennett's 'Gatherings of a Naturalist in Australia,' 1860, p. 162.—W. H. F.]

¹ How great, or how small the similarity existing between the vertebræ of our species and those

ments of one of the lumbar vertebræ in each of the species mentioned, will, perhaps, give an adequate idea as to this point, better than a long description, and I have chosen for this purpose to give the dimensions of the fifth lumbar vertebra, as one of those provided with the highest spines :

	In the specimen from Refsnæs.	In the specimen from Middelfart.	In a large <i>Orca glacialor</i> .	In a very large ca'ing-whale from the Farøe Islands.
Total height	8" 3'''	9"	15" 10'''	13" 6'''
„ breadth	11" 3'''	12"	17" 6'''	14" 8'''
Height of the vertebral spine	4" 2'''	5" 1'''	6" 9'''	7" 2'''
Transverse process	4"	4" 7'''	5" 6'''	5" 4'''
Length of the vertebral body	3" 8'''	4"	5"	4" 1'''
Breadth of the same	3" 2'''	3"	5" 9'''	4" 2'''

In the anterior lumbar vertebræ the spines lean continually more and more backwards ; but from the fifth the spines, as well as the arch itself, begin gradually to be placed in a somewhat more vertical position, without, however, proceeding so far that either the arch, or any of the spines (not even farther backwards in the caudal vertebræ) are inclined in a forward direction, and thus becoming, in this respect, directly opposed to the preceding ones, as is otherwise generally the case, more especially in forms nearly related with ours. The peculiarity may possibly, as far as the spines are concerned, be partly a consequence of their decreasing very considerably in length ; but whatever its cause may be, it is very characteristic of our dolphin, when compared with the allied forms, and it is only in the more distantly related beluga that the anticline in the vertebral column has also as it were disappeared. The transverse process of the first lumbar is inclined in a forward direction, contrary to the transverse processes of the dorsal vertebræ, which point in rather a backward direction ; the angle, however, which this process thus forms with the vertebral body has only a very slight deviation from a right one ; this deviation, becomes still smaller in the nearest succeeding vertebræ, and the greater part of the transverse processes of the lumbar vertebræ must be said to be placed at right angles with their respective vertebræ. They preserve the same breadth throughout without becoming broader towards their free extremities (as in certain other dolphins, for instance the narwhal), the first of them may, indeed, be said to be the longest ; but there is only very little difference in this respect between this one and those nearest succeeding it.

The foremost of the caudal vertebræ have bodies still thicker and as long as the hindmost lumbar vertebræ, but from the fifth they become progressively shorter, and at the same time more compressed, until finally the height of the bodies becomes greater than their breadth ; this shape is then retained up to the place where the hæmapophyses disappear (between the fifteenth and sixteenth caudal vertebræ) ; here, as usual in the dolphins, the appearance of the vertebræ is

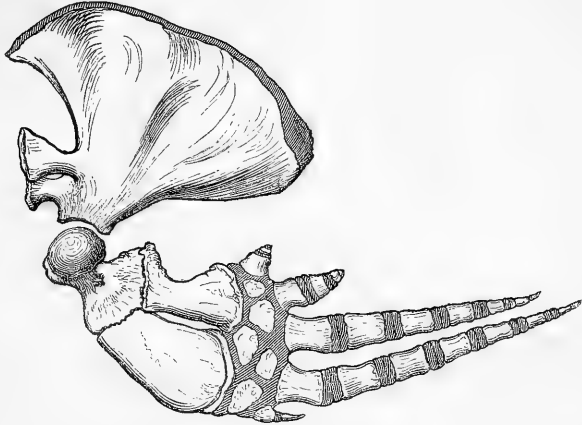
of the *Delphinus griseus* may be, can only be decided by an examination of the skeleton itself of the last mentioned, preserved in the Paris Museum ; in his remarks upon the osteology of this species, Cuvier mentions the vertebral column only very briefly, and does not give us any detailed description of the vertebræ. A new and more accurate description of the skeleton of this remarkable form would therefore remove an essential defect in Cetology.

changed quite suddenly, their breadth now becomes much greater than their height, and at the same time they are very short, and it is these peculiarly formed caudal vertebræ that are inclosed in, and support the caudal fin. The vertebral spines, already very low in the last lumbar vertebræ, become still lower in the caudal vertebræ; we should say that a spine, properly so-called, can scarcely be pointed out further back than in the twelfth; but the vertebral arch itself still remains as a narrow osseous bridge, and does not quite disappear until in the fourteenth caudal vertebra. The so called *processus articulares*, (*P. mamillares*, Retz.), as two separate processes, are not retained farther backwards than the fifth caudal vertebra, then they dwindle down into a single knob, placed in the mesial line at the root of the vertebral spine. The transverse processes, properly so called, may already be said to have all but disappeared in the eighth caudal vertebra, but an indistinct rudiment of such a process may, however, still be traced in the two succeeding vertebræ. As something quite peculiar to the species here treated of, it ought to be particularly mentioned that the transverse processes of the caudal vertebræ are, from the very first, perforated by a hole near the root, through which the lateral branches of the great artery of the tail ascend, whereas in the nearest related dolphins (the genera *Orca* and *Globiocephalus*), this hole does not appear until in the third, fourth, or even fifth caudal vertebræ, as in these forms, the arteries in question do not perforate the transverse processes of the foremost caudal vertebræ, but ascend behind them. The dolphin which, as regards this peculiarity, comes nearest to the species here treated of, may, perhaps, be the narwhal, the osteology of which in other respects is very different from that of our dolphin; for in that animal we find the hole already in the transverse process of the second caudal vertebra; in all other dolphins with which I am acquainted, it does not appear until farther backwards in the caudal region than even in the Orcas and ca'ing-whales, sometimes not until the thirteenth or fifteenth caudal vertebra (as in a species of *Lagenorhynchus*). The chevron bones (hæmapophyses) are sixteen in number; the two foremost are quite open beneath, or, in other words: their lateral parts are not united together; they are, moreover, much smaller than the succeeding one, and somewhat asymmetrical; in the Middelfart dolphin, the third one also, indeed, still consists of two separate lateral parts, but it seems that these would in time have been united into an arch, and this union has already taken place in the Refsnæs dolphin, though this individual is not a little younger than the former. On the other hand, it is not very probable that the lateral parts of the two foremost hæmapophyses ever grow together.

As the pelvic bones were wanting in both the otherwise complete skeletons at my disposal I can state nothing about them, and thus it only remains to give some account of the pectoral fins. The woodcut in the following page, which, at one fifth of the natural size, represents the structure of the left pectoral fin with the scapula, of the Refsnæs dolphin, will give a sufficient idea of the form of the different bones, so that a more detailed description will scarcely be necessary, and it may, therefore, be enough to add some few observations. The scapula is, comparatively speaking, as high as in the killers, and considerably higher than in the ca'ing-whale; but what especially distinguishes it from that of the latter, is that the three ridges destined for the insertion of the muscles, which run down from the superior arched margin towards the articular cavity, on the outer surface of the scapula, and which in the ca'ing-whale are so extraordinarily high and prominent, are here very feeble; the two foremost of them even scarcely distinguishable. Finally, it deserves to be mentioned, that the acromion and the *spina scapule* issuing from it, have been removed to the very foremost edge of the scapula, so that the so-called *fossa suprascapularis*,

can hardly be said to be placed on the side of the scapula, as it forms, on the contrary, a narrow surface slightly excavated, and turned in a forward direction.¹ The pointed pectoral fin itself,

FIG. 3.



in its outline, more resembles the same member of the ca'ing-whales, and partly that of *Grampus griseus*, than that of the Orcas; but still it essentially differs from the pectoral fins of the former by its inconsiderable length, and its much smaller size, generally speaking. In the carpus there are five bones, two of which are placed beneath the ulnar bone, two under the radius, and the fifth again under the latter two between the radius and the first phalanges of the second and third finger. Some of these bones may sometimes be ankylosed in old individuals; such at least, is the case in the Asnæs dolphin, with the two placed beneath the ulnar bone. In the male from Middelfart, the fingers were mutilated and incomplete, in both pectoral fins; in the Refsnæs dolphin there are two phalanges in the thumb, seven in the second finger, six in the third, three in the fourth, and two in the fifth finger, including the five metacarpal bones.

Very different is the structure of the manus of the *Globiocephali*. In the skeleton of a very large and old ca'ing-whale from the Farøe Islands, I find four phalanges in the thumb (though only in the right one, the left has but three), fourteen in the second, ten in the third, three in the fourth, and two in the fifth finger. Thus, the two fingers on which the length of the manus depends have almost twice as many phalanges in the ca'ing-whale as in the dolphin

¹ Cuvier says very little about the scapula of his *Delphinus griseus*; a comparison between this and the scapula of the species here described, must, therefore, be founded essentially on his very small figure ('Recherches sur les Oss. Foss.,' 4th ed., pl. 224, fig. 15); but it is doubtful whether such a comparison can be made with profit, especially as we are not quite sure, whether some mistake has not occurred relative to this figure. It is, at least, a suspicious circumstance, that this scapula, which is that of an animal that can not have been more than three and a half metres long, is in the figure considerably larger than the scapula of the much greater ca'ing-whale (fig. 16 of the same plate), though both are said to be represented at one eighth of their natural size. I have, therefore, not thought it right to found any comparison on this figure.

here described. It is not, however, only on the number of the phalanges that the extraordinary difference in the length of the fins of these two forms depends; the shape of the individual phalanges also contributes its share to this effect, being comparatively much longer in the ca'ing-whale than in our species, in which, indeed, their length still surpasses their breadth in the first three fingers, but the difference between the two dimensions is, nevertheless, only small. The dolphin here treated of stands in this respect about midway between the *Globiocephali* and the Orcas, in the latter of which the breadth exceeds the length of the phalanges, even in the two longest fingers; but as to the number of the phalanges, it approaches the latter more than the former; for in an old male Orca, from the Kattegat, I count two, seven, four, three, and two phalanges; but in spite of the resemblance, in this respect, the shape of the pectoral fin is (as we have said) extremely different also from that of the Orca. Cuvier states¹ the number of the phalanges of *Delphinus griseus* to be two, eight, seven, two, and one; if no errors have slipped into this statement, we are almost forced to believe that the phalanges of this dolphin are comparatively longer even than those of the *Globiocephali*, and accordingly as to their shape still more different from those of our dolphin than those of the last-named genus; for as we shall see presently, this *Delphinus griseus*, remarkable in several respects, but the description of which, we are sorry to say, is only rather superficial, must have comparatively longer, though, at the same time, broader pectoral fins than the ca'ing-whale; and it is not probable, that their great length is in any essential degree owing to an unusual length of the bones of the fore-arm.

	The specimen from Asnæs (♀)	The specimen from Refsnæs.	The specimen from Middelfart (♂).
Total length of the skeleton	—	13' 1'' ²	13' 5''
Length of the seven cervical vertebræ	—	4'' 4'' ¹ / ₂	3'' 1'' ¹ / ₂
„ „ six foremost cervical vertebræ	3'' 3''	3'' 4''	2'' 8'' ¹ / ₂
Length of all the lumbar vertebræ reckoned to the first hæmapophysis	—	3' 3'' 6'''	3' 5''
Length of all the caudal vertebræ	—	5' 3'' ²	5' 3'' 6'''
Breadth of the first cervical vertebra	9'' 6'''	9'' 1'''	9'' 2'''
„ first dorsal vertebra	—	6'' 7'''	6'' 4'''
„ last dorsal vertebra	—	11'' 4'''	1' 0'' 6'''
„ broadest (the first) lumbar vertebra	—	1' 0'' 3'''	1' 0'' 10'''
Height of the scapula measured from the middle of the articular cavity to the middle of the superior arched margin (<i>basis scapulæ</i>)	8'' 6'''	7'' 6'''	7'' 6'''
Breadth of the scapula measured by a straight line between the angles which the base forms with the anterior and posterior margins	1' 0'' 5'''	10'' 6'''	10'' 10'''
Length of the humerus	5''	4'' 5'''	4'' 6'''
„ the radius	5'' 6'''	4'' 8'''	4'' 7'''
„ the ulna	4'' 2'''	3'' 7'''	3'' 6'''
Breadth of both bones of the fore-arm at their inferior extremity	5'' 11'''	5''	5'' 2'''
Length of the manus measured in the recent (undried) condition	—	1'	—

¹ 'Recher. sur les Oss. Foss.,' 4me ed., t. viii, 2, p. 147.

² In this measurement, the three hindmost caudal vertebræ wanting in the skeleton are in-

It will have appeared from the above description, that the osteology of the dolphin here treated of bears in not a few respects a close resemblance to that of the killers, but that mixed with this resemblance we have found some features belonging to the ca'ing-whale and the Grampus, while, finally, besides these, certain peculiarities occur unknown in either of the forms mentioned. It might be supposed that something similar might be also said relative to the outward appearance of this dolphin; one glance, however, at the subjoined figure¹, which represents at a reduced scale the outline of the plaster-of-Paris model mentioned above of the individual captured at Kiel,² will show us, that such is only partly the case, and that the resemblance, more especially with the ca'ing-whale, is, perhaps, still smaller in the outward appearance than in the

FIG. 4.



osteology. This may easily be explained by the fact that some of the external characters that contribute most to give the ca'ing-whale its very peculiar appearance, do not at all depend on, nor are necessitated by, the osteology, and it is in these very peculiarities that the form here described differs completely from the ca'ing-whale. Thus its head has not the immense globular swelling in front, nor the short, but distinct, beak, or rather upper lip, jutting out from this, by which the ca'ing-whale is characterised; but its profile, on the contrary, slopes smoothly from the occiput down to the rounded and blunt snout, or in other words, its head resembles that of an Orca, only that the snout is thicker and shorter. The difference is scarcely less, as far as the back-fin is concerned. The very long, but low back-fin of the ca'ing-whale, of which the vertical height does not equal more than one third of the length, has no resemblance to the short, but pointed, and rather high than low fin of the species which is the subject of our examination; and whereas this fin in the ca'ing-whale, in spite of its length,

cluded, their length being assumed to be one and a half inches; for such is their length in the skeleton from Middelfart, and this is so inconsiderably longer than that from Refsnæs, that we run no risk of making a mistake, in supposing these three little bones to be of equal size in both.

¹ This figure which Professor Behn with great readiness has permitted me to have drawn and published is, on the whole, I hope, a faithful copy of the original plaster-of-Paris model; but the back-fin is according to his advice, drawn from one of the two photographs taken of the animal in its fresh condition, the plaster-of-Paris cast not being quite true to nature in this particular; in the outline of the pectoral fin, I have had an insignificant alteration made, according to the paper copy which I had taken of the member in question from the dolphin found at Refsnæs.

² See also the figure at the head of the memoir, copied from the photograph of the same specimen.

is placed entirely on the anterior half of the body, so that a line, drawn from its point vertically down to the axis of the body, will meet the latter at some distance in front of the centre of the whole body, it is on the contrary placed somewhat farther backwards in our dolphin, and the line just mentioned will here fall rather behind than before the middle of the body. A very conspicuous difference between these two dolphins, which though necessitated by the osteology, has only been briefly alluded to before, and which must therefore now be more minutely examined, is to be found in the shape of the pectoral fin. The ca'ing-whale, we know, is distinguished by the very long, narrow, and pointed pectoral fin; its breadth being scarcely one fourth of its length, and the latter dimension is so considerable as to equal one fourth of the whole length of the animal. In the dolphin here described, the cut (if I may use this expression) of the pectoral fin, indeed, still resembles that of the ca'ing-whale, but it is broader in proportion to its length (the proportion is about as one to three), and it is, moreover, so short, that it is contained eight or nine times in the total length; our dolphin, therefore, can by no means be said to have long, but on the contrary, short pectoral fins. To these important differences between these two forms, we must still, besides the remaining osteological characters, mention the great difference already pointed out in the size of the teeth and the comparative length of the dental row, on which, however, I shall dwell no longer, as it may be supposed that none of those who, generally speaking, admit of the necessity of subdividing Cuvier's genera *Delphinus* and *Phocæna*, would think of placing our species in the same genus with the ca'ing-whale.

We have seen above, that at present it is difficult or rather impossible to define exactly the degree of the difference in the osteology between the dolphin here treated of, and Cuvier's *Delphinus griseus*, the type of the genus *Grampus*;¹ and it is scarcely easier to do it, as far as the external form is concerned. D'Orbigny's description of this species,² published by Fr. Cuvier, the only original one founded on autopsy existing, is not particularly minute in its details, and the figure following the description, (though, indeed, far superior to the older, and extremely indifferent one, of the individual stranded at Brest, which accompanied G. Cuvier's first account of this dolphin,)³ was, as we know, not drawn until twelve or thirteen days after the stranding of the animal, so long after death, therefore, that the decomposition had most probably altered its appearance not a little, especially as the occurrence took place in the hot summer-time. Accordingly, even the latter and better figure must, on this account, be used with caution, and it

¹ Besides Cuvier's *Delphinus griseus*, the typical species of the genus, three other species have been placed by Gray, in the genus *Grampus*, one of these, however, *Gr. Richardsonii* is only founded on a single lower jaw in the British Museum, which was, moreover, for some time supposed by him to belong to the typical species itself; the *Gr. Sakamata* is only founded on the narratives of the Japanese, about a dolphin inhabiting the sea around Japan, in which others believe they have recognised a true killer; the third, finally, is Risso's *Delphinus aries* (*D. Rissoanus*, Desm.), which considered as a species is most certainly perfectly well-founded, but it can hardly be set down as an undoubted fact, that this Cetæcean is to be placed in the same genus with *Delphinus griseus*. Its osteology is still perfectly unknown, and other authors are inclined to consider it to be nearly related to the ca'ing-whale. Thus it is, in my opinion, only *D. griseus* that can be referred to, when we are speaking of the characters of the genus *Grampus*.

² Fr. Cuvier's 'l'Histoire naturelle des Cétacés,' p. 184, pl. xii, fig. 2.

³ 'Annales du Museum,' tom. xix, tab. i, fig. 1.

would scarcely be advisable to found even on this figure a detailed comparison with our dolphin. I shall not therefore lay any particular stress on the circumstance, that the Grampus seems to have a much thicker, and a much more swollen head than our dolphin, and that the back-fin, to judge from the drawing, is placed still further backwards than in the latter, although Gray has not hesitated to set down this position of the back-fin as one of the characters of his new genus. But even though it might be less prudent to found a comparison between our dolphin and *D. griseus* on the other differences which it may be possible to derive from D'Orbigny's figure, yet there is at all events one difference, moreover completely confirmed by the description of the same observer, and fortunately appearing in a part of the body which is attacked by putrefaction only very late, and the form and outline of which cannot be greatly altered by this process, I mean the pectoral fins. For these are not only much longer in the *Delphinus griseus* than in our species; but they must even be comparatively longer than the pectoral fins of the ca'ing-whales themselves;¹ for in the ten feet long individual, examined by D'Orbigny, they had the very considerable length of three feet, and thus their length was only contained three and one third times in the total length, a proportion between the length of the pectoral fin and that of the animal itself, that never occurs in the ca'ing-whale. The pectoral fin is, moreover (both in the drawing, and according to the measurements given), placed uncommonly far backwards in *D. griseus* (three and a half feet behind the point of the snout), so that its point, when the fin is laid along the body, almost reaches as far back as the posterior margin of the dorsal fin. When to this extremely important difference in the length and position of the fin, we add the no less essential one, appearing in the teeth, our dolphin keeping all its teeth until its greatest age, whereas *D. griseus*, provided even that, generally speaking, it retains its teeth in the upper jaw beyond the first period after its birth, or in other words, provided these teeth really ever become fully developed, loses them at all events so early, that not even a single one of them has remained in any of the individuals hitherto examined, though amongst these have been young animals of a length of only little more than seven feet,² if finally,

¹ Cuvier's description of the pectoral fins of *Delphinus griseus* is somewhat obscure, perhaps a consequence of the falling out of a word. However, if the meaning really is (as I should almost suppose), to ascribe to this dolphin pectoral fins comparatively shorter than those of the ca'ing-whale (Cuvier's *D. globiceps*), it seems to me that it is only a want of attention that has caused Cuvier to express himself in this manner; for in this case the measurements which he has given (the length of the animal ten feet, that of the pectoral fin three feet), would contradict his description, which is to the following effect: "Leur pectorales pointues sont longues de trois pieds sur un pied de largeur à leur base, moins qu'au globiceps, mais plus qu'à la figure de dauphin ventru de Hunter," ('Rech. s. l. Oss. Foss.,' 2me ed., t. v, 1, p. 284; 4me ed., t. viii, 2, p. 99).

² It is very well known, that it is not only in his *Delphinus griseus*, that Cuvier mentions such a falling out of the teeth of the upper jaw. According to him, the same is found to take place in a more advanced age also in other great, blunt-headed dolphins, among others in the ca'ing-whale. Without being willing, or venturing, to deny the correctness of the statement generally, yet, as far as the last-mentioned dolphin is concerned, I cannot but suppose, that such a falling out of the teeth must at any rate be of very rare occurrence. I have seen no trace of it in any of the numerous ca'ing-whales' crania (some of very old animals), which the Royal Museum, during a long course of years, have frequently received from the Faröe Islands, and once from Greenland; nor have I seen any cranium wanting the teeth of the upper jaw, among the many crania preserved in other collections in this town, except as far as they might have been lost during, or after, the preparation, nor have I

we also take the different osteological differences mentioned above into consideration, it seems to me, that we must come to the conclusion, that the species here treated of cannot find its place much more naturally in the genus *Grampus* than among the *Globiocephali*.

The next question is then, whether our dolphin is a killer (*Orca*)? We have seen that it has been considered as such by J. E. Gray, who was, however, only acquainted with it from the cranium discovered in the English fen, and this opinion of Dr. Gray's may at all events be considered as a proof of my not having overrated, in the preceding pages, the resemblance between our dolphin and the killer in this part of the skeleton. But this supposition, though, perhaps, quite justifiable, as long as the skull and the cervical vertebræ were all that we had to go by, cannot now be maintained any longer, the whole animal being known both as to its external appearance and its osteology. Our dolphin, come back, as it were, from the dead, appears to me to present sufficient differences in both these respects, to entitle us to consider it as the type of a special genus, the place of which will be between *Orca* and *Grampus*, and for which I propose the name of *Pseudorca*. The most essential external distinguishing marks between this and the genus *Orca* will be found then in the shape of the body, generally speaking, more slender and extended in length; in the small and pointed pectoral fins, so completely different from the large, very broad, and oval pectoral fins of the killers; and finally in the smaller and differently shaped back-fin; but besides these the snout of the killers, less blunt than that of our species, and the very peculiar colouring characteristic of the former, might we think also afford distinguishing characters of the two genera. The osteological characters of the two genera have been sufficiently illustrated above. This new genus will form a connecting link, hitherto wanted, between the genus *Orca* and the genera *Grampus* and *Globiocephalus*, and thus it will, if necessary, serve to prove how unsafe the opinion is, that the killers, from a systematic point of view, ought most properly to be considered as a division among the toothed-whales of more than generic worth, "as a group or family by themselves,"¹ an opinion lately expressed, but as I think neither sound in itself, nor, indeed, supported by any defensible reason.

One observation about this species must still find a place here. The female thrown ashore at Asnæs was stated to be nineteen feet long, and though its skull is, indeed, no larger than those of the two other, and smaller, individuals, yet the other bones of its skeleton which I succeeded in obtaining for my use, will show that it really must have been an animal not a little larger than the latter. The dolphin captured in the harbour of Kiel, also a female, which Professor Behn was kind enough to inform me was pregnant, but most probably only for the first time, and which, accordingly, we suppose was scarcely an old and full-grown animal, measured little more than sixteen feet. The male thrown ashore at Middelfart, most undoubtedly rather an old animal, was, on the other hand, about fourteen feet long, at the most. Thus the question remains whether in the *Pseudorca*, there may not possibly be a difference in the sizes of the different sexes, and whether the females are not larger, but at the same time, perhaps, provided with a head comparatively smaller, than that of the males. The question can of course only be solved by more numerous opportunities of observation, but I think it worthy of consideration.

been able to learn that such a want of teeth in the ca'ing-whale has ever been observed in the Faröe Islands.

¹ 'Oversigt over det Kongelige Danske Videnskabernes Selskabs Forhandlinger,' Mai, 1862, p. 87.

SYNOPSIS

OF THE

CETACEOUS MAMMALIA

OF

SCANDINAVIA (SWEDEN AND NORWAY).

BY

W. LILLJEBORG, PH. D.,

PROFESSOR OF ZOOLOGY IN THE UNIVERSITY OF UPSALA.

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SYNOPSIS

OF THE

SCANDINAVIAN CETACEA.¹

“Hvaldyrene (Cetaceerne) have altid hørt og höre endnu til de mindst nöiagtigt kjendte Dyr, hvad enten vi tage Hensyn til Artsbestemmelsen og den geographiske Udbredning eller til Anatomien og Physiologien.”—(D. F. Eschricht: Undersögelser over Hvaldyrere, 1^{ste} Afhandling, 1844, p. 1.)

THE above-quoted expression of an author, who, of all others, has made the most important contributions to our knowledge of the Whales, is, at least if the word “Dyr” be limited to Mammalia, still applicable, although so many years have passed since the remark was made. This should, it seems, be attributed to the great difficulties connected with the scientific preservation and examination of these often colossal Mammalia, and to the circumstance that the greater part of them very rarely, only accidentally, and at far distant places, fall into the hands of a naturalist. In order to gain a correct knowledge of the relation between different animals, it is generally important to be able to make direct comparisons, and for this object it is absolutely necessary to have access to them at the same time and at the same place. But even if the skeletons alone were under consideration, a tolerably complete collection of those of the order Cetacea would be very difficult to obtain. It has lately been proposed, in England, to establish a large museum for Cetacea, in order to gain this object.

The deficiency in the knowledge of Cetacea generally extends also to those members of the order belonging to our Scandinavian Fauna. Notwithstanding the important contributions to the knowledge of this order, given by Professor Nilsson in his ‘Scandinavian Mammalian Fauna,’ there yet remains very much to be explained, in regard both to the number of the different species and to their description. During a scientific journey last summer to the Zoological

¹ Scandinavia is here used with the same meaning as in Professor Nilsson’s ‘Skandinavisk Fauna’.

Museums of Lund, Copenhagen, Christiania, and Bergen, I therefore determined, as the principal object of my travel, to investigate the collections of Cetacea belonging to our Fauna in those museums, more especially their skeletons, as being undoubtedly the best means of obtaining a knowledge of the different species. These investigations now enable me to give a tolerably complete review of such Cetacea as belong to our Scandinavian Fauna. I must say that the museums in Copenhagen and Bergen offered the most abundant material; and it is particularly due to mention that Professor Eschricht, of Copenhagen, and Dr. J. Koren, of Bergen, have, by valuable information, very materially assisted these investigations.

Order CETACEA, Blumenbach.

Mammalia, with fish-shaped body and naked skin, with the anterior extremities fin-shaped; wanting the hinder extremities, in their place a horizontal forked caudal fin as the principal organ of motion, &c. &c.

Note.—Opinions have been divided with regard to the nature of the substance that the whales throw out from their blowers when they come to the surface of the water to breathe.¹ Some, G. Cuvier among others, have insisted that they not only blow out the air and vapour that they expire, but also send out high jets of water, and some have insisted that only the former takes place. Professor Eschricht has declared himself of the latter opinion, and bases his views upon anatomical and physiological considerations. This opinion seems to have been fully corroborated by later and more reliable observations. A statement by O. W. Brierly, in the English ‘Athenæum’ for this year seems fully to decide the question. It appears in No. 1767, page 320. He once observed, off the coast of Chili, quite near the vessel, a number of whales with dorsal fin, and had an excellent opportunity of closely observing the phenomenon of spouting, and that it was not water, but white vapour that they sent out through the blowers. As it is important to be able to examine the credibility of Brierly’s statement, I will quote his own expression in the above-mentioned journal. After describing how the whales were swimming and approaching the vessel (a frigate), he adds: “Each sending up two high columns of white vapour, like great jets of steam, which spread out into a cloud at their highest points, a distinct whistling sound being heard in the blowing of those that rose nearest the ship.” Mr. C. J. E. Haglund, medical student of this place, who also has visited some of the Southern seas, told me that on one occasion a large whale followed the vessel during a whole forenoon, and was often quite close to it, and that it, in expiration, blew out a whitish pillar of steam, which at the top spread into a little cloud, from which a few drops of water fell. Mr. O. Torell, Acad. Adj., has also informed me, that once off the coast of Greenland a whale was quite near the vessel on board of which he sailed, and that when it exhaled, it sent out vapour and a small quantity of water (probably arising from the cooling and condensing of the vapour) on the deck of the vessel, the vapour and water diffusing a very unpleasant odour. These observations seem to show that the older statement, that the whales send out through their blowers a part of the water that they take in by the mouth, does not correspond with the real fact.

¹ See ‘Förhandlingare vid de Skandinaviska Naturforskarnes,’ 6:te möte i Stockholm år 1851, p. 245.

1st Family DELPHINIDÆ, J. E. Gray.

Toothed-Whales.

Without baleen. With teeth in at least one of the jaws. Blowers opening in a single common aperture, Sc. Sc.

TABULA SYNOPTICA DELPHINIDARUM.

GENERA.

<p><i>Delphinidæ.</i></p> <p>Apertura na- rium .</p>	<p>longe a rostri apice remota. Maxilla supe- rior</p>	<p>dentibus in al- veolis insitis prædita. Symphysis max- illæ inferioris.</p>	<p>dentata. Rostrum</p>	<p>brevis, longitu- dine dimidia maxillæ bre- vioris. Maxilla inferior</p>	<p>obtusum vel ro- tundatum. Pinna dorsualis.</p>	<p>plus vel minus attenuatum et acutum. Pinna dorsualis.</p>	<p>adest 1. <i>Delphinus</i>, Lin. abest 2. <i>Leucorhamphus</i>, nov. nom.-g. conici 3. <i>Orca</i>, J. E. Gray. compressi 4. <i>Phocæna</i>, G. Cuvier. compressi 5. <i>Neomeris</i>, J. E. Gray. conici 6. <i>Delphinapterus</i>, Lacép. 7. <i>Monodon</i>, Linné. minime ante nares fornicata 8. <i>Iniia</i>, F. Cuvier. ante nares fornicata Apertura narium longitudinalis. } 9. <i>Platanista</i>, F. Cuvier. duobus vel pluribus in parte media insitis 10. <i>Delphinorhynchus</i>, Lacép. duobus vel quatuor in parte anterior insitis. } non elevata . 11. <i>Berardius</i>, Duvern. elevata tubere Ossa maxillaria superiora postica } magno 12. <i>Hyperoodon</i>, Lacép. dentibus numerosis, symphysis mediocri, capite brevi 13. <i>Kogia</i>, J. E. Gray. rostri apici propinqua longitudinalis. Caput maximum truncatum. Maxilla superior dentibus carens, in- terior dentibus numerosis, et symphysis longæ, fere ad medium porrecta 14. <i>Catodon</i>, Artedi.</p>

Notes to the annexed Synoptical Table of the Genera.—Although only the Cetacea belonging to the Scandinavian Fauna will be taken under notice in the following memoir, I considered that the foreign genera should also be mentioned in the table, in order to show the connection of the native genera with the others, and consequently the position that they occupy in the system.

The genus *Delphinus*, as here described, corresponds with the genera *Lagenorhynchus*, *Delphinus*, and *Steno*, of J. E. Gray,¹ as the differences between those genera, as defined by that author, are such, that they seem to run into each other through modifications occurring in forms belonging to them.

The second genus *Leucorhamphus* corresponds with Gray's² *Delphinapterus*, with its species *D. Peronii*. As the beluga or *Delphinus leucas* is the type of the genus *Delphinapterus*, as defined and described by Lacépède,³ it seems that the name should belong to its right owner, and not be transferred to a different species. I have therefore been obliged to find another generic name for *Delphinapterus Peronii* (*Delphinus Peronii*, Lacép.); and have, as I knew no name more suitable, selected that of *Leucorhamphus*, which was given by Peron as its specific name. The genus *Orca* corresponds with the genera *Grampus*, *Globiocephalus* and *Orca* of Gray.⁴

The generic name *Neomeris*, given by Gray⁵ to *Delphinus phocænoïdes*, G. Cuvier, ought to be changed for some other name, having been given as early as 1816, by Lamouroux, to a genus of *Polypi*; but as it has up to this time been known as belonging to the species in question, I have been unwilling to change it.

The genus *Pontoporia*, as constituted by Gray,⁶ seems properly to run into the genus *Inia*, and may be included with it.

I will finally remark that the genera *Leucorhamphus*, *Neomeris*, *Inia*, *Platanista*, *Delphinorhynchus*, *Berardius*, *Kogia*, and *Catodon*, are foreign to the Scandinavian Fauna.

1st Genus—DELPHINUS, Linné.

Nose or fore part of the head more or less elongated and pointed, generally with a conspicuous notch above. Blowers united into a single transverse opening on the upper side of the head, far behind the tip of the snout. Back with a fin, sometimes at the middle of the body, sometimes before, and sometimes behind the middle. Body fish-shaped, and sharply tapering towards both ends. Jaws armed with a great number (20 or more on each side in each jaw) of conical teeth, generally pointed.

The fore part of the skull (the beak) is limited behind by a sharp indentation on the outer side of the upper maxillary, and is of a conical, tapering form, more or less elongate, sometimes shorter, but generally longer than the hinder and larger part of the head. Both jaws with teeth. The symphysis of the lower jaw-bones is shorter than half the length of these bones. The skeleton generally is distinguished by a large number of lumbosacral vertebræ, and, indeed, of vertebræ generally.

Species of this genus are found in all seas, and are generally more lively and active in their motions than those of the genera with blunt noses.

¹ 'Zoology of the Voyage of Erebus and Terror,' "Mammalia," part v, p. 80.

² L. c.

³ 'Histoire Naturelle des Cétacées,' p. xli.

⁴ L. c.

⁵ L. c.

⁶ L. c., p. 46.

Thirty or forty species of this genus have been described, only four of which belong to the Scandinavian Fauna.

1. D. DELPHIS, *Linné*. Dolphin. *Swedish* "Springare."

On the skull, on the lower side of the superior maxillary, inside of each row of teeth, there is a longitudinal fossa extending about two thirds the length of the row of teeth.

- DELPHINUS DELPHIS, *G. Cuvier*. Recherches sur les Ossemens Fossiles, 3me édit., t. v, part 1, pp. 275 and 303, tab. xxi, figs. 9 and 10, 1825.
- — *F. Cuvier*. Histoire Nat. des Cétacées, p. 123, tab. ix, figs. 4 and 5, 1836.
- — *J. E. Gray*. Zoology of the Voyage of the Erebus and Terror, Mammalia, p. 40, 1846.
- — *S. Nilsson*. Skandinavisk Fauna, Däggdjuren, 2 : a Uppl., p. 591, 1847.

Length 6'—8'.¹ Body, fish shaped, rather robust, thickest about the middle, and most tapering towards the caudal fin, in front of which it is strongly compressed. Nose limited behind by a conspicuous indentation, in front of which it is rather depressed, and more elongated and pointed than in any other of our indigenous species of the same genus. Dorsal fin somewhat behind the middle of the body.

I have taken the following notes from a specimen, caught in Christiania Bay, now stuffed and preserved in the Zoological Museum of the University of Christiania:—Length 6' 1 $\frac{1}{4}$ ". Nose 4 $\frac{1}{4}$ " long from the notch. Dorsal fin 13 $\frac{1}{2}$ " along the anterior edge from base to point. Pectoral fins 12" long. Distance between the points of the caudal fin 14." Colour:—The nose and head above, the back, pectoral fins, caudal fin, and hinder part of body in front of this, a streak from the pectoral fins to the chin, another from the caudal fin to the sides of the body under the hinder part of the dorsal fin, and the parts around the eyes, black. The rest of the sides, the lower jaw, and the belly, white. A white streak runs forward above the angle of the mouth, under the black spot about the eyes.

I have taken the following measurements from an indigenous skull in the same museum:—Length of skull 1' 5 $\frac{1}{8}$ "; its width across the processus zygomatici of frontal bone 7 $\frac{1}{4}$ ". Length of nose, from the notch on the superior maxilla, 10 $\frac{3}{8}$ ", and its width at the base, 3 $\frac{5}{8}$ ". The shortest distance between the lateral edges of pars occipitalis 5 $\frac{1}{8}$ ". Length of lower jaw 14 $\frac{3}{4}$ ". Ossa intermaxillaria rising considerably in the middle, with sides almost vertical. The right one extends farther back than the left one, somewhat behind the posterior edge of the vomer. The triangular area on these bones pointed, and concave before the blowers, with somewhat projecting side edges. Both the longitudinal fossæ on the lower side of the upper jaw-bone extend to about 2 $\frac{1}{2}$ " from the point of the snout. Teeth $\frac{44}{32}$ — $\frac{44}{32}$; five of them in the middle of the upper jaw occupy a space of $\frac{15}{16}$ ". The row of teeth in the lower jaw is somewhat shorter than $\frac{2}{3}$ ds of the length of the bone.

¹ The measurements in this memoir are, unless otherwise stated, given in Swedish feet and inches, one of which is equal to 0.9742 of the corresponding English measure.

I have not had an opportunity of examining any skeleton. It has, according to G. Cuvier, 67 vertebræ, viz., cervical 7, dorsal 13,¹ and lumbar and caudal 47. The sternum consists of 3 bones, and there are 6 pairs of costæ veræ.

It is but seldom obtained on the coasts of Scandinavia. A stuffed specimen is preserved, as previously stated, in the Zoological Museum of the University of Christiania; also a skull of another specimen, from the south sea of Norway.² It is very common in the seas of England and France.

2. *D. ALBIROSTRIS*, Gray. White-beaked Dolphin. *Swedish* "Hvitnos."

The triangular area with the point directed forwards on the intermaxillary bones in front of the blowers strongly elevated, and with a convex surface behind.

DELPHINUS TURSIO, *Th. Brightwell*. *Annals & Magaz. of Nat. Hist.*, t. xvii, 1846, p. 21, pl. ii.

LAGENORHYNCHUS ALBIROSTRIS, *J. E. Gray*. *L. c.*, p. 35, pls. x and xi.

DELPHINUS IBSENI, *D. F. Eschricht*. *Undersøgelse over Hvaldyrene*, 5^{te} Afhandling, Kongl. Danske Videnskabernes Selskabs Naturvidenskabel. o. Mathemat. Afhandlinger, 1846, p. 297.

— — *S. Nilsson*. *L. c.*, p. 600.

Of a somewhat more elongated form than the preceding, with a tolerably long and pointed nose, limited behind by a conspicuous notch. The dorsal fin rather high, and directed strongly backwards, placed a little behind the middle of the body. The circumference of the body of a female, somewhat over 8' (English) long, was at the thickest place 4' 10" (Swedish), according to Brightwell. Its dorsal fin was 10" high and 11½" long at the base. The pectoral fins were 15" long, and the width of the caudal fin 22". Colour:—The nose, the upper lip above the angle of the mouth, the lower jaw, and the lower side of the body as far as a little beyond the dorsal fin, of a yellowish-white colour; the rest of the body, as well as the fins, black, with a tinge of purple. It reaches a length of over 9'.

I have had the opportunity of examining skeletons of this species at the Physiological Museum of the University of Copenhagen. One of the skeletons was 9' long; its skull was 1' 7¼" long and 10¾" wide across the temporal bones. Length of the nose about 1⅓rds its width at the base. The skull was particularly distinguished by the projecting area before the blowers being somewhat convex behind, and level and pointed in front. The intermaxillary bones on the upper side of the nose (the rostral ridge) very little elevated, and towards the sides gradually running into the superior maxillary bones. The upper jaw without longitudinal fossæ on the lower side.

¹ There are 14 dorsal vertebræ, according to Duvernoy.

² The newspapers mentioned that, in the summer of 1860, a specimen of this species was caught on the coast of Bohuslän (Sweden), and had been purchased for the museum of the college in Örebro. It was, however, *D. Phocæna*, according to later information given me by Lector Hartman.

Number of teeth on each side of upper and lower jaws 26—27. Dorsal vertebræ 16, lumbosacral vertebræ 23, and caudal vertebræ 44, 32 of which carry processus spinosi inferiores; altogether, with the 7. cervical, 90 vertebræ.¹ True ribs 5 pairs, and the 6th and 7th pair with their sternal part united to a cartilaginous extension of the sternum. This bone consists of four pieces, the foremost one of which has a more or less deep notch in front.

A lower jaw of a specimen that was stranded on a sandbank near Skanör,² is preserved in the Zoological Museum of the University of Lund; its length is 15 $\frac{3}{4}$ "', the row of teeth 7 $\frac{1}{4}$ "' long. The teeth are 26 in number on one side, and 27 on the other, and are worn down at the points.

A skull of a specimen caught in the vicinity of Bergen, is kept in the museum there. Although rather large, it has only 24 teeth on each side of each jaw. Our Scandinavian museums contain also parts of two specimens and a skeleton of another, caught within the boundaries of Sweden and Norway, two from Sweden, and one from Norway.³ It belongs to the North Sea, and has also appeared off the coasts of England and Jutland.

3. D. ACUTUS, Gray. White-sided Dolphin.

The triangular area before the blowers only slightly elevated behind, and with a level surface, concave in front. Teeth 30—40, on each side of each jaw.

DELPHINUS ACUTUS, Gray. Specil. Zool. 1, 2.—(According to Gray in Zool. Erebus and Terror,) 1829—1830.

— ESCHRICHTII, H. Schlegel. Abhandlungen aus dem Gebiete der Zoologie und Vergleichende Anatomie, p. 23, tabs. i and ii, fig. 4; tab. iv, fig. 5, 1841.

— LEUCOPLEURUS, H. Rasch. Delphinus leucopleurus. Nova species descripta, cum tabulis ii—Christianiæ, 1843. Nyt Magazin fur Naturvidenskaberne, 1845, p. 97.

— — S. Nilsson. L. c., p. 598.

Note.—Schlegel states (*loc. cit.*), probably through a misprint, that it has 32 lumbosacral vertebræ. He has since, in a letter to Eschricht, corrected the statement of their number to 23, whereby the difficulties of identification are removed (Eschricht verbally).

¹ Eschricht has stated 94 in the above-quoted treatise. Some vertebræ may possibly have been missing on the skeleton; 92 vertebræ are, however, given by the same author in his discourse at the meeting of naturalists in Copenhagen, 1847 (Forhandl., p. 611).

² Skand. Fauna, Däggdjuren, p. 602.

³ [Two females of this species were caught in July, 1862, at Gullholmen in Bohuslän (Sweden), both pregnant, each with a fœtus about 3 feet in length. The skeleton of one was preserved by F. A. SMITH, Acad. Docent., and transmitted to the zoological museum of this university. Its length is 6' 20". Length of skull 18", its width 9 $\frac{3}{4}$ " across the temporal bones. Length of nose 9". Ribs 15 pair, the last pair of which are not united to the transverse processes. Lumbar vertebræ 24. Teeth $\frac{25}{25}$ — $\frac{24}{24}$.—1865.]

According to Rasch, the length of the males is 9', and that of the females 8'. It is of a rather elongated form, with the nose sharply pointed, although short, and limited behind by a conspicuous notch. The greatest thickness of body is below the dorsal fin. Dorsal fin somewhat in front of the middle of body, rather high, and directed backwards, in shape very much resembling that of the preceding species. The dorsal fin was, according to Rasch, 1' 10" (Norwegian measure), high along the anterior edge from base to point, in a specimen of which the length was near 9'. Length of pectoral fins from the anterior edge at the base 1' 3"; distance between the points of the caudal fin 2' 3". Length of nose, from the notch, somewhat over 2". Colour:—The nose, and all the upper parts of the body and the fins, bluish-black; lower jaw and lower side of body, white. The white colour extends along the sides of the head to the upper edge of the eyes, and runs into a point above the angle of the mouth. There is an oblong white spot on the sides of the hinder parts of the body, which above and towards the tail is continued by a brownish-grey spot.

The nose is $8\frac{3}{4}$ " long, in a skull 16" in length, and just twice as long as its width at the base. Smallest width of pars occipitalis $7\frac{1}{4}$ ". Width across the anterior dilated part of ossa zygomatica 8". Length of nose $2\frac{2}{3}$ times the width of the area just before the blowers. The row of teeth extending more than half the length of the lower jaw, which is $13\frac{3}{4}$ " in length. The intermaxillary bones form a low ridge on the upper part of the nose. The lower side of the nose is without fossæ. The nasal and frontal bones unite into an elevated tubercle. Teeth $\frac{39-43}{31-31}$. I counted 15 dorsal vertebræ in a skeleton in the museum in Christiania, 23 lumbosacral, 37 caudal, and 24 processus spinosi inferiores;¹ altogether, with the 7 cervical, 82 vertebræ. The sternum consists of 3 bones, the foremost of which has a long process directed backwards on each side in front of the middle. There are 4 pairs of true ribs, and the 5th pair are united to a cartilaginous extension of the sternum (the skull, sternum, and ribs are described from the skeleton from the Farøe Islands).

It has appeared in Christiania Bay, as well as on the western coast of Norway. A whole shoal, numbering 22, were once caught at the former place in the month of June, according to Rasch. It is sometimes caught in the sea off Bergen. The capture in Christiania Bay shows that these, like most other dolphins, are social, and go about in large numbers.

4. D. TURSIO, G. Cuvier. Bottle-nose Dolphin. Swedish "Öresvin."

The triangular area in front of the blowers, on the upper side of the upper jaw, resembling that of the last. Teeth varying from 20 to 25, generally 22—24, on each side of the jaws.

DELPHINUS TURSIO?, O. Fabricius. Fauna Groenlandica, p. 49, 1780.

— DELPHIS, J. Hunter. Philosophical Transactions of the Royal Society of London, vol. lxxvii, p. 477, tab. xviii, 1787.

¹ I have counted 35 caudal vertebræ and 25 processus spinosi inferiores in a skeleton from the Farøe Islands. The number of caudal vertebræ seems to be subject to some variation.

- DELPHINUS DELPHIS*, *P. Camper*. Observations Anatomiques sur la Structure intérieure et le Squelette de plusieurs Espèces de Cétacés, p. 131, tabs. xxxv—xl, 1820.
- *TURSIO*, *G. Cuvier*. Recherches sur les Ossemens Fossiles, t. v. 1, p. 277, tab. xxi, figs. 3 and 4, 1825.
- — *F. Cuvier*. Histoire Naturelle des Cétacées, p. 142, 1836.
- — ? *H. Schlegel*. L. c., p. 25, tab. 5, figs. 1 and 2.
- — *J. E. Gray*. Zoology of the Erebus and Terror, Mammalia, p. 37, pl. x (the animal).
- — *S. Nilsson*. L. c., p. 602.
- — *W. B. Clarke*. Annals & Magaz. of Natural History, 2nd ser., vol. iv, p. 100, 1849.

Note.—The description of *O. Fabricius* is so short and incomplete, that the species described by him cannot with any certainty be identified with this, although both the form and the colour correspond so well, that it seems likely that this was the species he had before him. In the 'Catalogue of the Mammalia of Greenland,' by Professor J. Reinhardt (appended to Rinks's description of that country), the *D. tursio*, *Fabricius*, is, however, considered as synonymous with *Delphinus globiceps*, *Cuvier*, probably from the fact that *Fabricius* mentions the Greenlandic name "Nesarnak," which name is given by the Greenlanders to *D. globiceps*. *Fabricius*'s description seems, however, entirely to contradict this opinion; he states, for instance: "Frons rotundata, declivis, s. sursum repanda, desinens rostro attenuatiore; sic fronti anatis mollissimæ non absimilis." This, however, can agree with the Greenlanders naming *D. globiceps* "Nesarnak," as it may have arisen from an accidental confusion of the two species. The figures of the skull left by *Camper* seem fully to correspond with the present species; and as *Cuvier* refers to those figures, I do not doubt that the species described by him is the same, although his figures of the skull differ in the nose being too long. The figure of the animal by *Schlegel* differs so much, that I have not been able to quote him without a ?, more especially as even his description deviates somewhat. He has, for instance, counted 14 dorsal vertebræ on at least two skeletons, while I found only 12 on the skeleton that I had an opportunity of examining.

It reaches quite a large size, at least 10'—12' in length. *Clarke* gives (*loc. cit.*) the following measurements of the specimen described by him, which was a female. Length 8' 4" (English), circumference at the thickest part 4', length of nose 4", height of dorsal fin 8", its base 1' 4" long, length of fore edge of the pectoral fins, 1' 1", width of caudal fin 1' 8". The nose, although limited behind by a conspicuous notch, and apparently somewhat longer, is, however, more obtuse than that of the last-described species. The dorsal fin is rather high, but not very much directed backwards, and is about half way between the point of the snout and the tip of the caudal fin. The pectoral fins are half way between the point of the snout and the beginning of the dorsal fin, and the anal opening half way between the end of the dorsal fin and the base of the caudal (*Clarke*). The same author states the colour to be as follows, viz., upper part of the body black, sides grey, or grey with a tinge of purple, and lower side white, with some darker shades. Professor C. J. Sundevall has described the colour of a young specimen, sent last summer from the coast of Bohuslän (Sweden) to the National Zoological Museum of the Royal Academy of Stockholm as being, "belly black; side, from anus to point of lower jaw, pure white; but the point of the lower jaw grey or blackish; two light (whitish, but not pure white) streaks without

any distinct limits, the one oblique, nearer the back, from about the blowhole to under the beginning of the dorsal fin; the other straight with the side, from the end of the dorsal fin to somewhat behind the vent; from the eye to the pectoral fin whitish; all the fins black on both sides." This specimen had, according to Sundevall, 15 pairs of ribs.

Two skulls of this species from the coast of Bohuslän were presented to the Zoological Museum of Lund by the late Pastor C. U. Ekström, and are now preserved there. I have made the following observations from the larger one, viz.:—Length 22"; width across the projecting edges of the fore part of ossa zygomatica 10"; smallest width of pars occipitalis of the occipital bone 7 $\frac{1}{4}$ "; foramen magnum 1 $\frac{15}{16}$ " high and wide, forming an acute angle above; os zygomaticum 5 $\frac{3}{8}$ " long; ossa pterygoidea each 3 $\frac{1}{4}$ " long and 1 $\frac{5}{8}$ " wide, with their posterior edges forming an even, rather shallow furrow; beak 12" long, and 5 $\frac{15}{16}$ " wide at the base; lower jaw 19 $\frac{1}{4}$ ", one of its teeth lines 10" long, and its height at the processus coronoideus 4 $\frac{1}{4}$ ". The intermaxillary bones are separated above by a deep furrow, and form in front, on the upper side of the jaw, a conspicuous ridge, sloping at the sides, and gradually running into the upper surface of the superior maxillaries, without any distinct furrow between them. Their triangular area before the blowers is slightly concave forwards. The hinder edge of the maxillaries extends somewhat behind the nasal bones. The tubercle on the frontal bones, in which the nasal bones are situated, is low; also the sutura lambdoidea. There is a conspicuous longitudinal ridge along the pars occipitalis. The vomer visible only at one place in the palate, and not until nearly 4" in front of the angle formed by the palate bones.¹ Teeth $\frac{24}{24}$ — $\frac{24}{24}$, rather acute, and not worn down, with the points bent inwards; one of the hinder ones in the lower jaw 1 $\frac{1}{2}$ " long and $\frac{9}{8}$ " thick. The teeth in the other skull were of equal number.² A skull of a younger animal, and the incomplete skeleton preserved in the Marklinean Museum of this place, from unknown locality, but probably brought from Bohuslän or Norway by the late Acad. Adj. Marklin, show the following proportions:—Length 14 $\frac{3}{4}$ ". Beak 6 $\frac{7}{8}$ " long and 4 $\frac{1}{2}$ " wide at the base; width of parietal bone 6 $\frac{3}{8}$ " between the upper edges of pars occipitalis (being the smallest width of this bone); width of skull across the temporal bones 7 $\frac{5}{8}$ ", its width across the anterior dilated parts of ossa zygomatica 6 $\frac{3}{8}$ "; width of the triangular area on the intermaxillary bones in front of the blowers 3 $\frac{5}{8}$ ", its width, therefore, somewhat greater than half the length of the beak, the area but slightly projecting, being level near the blowers, and concave before them. The intermaxillary bones do not touch the nasal bones; the right one, the hinder end of which is broken off, seems to have been longer than the left. The vomer is visible in the palate only at one place, where its foremost point runs between the hinder ends of the intermaxillary bones, which are visible in front of it. The lower jaw is 11 $\frac{7}{8}$ " long, and its rows of teeth each 5 $\frac{3}{8}$ ". The teeth are quite close together, and are 24—25 on each side of both jaws. This skull is of a less elongated form, and the nose much shorter than in the former, a natural consequence of its being younger. The nose is shorter than the rest of the skull, and its length is not twice its width at the base. I counted, on the before-mentioned skeleton in the Physiological Museum in Copenhagen, 12 dorsal vertebræ,³ 17 lumbosacral ver-

¹ G. Cuvier states that it appears in 2 places.

² Camper has in his figures 24 teeth on each side of the upper jaw. G. Cuvier states 21—23 teeth. Schlegel says the normal number seems to be 24. Gray mentions $\frac{21}{24}$. Nilson 22—24, and Clarke $\frac{23}{23}$ — $\frac{23}{23}$. I counted $\frac{23}{23}$ — $\frac{23}{23}$ teeth in a skeleton in the Physiological Museum in Copenhagen.

³ Probably 2 or 3 pairs of ribs were wanting.

tebræ, and 28 caudal, altogether, with the 7 cervical, 64 vertebræ. Processus spinosi inferiores 22, the last two of which were rudimentary. The sternum consisted of three bones, all separate; 5 pairs of the ribs were costæ veræ, and besides these the 6th and 7th pairs seem to have been united to a cartilaginous extension of the sternum.

This dolphin is sometimes found off our coasts, as has been mentioned in the description, and oftener than *D. delphis*. Our museums bear evidence that it has been caught on our coasts at least four times. It has also at times appeared near the coasts of Denmark, England, Holland, and France, where it sometimes runs up the mouths of rivers. A skull of a *D. tursio*, caught in the Baltic at Gede, is figured in Missus 2dus 'Historiæ Piscium,' tab. 1, fig. 1, by Klein, and is mentioned in the text at page 23, under the name of *Orca*.

Note.—*Delphinus Euphrosyne* and *obscurus*, Gray, are mentioned in 'Skandinavisk Fauna,' as being Scandinavian with a ?, from the fact that skulls of these species from unknown localities are preserved in the Museum in Lund, but they probably do not belong to the Scandinavian Fauna. The latter inhabits, according to Gray, the Southern Pacific Ocean, and the locality of the former is, according to the same author, still unknown.¹

2nd Genus ORCA, Gray.

Nose blunt, more or less rounded, without a conspicuous transverse groove above. Blowers resembling those of the preceding genus. The back with a fin more or less high, sometimes on the middle and sometimes somewhat behind the middle of the body. Form of body generally more robust and thick than in the preceding genus, more especially the fore part. Both jaws with a smaller number of teeth on each side (in ours 12—14, or less, and in the foreign species seldom more). Teeth of a conical form, generally obtuse, and as age advances sometimes more or less deciduous.

Nose on the skull broad and obtuse, about equal in length with the hinder part of the skull; width at the base greater than half its length. The symphysis of the lower jaw-bones is shorter than half the length of these bones. The skeleton is generally of a heavier build, and has commonly a smaller number of vertebræ than in the preceding genus.

The species of this genus are not numerous (11—12), but are scattered in every ocean; and the distinctions between them are at times so insignificant, that the specific differences have been considered doubtful. We have at least three species, if not more, within the boundaries of the Scandinavian Fauna.

¹ [The same author has recently ("On the Cetacea, which have been observed in the Seas surrounding the British Islands," 'Proceed. of the Zoolog. Society,' 1864) stated that *D. Euphrosyne* is synonymous with Eschricht's *Delph. Holbøllii*, and that it appears in the North Sea and near the coasts of England. It may also belong to our Fauna.—1865.]

1. O. GLADIATOR, *Lacépède*. Killer. *Swedish* "Störhval."

Number of ribs 12 pairs. Dorsal fin very high. Each of the intermaxillary bones on the upper side of the beak of the skull not wider than that part of the maxillary that is visible at its outer side.

STOUR-WAGNEN ELLER DE GAMLES ORCA, *J. E. Gunnerus*. Det Kongl Norske Videnskabers Selskabs Skrifter, 4^{de} deel, p. 99, 1768.

DELPHINUS GLADIATOR, *Lacépède*. Histoire Naturelle des Cétacées, p. 302, 1804 (partly)¹.

GRAMPUS?, *J. Hunter*. Observations on the Structure and Economy of Whales. Philosophical Transactions of the Royal Society of London, vol. lxxvii, 1787, p. 371, tab. xvi.

DELPHINUS ORCA, *S. Nilsson*. Föredrag vid Naturforsk. Mötet i Stockholm, 1851, p. 55.

Note.—It seems quite evident that this large form or species is the same as the one described by Gunnerus at the above-cited place, partly from its size, and partly from the fact, that it is well known by the fishermen on the western coast of Norway, under the names of "Stour-Wagn," "Stour-Henning," and "Stour-Hynning," mentioned by Gunnerus, and is distinguished by them from the smaller species, which also is well known by them, and is oftener caught. The fishermen distinguish this species particularly by its larger size, and its higher dorsal fin projecting out of the water like a stake. Dr. J. Koren, of Bergen, who has had the opportunity of obtaining correct information about this, and of closely observing the smaller species, first called my attention to the probability of the Stour-Hynning being a different species from the *Delphinus orca* described by Schlegel. It is however very apparent, that the species of this part of the genus *Orca*, as here described, or of Gray's *Orca*, approach each other very closely. The following description of the dorsal fin given by Gunnerus, and based upon a statement of Captain Coldevin: "i Steden for Ryg-Finde har en Stagé, som paa Norsk kaldes Stör eller Stour, og hvoraf Fisken har faat det Navn: Stour-Wagn eller Stour-Henning. Denne är af Been, 3 Alen høj. overtrukket med Skind, flad paa Siderne, bredere ved Roden, og bliver alt smalere og smalere, ligesom et Sverd, dog noget budt i Enden," is partly unnatural and erroneous. It is evident from this, however, that it has a very high dorsal fin, and that its name is founded upon the form of this part. I have selected the specific name given by Lacépède, as being the first that with any certainty corresponds with this species, although he repeats the old errors and exaggerations, and partly seems to have confounded it with the *D. orca*, which he had previously described. As Hunter has not given a very minute description, and in describing the colour of the upper part of the body does not mention the white spot on the neck, it is not quite certain that he had this species before him, although the considerable dimensions (24 English feet in length) make it probable. All later authors have mixed the two forms, and could therefore not be mentioned in the synonymy. The skeleton that I had an opportunity of examining was from the specimen that was

¹ I have unfortunately not had an opportunity of gaining information from Bonnaterre's Cétologie of his Dauphin d'Anderson.

stranded on a shoal in the vicinity of Ronneby in Blekinge (Sweden) in the spring of 1851, and I have therefore been fully justified in quoting Professor Nilsson's remarks about this dolphin, in the synonymy, as they have reference to the same specimen.

The male that, according to Banks and Lacépède, was captured in the Thames in June, 1793, was 31' (English) long; and the specimen found near Ronneby was 24' (Swedish). The one described by Gunnerus was 24' (Norwegian) in length, the same as the one described by Hunter. I have seen two skulls from Christiania, from specimens caught in the bay there, and stated to have been about 25' long. This length seems, consequently, to be the most common. The form of its body has not yet been exactly described; but the skeleton, being of a heavier structure than in the following species, leads us to suppose that it is still more robust than the latter, although there is not much difference between them in this respect, in consequence of being two species so nearly related to each other. The Norwegian fishermen state, as I have mentioned, that its dorsal fin is considerably higher than in the succeeding species, viz., 4'—6'. From the short description of its colour given by Nilsson, at the place cited, it seems that it resembles that of the succeeding species, with the exception that it has a rounded white spot on the neck, and not any purple streaks on the back near the dorsal fin. As this spot is not mentioned by any other author it is certainly possible that it may be an individual deviation in colour; but as the colours of the whales generally seem to be very constant, I have considered it due to mention it as deserving attention.

Skeleton.—Entire length about 21' 6"; length of skull 3' 6". Its width over the anterior dilated part of ossa zygomatica at frontis 1' 9". Length of nose 1' 9"; its width at the base 1' 1 $\frac{1}{8}$ ". Teeth line in the upper jaw 1' 2 $\frac{1}{2}$ " long. Length of lower jaw 2' 8 $\frac{1}{2}$ "; its row of teeth 1' 3 $\frac{1}{8}$ ". Body of atlas 8 $\frac{1}{2}$ " wide and 6" high. Body of the 2nd lumbo-sacral vertebra 5 $\frac{1}{4}$ " wide, and its transverse processes 6" long. Body of the 10th, or penultimate lumbo-sacral vertebra 6 $\frac{1}{4}$ " wide, 6 $\frac{1}{8}$ " high, and 5" long; distance from body to the point of spinous process 8 $\frac{1}{2}$ ". The longest ribs are in a straight line, 3' 2"—3" long. Length of scapula, from the glenoid cavity to the upper opposite edge 1' 4 $\frac{1}{4}$ ", and its width 1' 10 $\frac{1}{2}$ ". The acromion is subquadrangular, 4 $\frac{1}{2}$ " long, and somewhat more than 4" wide. Processus coracoideus 3 $\frac{1}{2}$ " long. Os humeri 10" long and 7" wide at the lower end. Its tuberculum majus is very large, and head directed almost straight to the side. Radius 11" long and 8 $\frac{1}{2}$ " wide at the lower end. Ulna 9" long, 5" wide across the olecranon, and 6 $\frac{1}{2}$ " across the lower end. Ossa pelvis 11" long, in a straight line, and somewhat curved. The teeth 12—13 in number, on each side of the upper and lower jaw, short and thick, with the points worn down; the larger ones are 1 $\frac{1}{4}$ " in transverse diameter. The nasal and frontal bones form a high tuberosity behind the blowers. The triangular area on the intermaxillary bones in front of the blowers is slightly concave, and divided along the middle by the inner edges of these bones rising there. The three foremost cervical vertebræ are united by their bodies, and they are all, except the 7th, united by their spinous processes. Behind the strong lateral processes of the atlas there are a pair of smaller, but still quite large lateral processes that seem to belong to the axis, which is ankylosed with the atlas. The processus transversi of the 3rd cervical vertebra form a ring. Dorsal vertebræ 12, lumbo-sacral vertebræ 11, caudal vertebræ 24,¹ and, consequently, with the addition of the 7 cervical vertebræ, in all

¹ The caudal region is here, as always, counted from the beginning of the *processus spinosi inferiores*

54 vertebræ. All the lumbo-sacral vertebræ are keeled on the lower side of the corpus; but this keel assumes, on the first caudal vertebra, the appearance of a wide, flat ridge. On the last dorsal vertebra there appears also a ridge on the lower side of the corpus, but it is here obtuse. Processus spinosi inferiores 14. The 14 last caudal vertebræ entirely without processus transversi. I have, unfortunately, not taken any notes of the sternum. Five of the 12 pair of ribs are costæ veræ, and the 6th is united to a cartilaginous extension of the sternum. The 1st to 7th pairs have a long collum, and their capitula articulate with a conspicuous articulating area upon the corpora of the vertebræ, which are placed next before those, to the processus transversi of which the tubercula of these ribs are articulated. The capitula of the 1st pair articulate with the corpus of the 7th cervical vertebra. The carpus and metacarpus have each 5 bones; fingers 5. The thumb has only 1 phalanx, which terminates in cartilage. The fore-finger, which is the longest, has 6 phalanges, and, from its appearance, has probably had 7; the middle finger has 4, the 4th finger 3, and the little finger 1, and has probably had 2.

I have had the opportunity of examining five skeletons of the succeeding smaller species; two of these quite complete, and from old males, on which the sutures of the sternum had disappeared, and with firm and hard bones, are preserved in the museum in Bergen; and three are preserved in the Physiological Museum in Copenhagen.¹ The skeleton just described offers the following peculiarities in comparison with these, especially with those in Bergen, which have been more minutely examined. In the first place it is much larger. One of the skeletons in Copenhagen, was 17 $\frac{1}{2}$ " long, being the largest of these five; the two in Bergen were next in size, being of almost equal size, and differing but little from the skeleton in Copenhagen just mentioned, the one 16' 1 $\frac{1}{4}$ " in length, the other 15' 8 $\frac{1}{2}$ ". The specimen described by Schlegel was 16' 3" (Rhenish) in length, therefore nearly equal to those at Bergen; this length seems, consequently, to be common for full-grown specimens of the following species. II. It is distinguished by having 12 dorsal vertebræ and 12 pair of ribs, while the others, even the one described by Schlegel, have only 11. III. Its head is more elongated. Its width at the orbits is about half its length. The width is much larger, comparatively, in the others, of which the three largest present the closest resemblance in regard to the head, which was 36" long and 21" wide. IV. The tubercle formed by the frontal and nasal bones is much higher than in the smaller species, where it is not very high, and is directed backwards. V. All the cervical vertebræ except the 7th are united by their spinous processes, and the first three also by their bodies, while in the following species only the 3rd and 4th cervical vertebræ are united by their spinous processes, and only the first two by their bodies. The specimen described by Schlegel agrees in this respect with those examined by me. VI. All the teeth have obtuse and worn-down points, while in the following only the front teeth have obtuse points. VII. The carpal bones are 5, and in the following species only 2, at least on the skeletons in Bergen. I did not observe those on the skeletons in Copenhagen, and they are not mentioned by Schlegel. VIII. The second finger has one or two more phalanges, and the 3rd and 4th one more than in the following, according to observations on the skeletons

inclusive, so that it is the first of the caudal vertebræ that participates in the articulation, or the attachment of the first of these bones.

¹ [Professor Eschricht has since ('Om Spøkhuggeren,' Overs. over det Kongel. Danske Videnskab. Selskabs, Forh. 1862) demonstrated that two of these belong to another species.—See the second memoir in the present volume.]

in Bergen. The latter have one vertebra less in the lumbar and caudal region; but this difference is of no importance, as I found the number of vertebræ corresponding on one or two of the skeletons in Copenhagen.

It may seem that some of the above-mentioned osteological differences could be explained by difference of age; but the sternum being united into only one bone, the front teeth being much worn down, and the strongly-developed processes not exhibiting sutures, seem to show that the smaller skeletons at Bergen are of as great an age as the one at Lund.

This species does not appear to be very scarce on our western coasts, although it is not caught as often as the following. It is not so social, and is oftener found alone. It was probably this species that Nilsson saw off the coast of Helgeland, in Norway, from what he mentions, l. c., page 606. A complete skeleton of a specimen that was stranded at Ronneby in March, 1851, is, as previously stated, preserved in the University Zoological Museum at Lund, from which skeleton the above description is taken. The skull described in 'Skand. Fauna,' p. 604, probably also belongs to this species. Two skulls from the southern coast of Norway are preserved in the Zoological Museum of the University of Christiania.

2. *O. SCHLEGELII*, *Nov. Nom.* Lesser Killer, or Whale-dog.¹

Ribs 11 pairs. Height of dorsal fin about equal to its length at the base, and not very large. The intermaxillary bones resemble those of the preceding species.

DELPHINUS ORCA, Lacépède. Histoire naturelle des Cétacées, p. 298.

— — *H. Schlegel.* Abhandlungen aus dem Gebiete der Zoologie u. verg-leichende Anatomie, ii heft, p. 2, tabs. vii and viii, 1843.

Note.—Although Lacépède has distinguished his *Dauphin Gladiateur* from his *Dauphin Orque* he seems to have confounded them in the description. This seems to be the case more particularly with the latter, to which he has given dimensions that probably belong only to the former. His description is generally too incomplete, and too little discriminating to be applied to either with any certainty. Schlegel is the only late author that has described this species with such minuteness that the description can be applied to it with full certainty.

Its largest size is yet unknown; but from the measurements stated by Schlegel, and from the length of the skeletons examined by me, it seems that the usual length of full-grown specimens is from 16' to 18'. The form of its body is rather robust, although not much thicker than of some species of the genus *Delphinus*. Its greatest thickness is under the dorsal fin, which is placed considerably before the middle of the body, although behind the anterior third. The head is obtusely pointed and the nose blunt, but not rounded, and neither above nor behind limited by any conspicuous notch. The hinder part of body, behind the anal opening, which is about the

¹ This name is translated from the Norwegian "Wagnhund." It is probably this species that is called by this name on the northern coasts of Norway. Several of them attack the whales together, and cling to their sides, from which the name is derived. The specific name *O. Schlegelii*, here used, was long since suggested to me by Dr. J. Koren.

beginning of the posterior third of the body, is tapering and tolerably elongate, and, when the animal is seen from above, strongly tapering and compressed towards the caudal fin; but when seen from the side almost of equal width from the vent to the caudal fin, although, of course, much lower than the fore part of the body. The height of the body, at the beginning of the dorsal fin, was 2' 10" (Rhenish) in the specimen described by Schlegel, which was a female, 16' 3" (Rhenish) long; the dorsal fin was 1' 11" high; length of the pectoral fins from the bottom of the hinder notch at their base 2', and the width of the caudal fin 4' 7". On one of the specimens, of which the skeletons are preserved in the museum in Bergen, and the fins of which had the strongest resemblance, to those described by Schlegel, the dorsal fin was 2' 8" (Norwegian) high along its anterior edge from the base, and its base 2' 4" (Swedish) long. Pectoral fins 2' 9½" long (according to Dr. Koren). The colour is, according to Schlegel, above, black, changing into all the colours of the rainbow; beneath, porcelain white. Dorsal and pectoral fins black, also the caudal fin above. The under surface of the latter white with black edges. There is on each side, above and behind the eyes, a rather large, oblong, white spot, and a similar but smaller spot on the lower side behind the base of each pectoral fin. There is a purple streak on each side of the back, immediately behind the dorsal fin, and obliquely forward and down on each side of the base of the fin, which streak terminates in front in a very narrow line.¹ The white colour on the lower side of the body occupies the entire lower jaw, extends up the sides of the head nearly to the eyes, and forms a narrow line on the borders of the upper jaw. It forms a large curve backwards on the sides of the body behind the dorsal fin, and above the genital furrow. The black colour of the upper side extends, below the dorsal fin, to a portion of the sides of the belly, covers the hinder part of the body between the anus and the caudal fin, and has a forward extension on each side of the genital furrow.

After receiving the necessary information from Dr. Koren in regard to the two skeletons preserved in the museum in Bergen, I made the following observations:—Both are males, and appear, from what has been stated, to be from old specimens. One is 16' 1¼" in length, the other 15' 8½". The head of the latter is 3' long and 1' 9" wide over the anterior dilated part of ossa zygomatica and frontis. The beak is 1' 6" long, 10¾" wide at the base, and 9½" wide at the middle. The teeth row on each side of both jaws 1' 2½" long. Lower jaw 2' 4¾" long. Scapula 1' ¾" long and 1' 6¾" wide. Acromion 3¾" long, and of an irregular form. Os humeri 7¼" long, from the point of tuberculum majus, and 4¼" wide at the middle. Ulna 7¼" long and 3¾" wide at the lower end. Sternum 1' 6" long. The teeth are 12 on each side in the upper and the lower jaw, and all have a black spot on the outside in the cortical substance, whereby a black line is formed along the outer side of the row of teeth. The front teeth with an obtuse and worn-down point, the others acute. The tubercle formed by the nasal and frontal bones, behind the blowers and vomer, is but slightly elevated, and is directed backwards. The intermaxillary bones before the blowers rather sharply concave forward, most narrow on the middle of the upper side of the jaw, wider both forward and backward, and in shape resembling those of the preceding species. The maxillaries extend farther back than the intermaxillary bones, but leave a part of the frontal bones bare between them and the occipital bone. The form of the head is the same in both skeletons. The first 4 cervical vertebræ are united by their processus spinosi in the

¹ This line may be caused by a scratch in the epidermis. It was not observed on the specimens captured in the vicinity of Bergen.

smaller skeleton, only the first 3 in the larger. The first 2 cervical vertebræ are united by their corpora in both skeletons. The lateral processes or processus transversi of the 5 posterior cervical vertebræ are but slightly developed, and the lower branch (parapophysis) of the last or 7th is reduced to an articulating area for the capitulum of the 1st pair of ribs. The opening for the arteria vertebralis in the lateral processes is not closed on any of these vertebræ, nor do these processes form a ring. Dorsal vertebræ 11, lumbo-sacral vertebræ 9 in one skeleton, and 11 in the other; caudal vertebræ 25 in the former, and 23 in the latter; altogether, with the 7 cervical vertebræ, 52 vertebræ in each skeleton; the former has 14 and the latter 13 processus spinosii inferiores. The last 14 caudal vertebræ are in both without processus transversi. The sternum consists of only 1 bone.¹ Five pairs of the 11 pairs of ribs are costæ veræ, and the 6th pair are united to a cartilaginous extension of the sternum. The 1st to 7th pairs of ribs show at their upper ends the same relation as in the preceding species, viz., they articulate by their capitula to the corpora of the vertebræ next preceding those to the transverse processes of which the tubercula of these ribs are articulated, and the capitula of the 1st pair articulate with the corpus of the 7th cervical vertebra. The carpus has on both skeletons only two bones, but the metacarpus has 5; fingers 5. The thumb has 1 phalanx, the forefinger 5, the middle finger 3, the fourth finger 2, and the little finger 1. All the phalanges are complete in both skeletons, and are broad, but rather thin. The skeletons, with the exception of the head, seem generally to be of a less heavy structure than those of the preceding species.

One of the two smaller skeletons in the Physiological Museum in Copenhagen, which were of almost equal length, viz., about 12½', offered several peculiarities. Its head was comparatively broader, and the structure of the skeleton generally somewhat heavier, although it seemed to be young. Its head was 2' 9½" long and 1' 7½" wide, while it was 1' 6" wide on the other skeleton of the same length. Its sternum consisted of 4 pieces, while it consisted of 3 in the other two; its scapula was somewhat wider, and its ribs longer and wider, and the anterior ones more curved. These deviations may have been a consequence of difference of sex, and the coarser skeleton may have been from a male.² All three skeletons had 13 teeth on each side of the upper jaw and 12 on each side of the lower. Only the coarser had 13 teeth on one side of the lower jaw.

It is said to be not very scarce on the western coast of Norway. A herd of 12 were caught at once in a bay near Bergen, in Norway, during the winter of 1860; they were driven into shallow water, near the shore, until they grounded, and were then killed. The two skeletons in the museum in Bergen are from these. The smaller skull in the Zoological Museum in Lund, that is mentioned in 'Skandinavisk Fauna,' Mammalia, p. 604, and is 2' 11" long, is probably of this species. It is not stated where it is from; but it is probable that this species, at times, is found on the western coast of Sweden. It undoubtedly pursues the larger whales as eagerly as the preceding species.

Addendum to the description of Orca Gladiator.—I have been enabled to add the following to the description of this species from an outline sketch kindly furnished me by Professor F. Wahlgren, of Lund, which is copied from the figure of this species, mentioned by Professor

¹ The sternum was divided into three pieces in the specimen described by Schlegel.

² This more robust skeleton has been referred by Eschricht to a new species. It was taken at the Farøe Islands.

Nilsson in the report previously quoted, and deposited by him in the Zoological Museum in Lund, where it is now preserved. The height of the body under the dorsal fin is, according to the sketch, somewhat less than that of *Orca Schlegelii* as given by Schlegel. Its entire length is about $4\frac{1}{2}$ times its height; but in the latter it is less than $4\frac{1}{2}$ times, according both to the figure and to the description by Schlegel. The hinder part of the body from the anus is, on the contrary, less slender and elongated. The height of the body above the anus is contained 7 times in the entire length, while this height in the latter is contained nearly 8 times in the length. The most striking characters, however, are that the dorsal and pectoral fins are considerably larger, and that the latter are obtuse and the former almost straight. The vertical height of the former is considerably greater than its length at the base (exceeding it by $\frac{1}{4}$), while that of *Orca Schlegelii* is less than its length at the base, according to Schlegel's figure, as well as to an outline sketch of the same fin of the specimens obtained at Bergen, furnished me by Dr. Koren. This height is contained about 6 times in the length of the body. The length of the pectoral fins from the hinder angle at their base ("hintern Ausschnitt," Schlegel) is not contained quite $5\frac{1}{2}$ times in the length of the body, while, in the latter, it is contained more than 8 times in the length. To the above-stated difference of colour may be added that there is a similar smaller spot close in front of the large white spot above and behind the eyes.

3. ORCA MELAS, *Trail*. The Pilot-whale. *Swedish* "Grindelval."

The front of the head (nose) short, rounded, with a prominent hemispherical convexity or "fore-head." In the skull, each of the intermaxillary bones are, on the upper side of the beak, much wider than that part of the maxillary which is visible at their outer side.

- DELPHINUS MELAS, *Trail*. Nicholson's Journal, vol. xxii, p. 21, pl. iii, 1809 (according to F. Cuvier and Gray).
 — GLOBICEPS, *G. Cuvier*. Annales du Mus. xix, p. 14, tab. i, 1812 (according to J. A. Wagner).
 — — *Idem*. Recherches sur les Ossemens Fossiles, t. v, 1^{re} partie, p. 285, tab. xxi, figs. 11—13 (the skull).
 — — *F. Cuvier*. L. c., p. 190, tab. xiii, fig. 2, and tab. xiv, figs. 1—3.
 — — *H. Schlegel*. L. c., 1 Heft, p. 33.
 — — *J. A. Wagner*. Schreber's Säugethiere, 7^{te} Theil, p. 285, figs. 2 and 3.
 GLOBIOCEPHALUS SVINEVAL, *J. E. Gray*. L. c., p. 32.
 DELPHINUS GLOBICEPS, *S. Nilsson*. L. c., p. 608.

In length it reaches 20'. Form of body tolerably elongated, with the greatest thickness in front of the middle, the fore part short and thick, the hinder part rather elongated and narrow. Nose very short and rounded, and the head above the nose enlarged and hemispherically rounded. The fins are large. Dorsal fin, about the middle of the body, directed backwards. The greatest thickness of the body is at the beginning of the dorsal fin. The greatest circumference of a specimen 19'—20' long was, according to statements by Lemaout (also made by F. Cuvier) 10'

(French). The dorsal fin was 3' long at the base, and 4' high (probably along the curve of the anterior edge, and not in a straight line). The pectoral fins were long and narrow, 5' 2" long and 1' wide. Width of caudal fin 4' 3". General colour, black, but beneath, from chin to anal opening, white. The white colour extends in the shape of a heart under the chin and throat, from which place the white area suddenly tapers towards the tail. All the fins black.

The skull is distinguished by the broad intermaxillary bones, by the narrow strip of the maxillaries, visible at their outer edge, by the intermaxillary bones in front of the blowers being concave the greater part of their length, in consequence of the tuberosity formed by the nasal and frontal bones behind the blowers being very high, and by the teeth lines being very short, both in the upper and the lower jaw. The length of the skull is 2' 1", and its width across the temporal bones 1' 5" on a skeleton 13' in length. The least width across pars occipitalis 11 $\frac{1}{2}$ ", and the width across the orbits 1' 3 $\frac{1}{2}$ ". Length of beak 1' 1", and its width at the base 9 $\frac{3}{8}$ ". Intermaxillary bones, together, 6 $\frac{1}{2}$ " wide at the middle of the beak. Lower jaw 1' 7 $\frac{1}{2}$ " long, and its row of teeth 5". Teeth of this skull $\frac{8-3}{3}$, with indications that the 9th, on each side of the lower jaw, had fallen out.² Dorsal vertebræ 11, lumbo-sacral vertebræ 13, caudal vertebræ 26—29; in all, with the 7 cervical, 57—60 vertebræ. Processus spinosi inferiores 17. The sternum consists of three bones, the first of which has, on each side at its anterior end, a process which is directed backwards. True ribs 4 pairs; and the 5th and 6th pairs seem to have been united to a cartilaginous extension of the sternum (processus ensiformis).

The pilot-whale is very social, and is always found in shoals, either large or small. It occurs in the North Sea, and the northern part of the Atlantic Ocean, sometimes even so far north as near the coast of Greenland. It appears, at times, on the western and north-western coasts of Norway. Such observations are mentioned in the "Skandinavian Fauna," and more recently it was stated in the newspapers that some 2 or 3 years ago, a herd of 70—80 whales of small size had stranded and been caught on the coast of Nordland, in Norway, which, from the description, probably belonged to this species. It is said never to make its appearance in the Cattegat.

3rd Genus. PHOCÆNA, G. Cuvier.

Nose short and obtuse or rounded, neither above nor behind limited by any conspicuous notch. The opening into which the blowers are united on the upper side of the head is arcuate and transverse, and placed almost exactly above the eyes, far behind the point of the snout. Back with a fin about the middle of the body. Form of body robust, thicker and obtuse in front. Both jaws armed with rather numerous teeth (20 or more); small, obtuse, and compressed at the point.

¹ The upper jaw appears in consequence of this, when seen from the sides, to be more depressed and thin than in the preceding species.

² The number of teeth is variable; 14 on each side above and 12 on each side below is said to be the highest number; sometimes they are all lost in aged specimens.

The beak of the skull rather short and obtuse (but not so much as in the preceding species), and shorter than the hinder part of the head. Symphysis of the lower jaw short (shorter than half the length of these bones). The skeleton generally is distinguished by a greater number of vertebræ than in the preceding genus.

It seems that only one species of this genus is known, belonging to the North Sea, the Northern Atlantic, and the Polar Sea.

1. PH. COMMUNIS, *Lesson*. Common Porpoise. *Swedish* "Tumlare."

A rather high tubercle on each of the intermaxillary bones in front of the blowers. Teeth 20—28 on each side of the jaws.

DELPHINUS PHOCÆNA, *Linné*. Fauna Suecica, p. 17.

— — *Lacépède*. L. c., p. 287.

PHOCÆNA COMMUNIS, *Lesson*. Manuel de Mammalogie, p. 413, 1827.

— — *F. Cuvier*. L. c., p. 171, tab. xii, fig. 1.

DELPHINUS PHOCÆNA, *S. Nilsson*. L. c., p. 616.

Length 4'—6', generally 4'—5'. Thickest part of body nearly under the beginning of the dorsal fin, therefore somewhat before the middle. The head in front, above the nose, is strongly convex. The body tapers considerably towards the caudal fin, particularly when seen from above, as it is very much compressed posteriorly. Back broad and rounded. Height of dorsal fin, which is about the middle of the body, considerably less than its length at the base. Pectoral fins rather small and narrow. A stuffed specimen, 4' 2" in length, had the dorsal fin 4" high and 8" long at the base, the pectoral fins 7½" long from the front edge of their base, and the caudal fin about 12" wide between the points of the lobes. Colour:—above, black; beneath, white, without any distinct limits. All the fins black, and the black colour extending from the caudal fin over the part of the body next to it, or the tail. Lower jaw black in front. A black streak runs from the anterior edge of the pectoral fins under the eyes into the black colour on the sides of the head. The white colour extends partly upon the sides of the body, and is there sprinkled with fine spots of a blackish-grey colour. Skin shining.

A skeleton of an old female that was shot near Stockholm last summer is now preserved in the Anatomical Museum here, and offers the following characters:—Length of skeleton 4' 9¼". Length of skull 11¼"; width of skull across the processus zygomatici of ossa frontis 5½"; width across ossa frontis, before orbits, 4¾". Nose 4¾" long, and 2¾" wide at the base, and considerably shorter than the hinder part of the skull. Teeth line in the upper jaw 4" long. Lower jaw 8¼" long, its row of teeth 3¾". On each of the intermaxillary bones, before the blowers, a tolerably high, oblong, and uneven protuberance. The frontal and parietal bones form a rather high protuberance behind the nasal bones. Vomer visible only at one place on the lower side of the upper jaw, between the hinder points of the intermaxillary bones, which also are visible there. Teeth $\frac{28-38}{22-32}$ (I counted 24 teeth on each side of each jaw in a skull at Lund); round at the base, compressed, and with rounded margin at the crown. All the cervical vertebræ, except the 7th, ankylosed together; but the sutures have disappeared only between the first three. Dorsal vertebræ 13, lumbar

vertebræ 13 (I counted 15 in a skeleton at Lund), caudal vertebræ 32; in all, with the 7 cervical vertebræ, 65 vertebræ. The 18 last caudal vertebræ are without processus transversi. Processus spinosi inferiores 18. The sternum consists of only 1 bone. 5 pairs of costæ veræ.

The porpoise is the most common of this family in the seas on our coasts as far as Finmark, and on the coast of Europe generally. There is probably something periodical in its appearance, at least in the Baltic. It has been observed on the Danish coast that it runs from the Cattegat to the Baltic through Öresund in the spring, and returns through the Little Belt¹ in the autumn. I saw several specimens in the sea off Christianopol, in Blekinge, on 11th June last; and, according to C. Sundevall, it has been seen in the sea at the inlet to Stockholm. It appears also on the western coast of Greenland. This species is social, although not so much so as the preceding; several individuals being generally seen together.

4th Genus. DELPHINAPTERUS, Lacépède.

Nose short and rounded; head very convex in front. The opening into which the blowers are united on the upper part of the head, far behind the point of the snout, and transverse in direction. No dorsal fin. General form of the body very thick; obtuse in front; sharply tapering backwards, especially when seen from above, and very much compressed before the caudal fin. Both jaws armed with a small number (10 or less) of conical, obtuse, thinly-set teeth, that become more or less deciduous with age.

The beak of the skull is rather broad and obtuse, and somewhat shorter than the hinder part of the head; the facial section convex in front of the blowers, and, when seen from the side, somewhat descending forward. Teeth-line in lower jaw, as well as symphysis of the lower jaw-bones, shorter than half the length of these bones. The skeleton generally is distinguished by a small number of vertebræ.

Two species of this genus are known, one from the northern Polar regions, and one from the seas near Australia;² the former is said to appear sometimes off the extreme northern coasts of Norway. The Zoological Museums of Norway, however, afford no evidence of its existence there.

1. *D. LEUCAS, Pallas.* The Northern Beluga.

Beak somewhat, but not materially, shorter than the hinder part of the skull, and its length considerably greater than its width at the base or notch.

DELPHINUS LEUCAS, Pallas. Reisen, &c., III, p. 92, tab. lxxiv, 1776.

BALENA ALBICANS, O. F. Müller. Zoologie Danicæ Prodomus, p. 7, 1776.

¹ Compare what is stated in Skand. Fauna, p. 618, about its migration through the Little Belt.

² *D. Kingii* (Gray), 'Voy. Erebus and Terror. Cetacea,' p. 30.

- DELPHINUS ALBICANS, *O. Fabricius*. Fauna Groenlandica, p. 50, 1780.
 DELPHINAPTERUS BELUGA, *Lacépède*. L. c., p. 243.
 DELPHINUS LEUCAS, *G. Cuvier*. Recherches sur les Ossimens Fossiles, t. v. 1^{re} partie,
 p. 287, tab. xxii, figs. 5 and 6.
 PHOCÆNA — *F. Cuvier*. L. c., p. 199, tab. xv, fig. 1; tab. xvi, figs. 1—3.
 BELUGA CATODON, *J. E. Gray*. L. c., p. 29.
 DELPHINUS LEUCAS, *S. Nilsson*. L. c., p. 614.

Length of body 12'—18', or more. It is robust and thick, more so than the "lesser killer," Its greatest circumference, which is equal to about $\frac{2}{3}$ its length, somewhat before the middle of the body. Fore part of body less tapering, and ending obtusely, as the front of the head is almost perpendicular from above down to the somewhat projecting border of the snout or upper lip; above this, which is limited behind by a slight notch, it is rounded and convex anteriorly, and when viewed from above somewhat tapering forward. The upper margin of the head, viewed from the side, slopes somewhat at the blowers, and is almost straight before this point, until it suddenly inclines at the forward convexity. The lower edge of the chin is somewhat raised and arcuate. The transverse, crescent-like opening of the blowers is somewhat further back than the eyes. The body tapers very much backwards, particularly when viewed from above, and is considerably compressed from the caudal fin to a tolerable distance forward, with the upper and lower edges rather sharp, and extending backwards between the two lobes of the caudal fin. The hinder part of the body or the tail is, when seen from the side, much higher than the thickness of the caudal fin, and its lower margin rises considerably towards the caudal fin, while the upper margin is almost straight. There is, on the middle of the back, as a rudiment of a dorsal fin, a longitudinal, rough, compressed protuberance, about 18" long, formed by the skin, on which the epidermis is much harder than elsewhere. The pectoral fins are in their usual position, and are small, short, and blunt, having an obtuse angle in the middle of their hinder edge. The caudal fin is of the usual shape, deeply forked in its hinder edge. The small eyes are directly behind, and very near to, the angles of the mouth.¹ The pectoral fins were 14" long and $8\frac{3}{4}$ " wide in the specimen mentioned in the note below, which was a female about 10 $\frac{1}{2}$ ' in length, the caudal fin 2' 3" wide between the points, the tail 6 $\frac{1}{2}$ " before the caudal fin, was 9 $\frac{1}{3}$ " high, and 3 $\frac{1}{3}$ " in breadth. The head was 13 $\frac{2}{3}$ " high and 12 $\frac{2}{3}$ " broad, measured across the eyes. The colour was, according to Mr. Quennerstedt,² shining milk-white, with a narrow, blackish-blue edge on the pectoral and caudal fins. The old ones are, according to Pallas, white as ivory, and the young at first greyish-brown.

I have made the following observations from a skeleton, about 12' long, from Spitzbergen:—Skull 22 $\frac{1}{2}$ " long and 12 $\frac{1}{4}$ " wide across the temporal bones. Nose 10 $\frac{1}{2}$ " long and 7 $\frac{1}{4}$ " wide at the base. Lower jaw 16 $\frac{2}{3}$ " long, and its teeth-line 6 $\frac{1}{4}$ " long. The nasal and frontal bones form a tubercle, rising rather prominently behind the blowers. Crista lambdoidica low, and directed backwards.

¹ The head, the hind part of the body and the fins, are here described from a salted skin from Greenland, of which the head, the hind part, and the fore extremities, were uninjured. It is now stuffed, and the natural form of these parts has been preserved. It is preserved in the Zoological Museum of this University.

² 'Anteckningar om Spitzbergen' (manuscript).

The superior maxillaries extend behind the nasal bone. The right intermaxillary bone reaches somewhat further back than the left one, and neither of them touches the nasal bone. The upper margin of the facial section arcuate. The triangular area on the intermaxillary bones, before the blowers, rough, somewhat concave in the middle, convex forward, and on each side limited by a deep furrow. Its width in front of the blowers $4\frac{1}{3}$ ". Teeth $\frac{10-12}{3}$, obtuse, and worn down. Cervical vertebræ separate. Dorsal vertebræ 11; lumbo-sacral vertebræ 10; caudal vertebræ 22. In all, including the 7 cervical vertebræ, 50 vertebræ. Processus spinosi inferiores 12. The sternum consists of 3 bones; 4 pairs of the 11 pairs of ribs¹ are costæ veræ. The carpus and the metacarpus have 5 bones each. The fingers are 5, the thumb has 1, the fore-finger 5, the middle finger 4, the 4th finger 3, and the little finger 3 phalanges.

The Beluga, as it is called in Russian, is common in the northern parts of the Polar Sea, as at Greenland, Spitzbergen, Nova Zembla, the northern and north-eastern coasts of Siberia, where it sometimes runs up the mouths of the northern rivers (Pallas), and at the northern coasts of North America; it is therefore circumpolar. It thus does not properly belong to our Fauna. I have not received any information of its being found off Norwegian Finmark, but Quennerstedt ('Dissertatio pro Gradu Philos.' May, 1862, p. 17) states that he has heard that it appears there sometimes, probably during the migrations which it makes in winter, like all other toothed-whales. It feeds principally upon fish, cephalopodes, and other marine animals. Fabricius and Pallas state that fish is its food; Holböll, according to Eschricht, adds Crustaceans and Cephalopodes; and a specimen that was caught in the Firth of Forth (Scotland) in 1815 had, according to Neill and Barclay, been attracted there by the salmon, which it eagerly pursued. I was, nevertheless, informed at Tromsö by a seaman, who had frequently visited the seas near Spitzbergen, and had served as pilot on the French scientific expedition, and caught several belugas, that he had never found anything but fucaceous vegetables ("tarre") in their stomach.

5th Genus. *MONODON*, *Linné*.

Cetacea belonging to this genus are distinguished by having only one or two, more or less developed, teeth in the anterior part of the upper jaw; they are, with this exception, without teeth. The transverse common opening for the blowers is on the upper side of the head, far behind the point of the snout. The back is without fin, as in the preceding genus, to which it in many respects approaches. The head, anteriorly, has much the same obtuse and convex form, and the body is tolerably thick, with its greatest thickness about the middle. The mouth is small, and the pectoral fins small and short.

The skull resembles in form that of the next preceding rather than any other, but is more oblique, at least in the older males, where that side of the upper jaw which carries the long tusk is longer and wider than the other, and the hinder lateral angle on the superior maxillary of the former projects further than that of the latter. The beak is rather short and obtuse, and

¹ The ribs are said to be sometimes 12 pairs.

nearly of the same length as the hinder part of the head. The symphysis of the two lower jaw-bones is quite short, much shorter than half the length of the bones. It seems to approach the next preceding also in regard to the rest of the skeleton, and has only 2 or 3 vertebræ more.

Only one species of this genus is known, belonging to the northern Polar sea.

M. MONOCEROS, *Lin.* The Narwhal. *Swedish* "Narhval."

- MONODON MONOCEROS, *Linné.* Fauna Suecica, p. 16.
 — — *O. Fabricius.* Fauna Groenlandica, p. 29.
 DES NARVALS, *G. Cuvier.* Recherches sur les Ossemens Fossiles, t. v., 1^{re} partie,
 p. 319, tab. xxii, fig. 7.
 MONODON MONOCEROS, *F. Cuvier.* L. c., p. 230, tab. xvii, figs. 2 and 3.
 — — *J. A. Wagner.* L. c., p. 267, tab. cccxxx.
 — — *S. Nilsson.* L. c., p. 619.

Length 12'—20', exclusive of tusk, which is 6'—10' long. In general form the body seems to be less thick than that of the next preceding. It has, like that, a longitudinal protuberance on the back, about the middle of the body, as a rudiment of a dorsal fin. The body is thickest at the foremost part of the protuberance; it tapers backwards, and is, near the caudal fin, considerably compressed, with sharp edges above and below, although to not quite the same extent as in the preceding species. Scoresby (according to J. A. Wagner) gives the following measurements of a male:—Length of body, exclusive of tusk, 15' (English). Circumference at the beginning of the protuberance on the back 8' 5". Distance from nose to anus 9' 9". Pectoral fins 13" long and 7½" wide. Caudal fin 3' 1½" wide. Tusk, external to the jaw, 5' ¼". The colour of grown specimens is, according to Scoresby, white, or yellowish-white, with grey or dark-brown spots. The young, when quite small, are said to be bluish-grey or dark grey;¹ when somewhat larger they are, above, black; beneath and on the sides spotted with grey and white.

The length of the beak of the skull is about 1¼ its width at the base. The intermaxillary bones, on the upper side of the beak, are about as wide as the superior maxillary, at their outer side. The intermaxillary bones and the nares are directed posteriorly somewhat to the left. The right intermaxillary bone extends somewhat further back than the left one, neither of them touching the nasal bone. The skull of a full-grown specimen is about 2' long and 16" wide (*S. Nilsson*). The long and sharp tusk, which is generally in the left side of the upper jaw, is spiral to the left, or has on its surface spiral ridges or protuberances running to the left. The spiral ridges run to the left, even when the tusk is in the right side of the upper jaw. It is hollow to near the point, and has a persistent pulp in this cavity. Its alveolus is about 14" long, and extends somewhat behind the lateral notch of the superior maxillary, or about to the orbits. The diameter at its base is about 4", when its length is 9' or 10' (*Owen*). The tusk is nearly 6' long from its base in a skeleton 14½' long, in the Zoological Museum in Lund. This skeleton has 12 dorsal vertebræ, 9 lumbo-sacral, and 25 caudal, 16 of which carried processus spinosi

¹ This seems to be the colour to which Fabricius refers, in stating: "Colore totus niger."

inferiores; with the 7 cervical vertebræ, in all 53 vertebræ.¹ Six out of the 12 pairs of ribs are costæ veræ, and the 7th pair are united to the cartilage as far as the end of the sternal part of the 6th pair.

The narwhal, like the beluga, does not properly belong to the Scandinavian Fauna. It inhabits the most northern Polar seas, or the regions of the Polar ice, and appears only during the winter on the coasts of Greenland, and even then never south of 65° north lat. (Rink. Grönl.). It is said sometimes to appear near Spitzbergen (according to Martens), but does not seem to be at all common, as Martens himself never saw it during his travels there. It exists, according to Pallas, at Nova Zembla, and in the seas north of Siberia. Only one specimen has, according to S. Nilsson (l. c., p. 621) been caught on the north-western coast of Norway, viz., in Bindals Fiord, near Helgeland. It very seldom runs far south from its northern home. Two specimens were caught, in 1736, on the north-western coast of Germany (J. A. Wagner), and it has been observed, some three or four times, on the coasts of England.² There is a drawing at the "Landbohojskola," at Copenhagen, representing a narwhal, that was stranded, in 1803, in the "Kielerbugt" ('Stud. C. R. Sundström,' verbally). It does not generally appear out of the Polar basin, and is, consequently, never seen in the northern parts of the Pacific. It lives, according to Scoresby, principally upon cephalopods, also upon fish, sometimes taking rather large thorn-backs. Scoresby believes that it kills these with the tusk. At all events he does not know to what other purpose this weapon is applied. The statements of Fabricius respecting its breathing at holes in the ice, make it probable that it uses the tusk to keep these holes open. It is social and lively and quick in its movements.

6th Genus. HYPEROODON, *Lacépède*.³

(*Chaenocetus*, *Eschricht*.)

Distinguished as regards external form by a small, cylindrical, somewhat pointed nose or beak, which is sharply defined posteriorly, and behind which the head rises more or less vertically, with a rounded forehead-like convexity. There are two longitudinal deep furrows under the chin and throat, partly along both rami of the under jaw, and partly behind and inside of the same (Eschr.). Form of body rather elongate, with its greatest thickness before the middle, and the fore part but little tapering, and, except the beak, obtuse. The eyes are far behind the angles of the mouth, and the transverse lunate opening for the blowers, which is concave before and convex behind, is above the eyes. The hinder part of the body, on the contrary, tapers, as usual, very much, and is compressed towards the caudal fin. The back with a tolerably small fin which is directed backwards, and is behind the middle of the body. The pectoral fins are very small, and

¹ Schlegel (l. c., p. 35) enumerates 26 caudal vertebræ, and Giebel (Die Säugethiere, p. 113) only 24. I counted 26 caudal vertebræ on a skeleton in the museum at Bergen.

² Lord Clermont: 'A Guide to the Quadrup. and Rept. of Europe,' p. 157.

³ From *ὑπερώα*, palâte, and *ὀδών*, or *ὀδών*, tooth, according to Lacépède.

the caudal fin is but slightly forked in the hinder edge. The anus is under the dorsal fin. There are two pairs of teeth in the fore part of the lower jaw, more or less hidden in the gums; the hinder and outer pair are considerably smaller than the anterior, and are deciduous; there are also on each side of the upper and lower jaw a row of 12—13 very small and rudimentary teeth, hidden and loose in the gums (Lacépède and Eschricht).

The skull has several peculiarities; the upper jaw is prolonged in front into a narrow and pointed beak. A very large compressed and longitudinal protuberance or crest arises posteriorly and inside of the lateral angle of each superior maxillary, sloping in front, and having more or less perpendicular sides, behind and inside. This protuberance is more developed in the older than in the young specimens. The concavity behind these tuberosities is limited behind by a vertically rising wall, formed, principally at least, by the superior maxillaries, the intermaxillaries, the nasals, the frontal, and the occipital bones, and terminating above in a high lamboidal or occipital crest. The ossa pterygoidea, on the lower side of the skull, are remarkable for their great elongation. Eschricht has found a strongly-developed lachrymal bone, which is said to be absent in other toothed-whales. The lower jaw-bones, viewed from the side, are curved like an S. Their symphysis is rather long, but shorter than half their length. The skeleton is remarkable for the small number of vertebræ, which have bodies of more than usual length; their spines are very high, and the transverse processes of the lumbo-sacral vertebræ and the anterior caudal vertebræ are comparatively short, and directed forward on all. All the cervical vertebræ are united, and have a common spinous process. The ribs are few in number.

According to Eschricht's investigations it seems that only one or two species of this genus are positively known; these belong to the northern parts of the Atlantic, the North Sea, and the Frozen Ocean. Only one species has, up to the present time, been found on the coasts of Scandinavia.

H. ROSTRATUS, *Pontoppidan*. The Bottlehead. *Swedish*, "Näbbhval."

Sufficient space between the two protuberances on the superior maxillary bones for at least one of the same size between them.

BALENA ROSTRATA ODER NEBBE-HVAL, *E. Pontoppidan*. Versuch einer natürlichen Historie von Norwegen, p. 233, 1754.

MONODON SPURIUS, *Groenl. ANARNAK.*, *O. Fabricius*. L. c., p. 31.

THE BOTTLE-NOSE-WHALE DESCRIBED BY DALE, *J. Hunter*. L. c., pp. 373 and 447, tab. xix.

DELPHINUS DIODON, *Lacépède*. L. c., p. 309.

HYPEROODON BUTSKOPF, *Idem*. L. c., p. 319.

L'HYPEROODON, *G. Cuvier*. L. c., p. 324, tab. xxiv, figs. 19—21.

HYPEROODON BUTSKOPF, *F. Cuvier*. L. c., p. 241, tab. ix, figs. 1—3; tab. xvii, fig. 1.

DELPHINUS EDENTULUS, *J. A. Wagner*. L. c., p. 360, tabs. cccxlii, cccxliii, and cccxliv, fig. 1.

HYPEROODON BUTSKOPF AND ROSTRATUM, *J. E. Gray*. L. c., pp. 25 and 26, pl. iii, figs. 1—5.

- HYPEROODON BOREALIS, *S. Nilsson*. Skandinavisk Fauna, Däggande Djuren, 1^{sta} uppl., p. 404, 1820.
 — — — *Idem*. Skand. Fauna, Däggdjuren, 2^{dra} uppl., p. 622.
 CHAENOCETUS ROSTRATUS, [*D. F. Eschricht*. Zoologisch-anatomisch-physiologische Untersuchungen über die nordischen Wallthiere, p. 21, tab. i, 1849.
 HYPEROODON ROSTRATUM, *C. G. Giebel*. Die Säugethiere, p. 108, 1855.

Note.—That the *Balena rostrata* described by Pontoppidan is the same as this toothed-whale is very evident, from the descriptions and figures, incomplete and deficient as they are, which he gives of it; it has therefore not been doubted by any one. It will, however, be of interest to give an additional evidence of this. At Hammarby, the late country residence of Linné, where two of the rooms are still left in their original condition, there is a small picture above the door of the inner room, representing a *Hyperoodon rostratus*, which, although deficient in many respects, is much better than the one given by Pontoppidan in his history. Below the larger figure there is a smaller one representing the young. The following interesting inscription will be found on the picture: "This fish was caught in Eskevik Bay, on the estate of Colonel Hans Kolbjörn, at Fredrikshall in Norway, on the 17th Novbr. 1749, and was ascertained to be 26' long and 15 feet in circumference. When opened a foetus 7 feet long was discovered." This inscription shows that the figure was made from the same specimen which Pontoppidan has described. The figure represents the body rather too thick, probably caused by the animal being distended by gas arising from its decomposed state. The dorsal fin is rather long, and placed in a wrong direction, and the eye is rather too large; the figure is, with these exceptions, correct, and undoubtedly represents the species in question. A spout of water arises from the blowhole. The inscription being in Swedish, would seem to indicate that the figure had been sent to Linné by some Swede in Fredrickshall, unless Pontoppidan himself sent it, and Linné afterwards made the inscription from the information received. It seems from this that the present species could not have been unknown to Linné, and such being the case, it is surprising that it is not anywhere mentioned by him.¹

It may, according to Hunter, reach a length of 30'—40'. Those obtained have generally been 18'—20'—26' in length, and mostly females. It is tolerably thick forward, and its greatest circumference, which, according to the above statement on the figure, as well as measurements given by Eschricht and Wesmael, is greater than half the length of the animal, is immediately behind the pectoral fin. From this point it tapers gradually towards the caudal fin. The head behind the beak rises vertically and is very convex in old specimens, in which the protuberances or crests on the maxillary bones are fully developed. This part is sloping in young specimens as represented by Wesmael, apparently in consequence of the crests being lower. The base of the dorsal fin begins about the beginning of the hinder third of the body. The length of the beak is according to Eschricht $\frac{1}{15}$ th of the length of the body. The length of the oblong oval pectoral fins is,

¹ The *H. latifrons* from the North Sea described by J. E. Gray (l. c.), with the protuberances on the superior maxillary bones much higher than the occipital crest, and so thick that they almost touch each other, is, according to the same author's later observations, a distinct species. Eschricht considered it an old male of the present species. I have not seen any such skull in our Scandinavian museums.

according to the same author, $\frac{1}{10}$ th of the length of body. Eschricht¹ furnishes, partly from statements by Mr. Haalland, the following measurements of a female, caught at Westmannö. Length of body 18' 8" (Danish). Distance between the hinder edge of the caudal fin, and the dorsal fin 6' 4"; length of mouth 1' 7"; distance from eye to angle of mouth 1' 2 $\frac{1}{2}$ "; circumference of body behind the pectoral fins 10'; dorsal fin 1' and a few lines high, and 1' 3 $\frac{1}{2}$ " long at the base; pectoral fins 2' 1" long along the front edge; width of caudal fin between the points 5' 10". The dorsal fin is erect, convex along the fore edge, and concave at the hinder edge. The colour appears to be variable. According to Eschricht, it is black, with a tinge of lead colour, and somewhat lighter on the under side.

In the skeleton the skull appears large in consequence of the large protuberances on the upper jaw, and the high occipital crest. The skull of the female 26 $\frac{1}{2}$ ' long, which, according to Nilsson was stranded at Landskrona (Sweden), and the greater part of the skeleton of which is preserved in the Zoological Museum in Lund, is 5' 9 $\frac{1}{2}$ " long, and 2' 9 $\frac{1}{2}$ " wide across the orbits. Its height at the occipital crest is 2' 2 $\frac{1}{2}$ ". The height from the protuberances of the superior maxillaries to the lower edge of the same bones 2'. The height of the protuberances on their inner side 1' 3 $\frac{1}{2}$ "; distance between them 8"; lower jaw 4' 9" long. The skull of a younger skeleton 18' 7" long in the Zootomical Museum in Christiania was 4' 11" long and 2' 2 $\frac{1}{2}$ " wide, and its height at the protuberances on the superior maxillaries 3 $\frac{1}{2}$ ". This skeleton had 9 dorsal, 10 lumbar, and 16 caudal vertebræ (1 or 2 of the last were missing.) The processus articulares are very close to each other, and are very small on the high processus spinosi of the lumbo-sacral and anterior caudal vertebræ. The sternum consisted of 3 bones, and 5 pairs of the ribs were costæ veræ. I counted 9 dorsal, 11 lumbo-sacral and 17 caudal vertebræ, 8 of which had processus spinosi inferiores, on a larger skeleton in the Physiological Museum in Copenhagen. Number of fingers 5; the thumb had 1 phalanx; the fore-finger 6; the middle finger 5; the fourth finger 2, and the little finger 1 phalanx.

It has very seldom been found on the coasts of Sweden and Norway. A female was caught at Fredrikshall, in Norway, on the 17th of November, 1749, according to Pontoppidan, and the above-quoted inscription on the figure at Linné's, Hammarby; a female of about the same size as the above was stranded near Landskrona, in April, 1823, (see Nilsson's 'Skand. Fauna,' l. c.), and there is a skeleton of a specimen, caught in Christiania Bay, preserved in the Zootomical Museum in Christiania.² It has also been obtained on the coasts of England and France, and, at times, even recently, small herds of them have been stranded on the coast of the Little Belt in Denmark. It appears oftener at the Faröe Islands, seldom at Iceland and Greenland, but not so seldom off the north-eastern coasts of North America, and sometimes even further south on the eastern coasts of that part of the world. Martens has observed it at Spitzbergen. It is pelagic, and approaches the coasts very seldom. It is, according to Eschricht, very probable that it spends the summer far north in the Polar Sea, and migrates to the North Sea, and the northern parts of the Atlantic towards autumn or winter. It is social, and two or more individuals are generally seen together. Its food consists principally of cephalopods, but it lives also upon fish, holothuriæ, &c., &c.

¹ Undersögelse over Hvaldyrene, 4^{de} Afhandling, pp. 5 and 9.

² [Dr. J. Koren has informed me by letter, that a specimen, 22' long, was killed in October, 1863, at Laago, 5 miles from Bergen in Norway; and a specimen, 16' long, was stranded, according to a letter from Professor Esmark, at Fredriksvarn in Norway, in October, 1864.—1865.]

Second Family. BALÆNIDÆ, J. E. Gray. Whalebone-Whales.

Without developed teeth; in their place, on each side of the upper jaw, transverse horny plates (baleen or whalebone), fringed on the inner and lower edge, and acting as a screening apparatus in taking their food. Blowers, with separate longitudinal openings on the upper side of the head, far behind the point of the snout. Only the first pair of ribs united to the sternum.

What I have previously stated with regard to the deficiency in our knowledge of the Cetacea generally, may be applied in a higher degree to this family than to the preceding, partly because the whalebone-whales are more seldom caught, and partly from their being generally of more colossal dimensions and, consequently, offering greater difficulties for scientific examination and preservation. Although the profitable whale fisheries have for centuries—indeed before the 12th century, when the Basques began to occupy themselves with it—attracted attention to them; and, although zoologists from the time of Aristotle have given much consideration to them, it may be said that this science has only recently taken such a direction, that the knowledge of their structure and natural history generally have come to rest on a solid basis. The merit of this is due to Rudolphi, G. Cuvier, and principally to D. F. Eschricht.¹ The former has, in the 'Transactions of the Berlin Academy, accurately described and figured the bones of two species, and called attention to the defining characters thus obtained. The second has, in his 'Recherches sur les Ossemens Fossiles,' based the distinctions of forms and species upon a minute comparative examination of the skeletons of whales, adopting the same excellent method as for other living and extinct mammalia and reptiles. The third has in his 'Undersøgelse over Hvaldyrene,' and in his 'Zoologisch-Anatomisch-Physiologische Untersuchungen über die Nordischen Wallthiere,' carefully described the external form, as well as the internal structure and development of two whalebone-whales (*Balænoptera rostrata* and *Megaptera boops*), and thereby given us the proper course to pursue, in determining the importance of the characters, and considering the relation between the forms. He has also specially pointed out some characters of the greatest importance in distinguishing the species of the entangled and difficult group of *Balænoptera*.

We may form an idea of the former state of cetology, by considering that the *Balæna mysticetus* had been hunted for upwards of 200 years in the northern Polar sea, and had been caught by the 100,000, without any European museum having a complete skeleton of this whale, until Eschricht, a few years ago, procured one for the Physiological-Anatomical Museum in Copenhagen. We find, therefore, in Lacépède, as late as 1804, erroneous statements of the number of vertebræ and ribs in this species. The Nordcaper or Biscay whale, a remarkable species mentioned by earlier authors, and for centuries the principal object of the whale fisheries

[¹ The name of John Hunter, whose classical work, "Observations on the Structure and Economy of Whales," 'Phil. Trans.,' 1787, preceded those of the three authors above mentioned, should not be omitted.—W. H. F.]

of the Basques was, in consequence of these deficiencies, not recognised by G. Cuvier, but taken from the number of the species, and has been quite recently restored to science by Eschricht and Reinhardt. This seems sufficient to show the former state of the study of cetology.

<i>Balenidæ.</i> Corpus infra antice	{	sulcis crebris longitudinalibus aratum.	{	perfecti	1. <i>Balænoptera</i> , Lacép.
		Processus coracoideus et acromion scapulæ		imperfecti vel nulli	2. <i>Megaptera</i> , Gray.
		sulcis carens		3. <i>Balæna</i> , Lin.	

1st Genus. BALÆNOPTERA, *Lacépède*.

(*Pterobalæna*, Eschricht.)

Form of body more or less slender and elongated,¹ the greatest circumference about or before the middle; the hind part much more slender than the fore part and very compressed near the caudal fin. Head not very large, and tapering forward. Pectoral fin short, with the anterior edge even. Dorsal fin generally rather high and conspicuous, placed far back above the vent. Caudal fin more or less forked in the hinder edge. Fore part with numerous longitudinal furrows beneath, the middle ones being the longest and extending to the middle of the body. Baleen small and short, more or less twisted.

In the skeleton, the facial part, or the beak of the skull, is rather broad, and seen from the side, but little curved, hence the distance from the nose to the lower jaw is not considerable. When the skull is seen from above, the intermaxillary bones appear much narrower than the superior maxillaries. Processus coronoideus of the lower jawbones generally rather high and distinct. Cervical vertebræ separate, sometimes one pair united by the processus spinosi. Bodies of the lumbo-sacral vertebræ and the anterior caudal vertebræ larger than in the succeeding genera, and with their lower sides generally carinated in the former vertebræ, although the keel is sometimes slightly, or not at all perceptible in the first and those nearest to it. The processus transversi of these vertebræ are shorter, and the processus obliqui of the anterior caudal vertebræ less separate than in *Balæna*. The sternum is very variable in its form. The ribs, although sometimes rather large, are generally smaller than in the succeeding genera, which is in accordance with the more slender form of the body. The scapula has the coracoid process and acromion fully developed and conspicuous, and is comparatively smaller than in *Balæna*, and of a wider form than that genus, so that its length from the glenoid cavity to the opposite upper edge is considerably less than its width. Its general form seems to correspond in all the known living species. The head of the humerus is more terminal and directed less obliquely than in *Balæna*, and the lower arm-bones are more elongated. Carpal bones 5, and fingers 4.

¹ The characters based upon the external form of body, the fins, &c., can of course be applied only hypothetically to the subfossil species, which is only known by a part of the skeleton.

Note.—The number of the ribs and vertebræ seems generally to be very constant, so that deviations in this respect may be considered characteristic of distinct species; different species may, however, have the same number of ribs and vertebræ. Balanoid cirripeds are said not to infest the Balænoptera.

This genus probably includes a considerable number of species from all seas. Only a few (7 or 8 living), however, are known. Four or five species have been found within the boundaries of Scandinavia, one of which now seems to be extinct. They are quicker in their movements than the Greenland whale, and do not rush towards the bottom like it, when struck by the harpoon, but swim forward with the greatest speed, and immediately pull out the entire harpoon line, which must at once be cut in order to save the crew and the boat, and they are consequently very difficult to catch with the harpoon. They feed upon small marine animals and even fish and larger invertebrata.

<i>Balænoptera.</i> Processus coronoideus maxillæ inferioris	}	eminens et distinctus. Numerus vertebrarum	}	55 vel ultra.	}	indivisa 1. <i>musculus</i> , Companyo.
				Extremitas superior costarum 1 ^{mi} paris.			fissa . . . . { 14 paria 2. gigas (Eschricht). 13 paria 3. laticeps, Gray.
				48—49. Costarum 11—12 paria		4. <i>rostrata</i> (Fabricius).
						5. <i>robusta</i> , Lilljeborg.
						depressus et tuberculum parum distinctum formans

1. *B. MUSCULUS*, *Companyo*. The Rorqual or Razorback. *Swedish*, "Rörhval".

Number of vertebræ 61—62, of which 15 are dorsal. 2nd to the 5th or 6th cervical vertebræ with ring-like processus transversi.¹ *Processus coronoideus* of the lower jaw high and distinct. 1st pair of ribs with the upper end single.

RORQUAL DE LA MÉDITERRANÉE, *G. Cuvier*. Recherches sur les Ossemens Fossiles, t. v, 1^{re} partie, p. 372, tab. xxvi, fig. 5.

BALENOPTERA MUSCULUS, *L. Companyo*. Mémoire descriptif et osteographie de la Baleine échouée sur les côtes de la mer, près de Saint Cyprien, Département des Pyrénées-Orientales, le 27 Novembre, 1828; Perpignan, 1830.

RORQUALUS — *F. Cuvier*. Histoire naturelle des Cétacées, p. 334.

BALENOPTERA ARCTICA, *H. Schlegel*. Abhandlungen aus dem Gebiete der Zoologie, und vergleichenden Anatomie, 2 heft, p. 10, tab. ix. (The best figure of the animal.)

— MUSCULUS, *Joh. Müller*. Archiv für Anatomie, Physiologie, &c., Jahrg. 1842, p. 237.

¹ This character was first mentioned by J. Müller, and afterwards more fully developed by D. F. Eschricht.

PTEROBALÆNA MUSCULUS, *D. F. Eschricht*. Undersøgelser over Hvaldyrene, 6^{te} Afhandling, Kongl. Danske Vidensk. Selskabs Skrifter, 5^{te} Række, 1^e bd., p. 87, 1849.

— COMMUNIS, *P. J. van Beneden*. Bulletin de l'Académie Royale des Sciences, etc., de Belgique, 2^{me} série, t. 1, 1857, p. 403.

Note.—The name “Rörhval” is derived from the Norwegian name “Rör-Qval,” used by Ström¹ for a whale, which, from his account, is probably the species now in question. Another whale, smaller, but resembling this, is spoken of at the same place, as being in the habit of driving the spring herring towards the coast, and therefore has been called “Sild-Qval,” or Herring-whale, probably the *Balænoptera laticeps*, or Rudolphi's *Balæna rostrata*, as it can hardly be the Bay-whale, or “Waagehvalen,” which on the west coast of Norway is well known under the latter name, but is not called “Sild-Qval.”² The name “Rorqual” has since, by G. and F. Cuvier, been considered generic, which, however, does not prevent its being applied to the species to which it originally belongs, and which may be considered as the type of the genus. At first it did not appear to me probable that the rorqual, the skeleton of which is preserved in the museum in Bergen, and the skull, &c. in the Zoological Museum in Christiania belonged to the same species as that from the Mediterranean, described by Companyo, in consequence of the much greater length of body of the latter, although younger, and some difference in the shape of the skull, atlas, and axis. The comparison below between the size of certain parts of the skeletons of these rorquals has, however, very much removed these doubts, as it thereby seems likely that the measurement of the length of the body stated by Companyo is not to be relied upon, and that the same measurement given of the rorqual at Bergen is too small. Companyo states the length of the body of the specimen described by him to be 25·60 mets., or 86' 8", and the length of the skeleton 22·6 mets., or 76' 6½".³ The length of the rorqual caught at Bergen is, according to Dr. Koren, said to have been 56' (Norwegian), or somewhat more than 58' (Swedish). As, with the exception of the skull, the measurements of the various parts of the skeleton of Companyo's rorqual, for instance the lower jaw, ribs, shoulder blade, upper arm-bone, and lower arm-bone, seem to correspond with those of the latter, and not to denote any extraordinary size, it is reasonable to doubt the correctness of the length of body stated by Companyo. It must be remarked, however, that the measurements of a dorsal vertebra, given by Companyo, show a greater length of its body than on the skeleton in Bergen. I presume that the length of the specimen in Bergen has been estimated too low, from the fact that its skull and lower jaw very nearly correspond in their dimensions with the skull and lower jaw in the Christiania Museum, and the specimen from which the latter were taken is, according to Lector Esmark, said to have been 68' (Norwegian), or nearly 71' (Swedish), in length, which is more in correspondence with the usual length of older specimens of this species. The measurements given of those colossal animals seem generally to have very little value in comparing them, in consequence of the difficulty of taking the measurement in a straight line; more particularly when the body is much distended by gas. Besides, we find from measurements given by Eschricht (loc. cit. No. 43), and those given by Van Beneden, that the older ones, even of the same sex, are subject to considerable variations—more than 10'—in the length of the body. So much for the difference of the measurements between Companyo's rorqual and the rorqual found

¹ Söndmör's 'Beskrivelse,' p. 298.

² The same opinion is expressed by Nilsson, in 'Skand. Fauna,' Däggdj., p. 637.

³ The near correspondence in the length of the lower jaw makes it probable that Companyo's measurement of the length of the skull is too great, and was taken along the upper arched margin of the skull.

on the coast of Norway. I have mentioned, that there is also some difference in the form of certain parts. The skull of the former seems to be more elongated and narrow, although the difference in this respect is not great, after allowing for what Companyo overrates in length. There are greater differences between them, both in the form and in the length of the processus transversi of the axis. These processes are much shorter in the former, and according to Companyo's figure of this bone, bent down at the point, while the ends of those on the skeleton in Bergen are directed upwards towards the back. They are much more pointed on the latter. The atlas also shows some difference. It has, according to Companyo's figure (which, however, seems to be rather indifferently executed), the tuberculum atlantis posticum higher, the lateral processes somewhat lower, and the articulating areas smaller than in the atlas of the latter. It is also entirely without tuberculum atlantis anticum, and has in its place a tolerably deep incision or hollow, while the atlas on the latter has the tuberculum atlantis anticum distinct behind, and is without the hollow. The sternum offers some differences, but this bone is so variable in its form, according both to what Eschricht has shown and to what I have observed, that these differences may be considered individual. In the skeleton at Bergen it almost corresponds with the figure of this bone which Eschricht has given of No. 43 (l. c., p. 131), only having a smaller hollow in front, and thus denoting a transition to its form in Companyo's rorqual. This hollow is still smaller in the sternum in the museum in Christiania, which is from the same specimen as the skull at the same place. Companyo gives 14 pairs of ribs, and after him, even Eschricht and Gervais; if this were correct, I should not hesitate to consider Companyo's rorqual a different species from ours, taking other differences into consideration. By examining the rib figured by Companyo as being the 1st, it will be easily seen that it cannot be the 1st, but is the 2nd. It is nearly of the same length as the one he has figured as the 2nd, and is, like the latter, tapering at the lower end, which is not the case with the first rib, and it has, like the 2nd figured, a capitulum with a short collum. The ribs, described by him as the 1st and 2nd, correspond in form precisely with the 2nd and 3rd pairs on the skeleton in Bergen, and with the same pairs on a skeleton of this species in the Physiological Museum in Copenhagen. It is therefore unquestionable, that the ribs figured by Companyo as the 1st and 2nd are, in fact, the 2nd and 3rd; the 1st rib has therefore to be found. It is very evident that the bone figured by him under the name of "corne de l'os hyoide," is the first rib.¹ It has its general form and size, its strong bend, and its expanded upper and lower ends. It is, however, less dilated at the lower end than in the skeletons in Bergen and Copenhagen, with which two ribs of the same pair in the museum in Christiania correspond exactly. The rorqual of Companyo had consequently 15 pairs of ribs and 15 dorsal vertebræ, like all other specimens of this species, of which the number of ribs have been fully known. It has, according to Companyo and Gervais, 15 lumbo-sacral vertebræ, and corresponds in this respect with ours. The corpus of the hinder dorsal vertebra in Companyo's rorqual seems, as previously stated, to be longer than that of the same vertebra on the skeletons of this species that are preserved in Bergen and Copenhagen. He gives this length at 0.3 met. or $12\frac{3}{16}$ ". I have unfortunately not noted the length of the body of these vertebræ on the before-mentioned skeletons, but I have noted the length of the 1st lumbosacral vertebra, which generally is equal to or somewhat longer than the posterior dorsal vertebra. The corpus of this vertebra is in the skeleton at Copenhagen 9", and in the one at Bergen $9\frac{3}{8}$ " long. The corpus of the posterior dorsal vertebra on these skeletons can be estimated from

¹ Farines and Carcassonne have rightly considered this supposed "corne de l'os hyoide" as a rib, although Companyo in his later above-quoted treatise reproaches them with this as erroneous. They are also right in another remark made by them against Companyo's statements, viz., that the first three pairs of ribs articulate with both processus transversi and corpora of the corresponding vertebræ, for none of these ribs articulate with the corpus vertebræ.

this to be 3" shorter than in Companyo's rorqual.¹ As the difference of length of the dorsal vertebræ probably extends, as usual, to the length of the other vertebræ, we may thus partially explain the difference of length of body between this rorqual and those obtained in Norway, but this difference in length of body is rather too great to be satisfactorily explained in this manner. That it, notwithstanding it had the dorsal vertebræ considerably longer than those on the skeleton in Bergen, had them no wider than on this (width 0.34 met., or 1' 2"), seems to be in consequence of its being younger, while the latter skeleton was from an old whale. This will be seen in comparing the dimensions of the first lumbo-sacral vertebra, according to the table below, of the skeleton in Copenhagen, which was from a young whale, with those of the same vertebra on the skeleton in Bergen. Although this vertebra in the latter skeleton is only $\frac{5}{8}$ " longer than in the former, it is somewhat more than 2" wider. We find, also, no difference of consequence in the form of the vertebræ in Companyo's rorqual and ours, although those of the former are of much larger size. Of the deviations mentioned here, to which may be added that Companyo's rorqual, to judge from the figures and measurements, had the ulna somewhat narrower, those based upon the form of the atlas and axis are undoubtedly the most important, and might possibly denote specific differences; but as the figures given by Companyo do not seem to be executed with particular accuracy, and these vertebræ are subject to some changes, both from age and from individuality, it has not been considered justifiable to arrange them as distinct species, when they agree in so many other respects; more accurate and positive comparison would be necessary for this. The difference existing in the relation between the anterior extremities and dimensions of the body are not worth attention, considering the great variations existing in this respect, according to what Eschricht has shown. The earlier authors, Linné and others, have described their *Balena musculus* too incompletely to be mentioned in the synonymy; such is also the case with Lacépède. It may be possible that *Balænoptera jubartes* and *B. rorqual*, in Lacépède ('Hist. nat. des Cét.), belong to this species (such is the opinion of Gervais), but the descriptions of them are so indefinite, that even other *Balænoptera* might be included in the same. Gervais has even considered Lacépède's *Balænoptera acuto-rostrata* as a synonym,² although the description, as well as the figures of it, evidently show that it belongs to another species, viz., Fabricius's *Balæna rostrata*. As for Cuvier, he has not given any more minute description of this rorqual, but the figure of the skull furnished by him agrees so well with this, that there is no doubt that this is the species that he calls "Rorqual de la Méditerranée." Schlegel has in his 'Abhandlungen,' &c., united all the *Balænoptera* into one species, which in the first volume he calls *Balæna sulcata Arctica*, and in the second volume *Balænoptera Arctica*. The specimen—a young male somewhat over 40' in length—that is particularly described by him in the second volume under the latter name, seems to belong to this species, and is therefore here mentioned as a synonym, partly on Eschricht's authority, and partly because Eschricht, from personal examination of its skeleton, has been enabled to add one vertebra to those stated by Schlegel, whereby their number seems fully to correspond with those of the Razorback. It seems, however, to have presented some deviation in colour, and had only 15 processus spinosi inferiores, while the specimen examined by me had 18 such processes. The skeleton described by Van Beneden had 17.

¹ [Since this was written, I have been informed by Dr. Koren that the length of the corpus of the last dorsal vertebra of the Bergen rorqual is 9".—1865.]

² 'Zoologie et Paléontologie Françaises.'

Measurements of some parts of the skeleton of Balenoptera musculus.¹

	Skeleton from Greenland, at Copenhagen. Young male.	Parts of a Skeleton at Christiania from southern Norway.	Skeleton at Bergen from Norway. Old male.	Skeleton described by Companyo. Young male.
Length of skeleton	53'	—	58'	76' 6 $\frac{1}{8}$ ''
„ of skull	—	14'	14'	16' 5 $\frac{1}{8}$ ''
Width of „	—	6' 4 $\frac{3}{4}$ ''	6' 8 $\frac{1}{2}$ ''	6' 1''
Length of lower jaw	13'—14'	14' 6''	15'	15' 4 $\frac{3}{4}$ ''
Circumference „ „ at the middle	2' 3''	2' 6 $\frac{5}{8}$ ''	2' 9''	2' 7 $\frac{11}{16}$ ''
Distance from hinder edge of condylus to processus coronoideus	—	2' 1 $\frac{1}{8}$ ''	2' 1 $\frac{1}{8}$ ''	—
Height of processus coronoideus	—	7 $\frac{1}{4}$ ''	8 $\frac{1}{3}$ ''	—
Distance between the points of processus transversi of atlas	—	—	2' 2 $\frac{3}{8}$ ''	—
Height of atlas	—	—	1' 2''	—
Distance between the points of processus transversi of axis	—	—	3' 9 $\frac{3}{4}$ ''	3' 0 $\frac{1}{2}$ ''
Height of axis	—	—	1' 2 $\frac{9}{8}$ ''	—
Distance between the points of processus transversi of the 5th cervical vertebra	—	—	3'	—
Height of 5th cervical vertebra	—	—	11 $\frac{1}{2}$ ''	—
Length of corpus of last dorsal vertebra	—	—	9''	1' 0 $\frac{3}{16}$ ''
„ of first lumbosacral vertebra	9''	—	9 $\frac{5}{8}$ ''	—
Width „ „ „	11 $\frac{5}{8}$ ''	—	1' 2''	—
Length of processus transversi of „ „	1' 2 $\frac{3}{8}$ ''	—	1' 3 $\frac{1}{2}$ ''	11 $\frac{1}{8}$ ''
„ of corpus of 15th lumbosacral vertebra	11 $\frac{1}{2}$ ''	—	11 $\frac{1}{2}$ ''	—
Width „ „ „	1' 0 $\frac{3}{8}$ ''	—	1' 3 $\frac{3}{8}$ ''	—
Length „ 1st caudal „	11''	—	10 $\frac{1}{2}$ ''	—
Width „ „ „	1' 1''	—	1' 2''	—
Length „ 3rd „ „	11 $\frac{1}{2}$ ''	—	10 $\frac{1}{2}$ ''	—
Width „ „ „	1' 0 $\frac{1}{8}$ ''	—	1' 1''	—
Length of processus transversi of 3rd caudal vertebra	5 $\frac{5}{8}$ ''	—	7 $\frac{1}{2}$ ''	—
Width „ „ „	6 $\frac{3}{4}$ ''	—	7 $\frac{1}{3}$ ''	—
Distance between the outer edges of processus obliqui of the same	4 $\frac{3}{2}$ ''	—	6 $\frac{1}{2}$ ''	—
Length of processus spinosus superior of the same	10 $\frac{1}{2}$ ''	—	1' 3''	—
„ of corpus of the 5th caudal vertebra	11 $\frac{1}{2}$ ''	—	10 $\frac{1}{2}$ ''	—
Width „ „ „	1' 1 $\frac{1}{2}$ ''	—	1' 1''	—
Length of the last caudal vertebra	1''	—	1''	—
„ of sternum	1' 3 $\frac{5}{8}$ ''	1' 4 $\frac{3}{8}$ ''	1' 1''	1' 7 $\frac{1}{3}$ ''
Width „	1' 8 $\frac{1}{2}$ ''	1' 10 $\frac{1}{8}$ ''	2' 4 $\frac{1}{2}$ ''	2' 4 $\frac{1}{2}$ ''
Length of 1st rib	3' 9 $\frac{1}{2}$ ''	—	4' 7 $\frac{1}{4}$ ''	—
„ of one of the longest ribs	—	—	8' 10 $\frac{1}{2}$ ''	8' 11 $\frac{1}{2}$ ''
Circumference at caput	—	—	1' 2 $\frac{1}{4}$ ''	11 $\frac{3}{4}$ ''
„ at the middle	—	—	1'	10 $\frac{1}{8}$ ''
Length of the last rib	—	—	4' 7 $\frac{1}{4}$ ''	—

¹ The measurements of the first 3 were taken by myself; those of the 4th are based upon the statements of Companyo.

	Skeleton from Greenland, at Copenhagen. Young male.	Parts of a Skeleton at Christiania, from southern Norway.	Skeleton at Bergen, from Norway. Old male.	Skeleton described by Company. Young male.
Length of scapula from cavitas glenoidalis to the upper opposite edge	2'	—	2' 6''	2' 6''
Width of " " " "	3' 7 $\frac{1}{2}$ ''	—	4' 2''	4' 1 $\frac{1}{8}$ ''
Length of acromion	11 $\frac{1}{2}$ ''	—	11 $\frac{1}{2}$ ''	—
" of processus coracoideus	—	—	9 $\frac{1}{2}$ ''	—
" of os humeri	1' 7 $\frac{1}{4}$ ''	1' 7 $\frac{1}{4}$ ''	1' 7 $\frac{1}{4}$ ''	1' 7 $\frac{1}{2}$ ''
" of ulna	2' 4 $\frac{2}{3}$ ''	2' 8 $\frac{1}{2}$ ''	2' 9 $\frac{2}{3}$ ''	2' 3 $\frac{2}{3}$ ''
" of radius	2' 3 $\frac{5}{8}$ ''	ditto ditto	ditto ditto	2' 3 $\frac{5}{8}$ ''
" of one of the anterior extremities on the skeleton from the head of the humerus	6' 7 $\frac{1}{4}$ ''	—	6' ¹	6' 2 $\frac{3}{8}$ ''

The usual length of full-grown whales of this species seems to be about 70', sometimes several feet more, and sometimes less. Eschricht mentions that a specimen 68' (Danish) in length was caught at Kragerö, in southern Norway. The whale of which some parts of the skeleton are now preserved in the museum of the University of Christiania, and which, according to Lector Esmark, was caught at "Oster Risör," on the southern coast of Norway, is said to have been 68' (Norwegian), or about 71' (Swedish) in length. The old male, of which the skeleton is in the museum in Bergen, and which was caught on the western coast of Norway, in the vicinity of Bergen, in October or November, 1858, is said to have been 56' (Norwegian) or 58¹' (Swedish) long, but was probably as large as the one caught at "Oster Risör."² The old male, described by Van Beneden (loc. cit.), caught in November, 1851, near the coast of Holland, and of which the skeleton is preserved at Antwerp, is said to have been 22 metres or 74' 6'' long. The specimen (also an old male) described by Eschricht in his 5th treatise,³ that was obtained in September, 1844, on the northern coast of Seeland, in Denmark, and of which some parts are preserved in the Physiological Museum in Copenhagen, was, according to Eschricht, 65' (Danish), or about 67' 8'' (Swedish) in length. Eschricht also speaks, among others, of two specimens that were caught on the coasts of England and Scotland, one of which was 75' and the other 76' long, Danish measure.

It is, according to the description and figure given by Schlegel, which seems to be very good, of a slender and elongated form of body, with its greatest height, which is far before the middle, and somewhat behind the pectoral fins, about $\frac{1}{5}$ or $\frac{1}{7}$ of its entire length. The specimen, a young male, described by Schlegel, was 40 $\frac{1}{2}$ ' long and 6' 3'' high (Rhenish measure), at the thickest part. The whale 74' 6'' long, described by Van Beneden, was, according to him, 40' 7'' in circumference on the thickest part, but it had been found floating on the sea, much distended

¹ The terminal phalanges were missing.

² Dr. Koren has since informed me, that the articulated skeleton is now 58' long.

³ 'Kongl. Danske Videnskabernes Selskabs naturvidenskabelige og Mathematiske Aphanhandlingar, 12^{de} Deel,' p. 348 and following.

by gas, and the circumference is, therefore, probably too large. The head, seen from the side or from above, tapers considerably anteriorly, although the point is obtuse. The lower jaw is longer as well as broader than the upper jaw, with a rather high under lip on both sides, which surrounds the borders of the upper jaw or upper lip when the mouth is closed. There is, on the upper side of the head, somewhat in front of the angle of the mouth, a shallow concavity, in which the nasal openings are placed. The navel is somewhat before the middle of the body, and behind this the body tapers considerably backwards, particularly if seen from the upper side. The hinder part of the body, or the tail, behind the anal opening, which is placed somewhat behind the beginning of the hinder third of the body,¹ is, when seen from the side, almost straight to near the base of the caudal fin; the height is even somewhat greater nearer the caudal fin, being rather less than about half the greatest height of the body. It is, if seen from above, much compressed behind the anus, so that its width is not more than half its height, and nearer the caudal fin even less, and its upper and lower thin edges extend on the caudal fin between its lobes to near the fork in the middle of its hinder edge. The hinder part of the body or tail is thus of the same form as that of the dolphins. Head somewhat shorter than $\frac{1}{4}$ the length of the body. The pectoral fins, placed somewhat before the end of the anterior third of body, are small, narrow, and short; their length about $\frac{1}{5}$ or $\frac{1}{10}$ length of body; they are lancet shaped and pointed, with the fore and hind edges smooth.² The dorsal fin, with the beginning of its base almost directly above the anus, is small and directed backwards, and was, on Schlegel's specimen, 1' high ($\frac{1}{10}$ length of body), and it had about the same proportion to the length of the body on the specimen described by Van Beneden. Caudal fin of moderate size, its width, according to Van Beneden, about $\frac{1}{2}$ length of body (its width being 10' 1" on the specimen described by him), and deeply forked in its hinder edge. Eyes small, and immediately above the angles of the mouth. Blowers with two longitudinal, forward converging, approximate openings on the upper side of the head, somewhat before the eyes, in a small concavity, surrounded by a circular dermal elevation.³ The orifices of the ears, between the eyes and the pectoral fins, but nearer the former, are so small that a goose-quill can hardly be introduced into them. The external genital organs in the male are half way between the navel and the vent, and in the female close before the latter. The furrows, which in larger specimens are $1\frac{1}{2}$ ', or more, deep, occupy the entire lower side of the body from the borders of the under lip, and the middle ones, which are the longest, extend all the way to the navel; they are very numerous, and extend upon the sides behind the angles of the mouth and to the base of the pectoral fins. There are some short bristles on the upper side of the point of the upper jaw, and on a wide dermal band on the middle of the chin; but these are sometimes absent. Baleen short; the longest blades of the specimen caught at Oster-Risør were 3' long in a straight line. About 360 transverse

¹ It was 12' 3" before the hinder edge of the caudal fin in the specimen described by Schlegel, on which the above description of the external form of body is based.

² They appear, according to both Companyo and Eschricht, to be often injured on stranded specimens. The terminal phalanges were missing on the skeleton in Bergen, and those next to them were injured by caries.

³ According to Companyo, they are situated on a pyramidal fleshy convexity. Martens has also drawn such a convexity in the figure of his Winnefish. In this there seems to be some deviation from Schlegel's orqual.

rows, excluding the shortest, were counted on each side on the specimen preserved in Bergen.¹ Their colour, when fresh, is, according to Eschricht, light blue with white streaks. Those in Christiania and Bergen are of a similar colour, but, in consequence of their dry state, somewhat darker than the colour stated by Eschricht—dark grey, with more or less conspicuous longitudinal greyish-white dashes, somewhat lighter inwards, and with grey bristles. The anterior blades were slate coloured. This colour agrees very nearly with that given by Schlegel, and seems to be quite constant.²

The colour of the specimen obtained near Bergen was, according to Dr. Koren, dark grey on the upper side of the body, the pectoral and the upper side of the caudal fin; belly and lower part of caudal fin, white. It is, according to Eschricht, light grey on both the upper and lower sides of the body, and on both sides of the pectoral fins. This colour may have been caused by the advanced state of decomposition. The colour, according to Van Beneden, is, above, greyish-blue; beneath, white. The colour, according to Companyo, is, above, dark slate colour; beneath and on the lateral parts of the pectoral fins, white; the furrows on the lower side of the body bluish. The colour of the one figured by Schlegel was, above, black; beneath, white; the upper side of the pectoral fins and the outer side of the upper lip are on the figure also black; this description seems to be the most reliable, as the specimen was fresher than the others.

The Skeleton.—Its general form corresponds with the elongated body. The ribs are, in comparison with the length of the skeleton, small and short, and the bones of the anterior extremities small; the skull, the length of which is about $\frac{1}{4}$ of the length of the entire skeleton, resembles the skull of the Bay whale very much, but has the facial part, in front of the lateral notches of the superior maxillaries, somewhat narrower. The width of this is less than half the width of the skull;³ the posterior part of the skull is also narrow, so that its width is less than half the length of the skull, whereby the whole skull is of a more slender form than in the above-mentioned whale, with the exception that the lower jaw-bones are more strongly curved;⁴ the beak is almost twice as long as the hinder, wider part of the skull, from the notch of the superior maxillaries. The distance from the middle of the lateral borders of the beak to the lower jaw-bone is considerable, although less than in *Balæna*. The lower jaw-bones extend beyond the point of the upper jaw. I have made the following notes from the skeleton in Bergen:⁵—Number of vertebræ 62, viz., dorsal 15, lumbosacral 15, caudal 25; cervical vertebræ 7, as usual, and all free. Atlas and axis most strongly developed; the former has a wide and rounded corpus; the posterior articulating surfaces, united below without any sign of distinction, do not extend to the upper borders of the arcus, but reach the lateral edges of the corpus, so that its outer gradually curved edges coalesce with those of the latter; they form, on the middle of the lower edge at their junction,

¹ Eschricht states nearly 400.

² Van Beneden states that the colour of those observed by him was black on the outer side and white on the inner side.

³ According to the skull in Christiania.

⁴ The length given was taken by me along the curve of these bones on the outer side.

⁵ I will here acknowledge my thanks to Dr. Koren for having afforded me the opportunity of examining this skeleton, and giving me much necessary information. The skeleton was cleaned, but not put together.

a hollow, in which the tuberculum atlantis anticum is visible. The transverse processes are single, rather long, and obtusely conical; their height, however, is greater than their width; their length is not half the height of the atlas; the foramen spinale is widest above, and its lower, much narrower part, is on each side separated from the upper wider part by a projecting process.¹ The axis is larger than the atlas, in consequence of its strongly developed lateral processes. Its corpus, 4 $\frac{3}{4}$ " in length, is somewhat longer than that of the atlas. It has a low elevation on its anterior articular surface, answering to the processus odontoides, and on its posterior articular surface a groove, running inwards from the middle of the upper and lower edges, indicating its division into two lateral parts, but not extending to the middle of the articular surface. Each lateral process, which is longer than the width of the corpus, and not much lower than the height of the axis, has, near the corpus, a large oval perforation, which is directed obliquely upwards. Their ends point upwards, and there is a considerable notch above to their inner side. The lateral processes are directed somewhat backwards. The processus spinosus is bipartite, and consists of two low, rather dissimilar tubercles, which have their largest measurement in their length. This vertebra, by the different direction of the points and the perforations of the processus transversi, differs very much from the same vertebra of Companyo's, according to his figure. This deviation may, however, be a consequence of the different age, as Companyo's whale was young, and this was an old one; they show also a considerable difference in the form of the atlas, as previously stated. The processus transversi of the 3rd to the 6th cervical vertebræ are ring-shaped, and even the exterior part of this ring is ossified. The lateral process of the 7th cervical vertebra is without the lower ramus or parapophysis; the corpus of this vertebra is 3 $\frac{5}{8}$ " long. The corpora of the dorsal vertebræ gradually increase in length in passing backwards, as do the processus spinosi. Corpus of 2nd dorsal vertebra 5 $\frac{1}{4}$ ", and that of 3rd dorsal vertebra 6" in length. Even the most posterior dorsal vertebra has scarcely any ridge on the lower side of the corpus. The corpus of the lumbosacral vertebræ also increases in length backwards, and has on all a longitudinal ridge on the lower side, although this ridge is hardly perceptible on the 1st. All the vertebral epiphyses are united on these, as well as on the other vertebræ. The caudal vertebræ have not any ridge on the lower side of the corpus; those carrying processus spinosi inferiores are, on the contrary, longitudinally concave. Processus spinosi inferiores 18, the posterior ones very small. The sternum resembles in its form very much that of the rorqual from the northern coast of Seeland, which is figured by Eschricht in his 5th memoir,² and which figure has been copied in 'Skand. Fauna.'³ It differs from this only in the concavity in front being smaller, the lateral processes wider, and the posterior process or point wider and more obtuse. Its width is more than twice its length; its anterior middle part (manubrium) projects rather strongly, and

¹ It should here be stated that the atlas figured (No. 7) in 'Skand. Fauna Däggdjuren,' p. 644, as belonging to *Balæna prisca*, and which more recently, in the 'Ofversigten af K. Vetensk. Akademi. Förhandlingar,' 1860, p. 105, was mentioned as belonging to *Balenopt. musculus*, is not from this species, but from a *Megaptera*, probably *M. boops* (Fabricius). It agrees in its form very nearly with that which G. Cuvier, in 'Recherches sur les Ossemens Fossiles,' t. v, 1, pl. xxvi, fig. 19, has figured as belonging to the 'Rorqual du Cap,' which, according to Eschricht, is the same species as *Megaptera boops vel longimana*.

² L. c., p. 364.

³ 'Däggdj.' p. 640, fig. 3.

has, in the middle, a concavity or notch, which is deep and a little oblique. A large wing-like process projects from each side of its middle part or corpus, and is obtusely pointed. Its posterior obtuse process or point is shorter than the wing-like processes, and somewhat wider than the parts of the manubrium projecting on the sides of the anterior notch, and has on its lower side a very inconspicuous longitudinal ridge.¹ The ribs of this skeleton are rather thick, and much larger than in the skeleton in Copenhagen, probably in consequence of its having been older.² The first rib, which is more curved than the others, and of the same length as the last, is without a collum at its upper dilated end, and does not show any indications of being forked. Its lower end, united to the sternum, is also single, considerably dilated, and wider than the upper end. The same rib in the skeleton in Christiania and in the skeleton in Copenhagen was of the same form; the 2nd and 3rd pairs of ribs have a small collum, but do not reach the corpus of the vertebræ by their capitulum. Circumference of 1st ribs at upper end 1' 4", and at the middle 1' $\frac{1}{3}$ ". The scapula resembles very much that of other *Balenoptera*; its width is more than $1\frac{1}{2}$ times its length. Processus coracoideus and acromion strongly developed, and almost parallel. Caput ossis humeri slightly oblique. This bone is 1' broad at its lower end. The lower arm-bones (radius and ulna) differ but little in length, but the former is perceptibly broader than the latter; the difference in this respect is, however, less than in Companyo's figure of the bones of the anterior extremity; the former is 6", the latter 4 $\frac{1}{2}$ " wide in the middle. The carpal bones are 5; 3 in the upper and 2 in the lower row.³ The ossa metacarpi are 4, and fingers the same number. The phalanges were incomplete, as the terminal ones were missing on almost all the fingers.⁴ The pelvis and hyoid bones resemble in form very nearly the figures of the same bones given by Companyo; the former have three processes, one of which is longer and narrower than the others; the latter has, in the middle of its anterior projecting part, two processes separated by a deep and narrow notch, to which the anterior cornua are united by cartilage. A long straight process, which is obtuse, projects behind these from each side of the corpus. In regard to the skeleton at Copenhagen from Greenland, I will add, it is that of a young animal

¹ The sternum of this whale seems to be subject to much variation of form. The anterior middle part (manubrium) is sometimes very little or not at all projecting, and the notch there hardly perceptible, or even wanting. There are sometimes in its place one or two small perforations. The wing-like processes are sometimes shorter and wider, and the posterior process is sometimes shorter, sometimes longer, &c. The sternum preserved in Christiania has not the anterior part projecting, and the incisure was much smaller, the wing-like processes wider and shorter, and the posterior process longer. The sternum of the skeleton from Greenland, in Copenhagen, was more oblique, without either the notch or the perforations in front, but was somewhat projecting at this part. Both the lateral and the posterior processes were wider, and the former were shorter. The one described by Van Beneden much resembles the last mentioned. The sternum of Companyo's rorqual has the anterior part (manubrium) larger and more prominent, without a notch, but with a perforation, and the lateral processes are narrow.

² The measurements of the length given in the table are taken along the curve on the outer side.

³ Companyo states that there are 6 bones in the carpus, but his figure shows only 5.

⁴ I counted 6—7 phalanges on the 2 middle fingers, which were about equal in length, on the skeleton from Greenland at Copenhagen. The forefinger, which was longer than the little finger, had 5, and the latter 4 phalanges.

with loose vertebral epiphyses, and with the exterior part of the ring-like lateral processes of the 3—6th cervical vertebræ yet cartilaginous. Number of vertebræ 61, 24 of which are caudal.¹ The posterior dorsal, as well as all the lumbosacral vertebræ, are ridged along the lower side of the corpus, although this ridge is less perceptible on the anterior ones. Even the last of the 13 anterior caudal vertebræ decrease very little in length backwards. The processus transversi of the last dorsal vertebra are blunt at the point, differing from those of the first lumbosacral vertebra, and are directed slightly backwards, while the latter are directed forward. The processus transversi of the 6 anterior dorsal vertebræ are directed forward, those of the 1st most so, and those of the 6th hardly perceptibly; so much, however, that if a straight line is drawn from the middle of the extremity of the one to the same place on the other, it will run in front of the middle of the corpus vertebræ. The processus transversi of the 7 posterior dorsal vertebræ are directed backwards, but those of the 1st and the last of them less perceptibly. Processus transversi of the 7th and 8th dorsal vertebræ are directed to the sides. The processus transversi of all the lumbosacral vertebræ, except those of the last, are directed forwards.² Processus spinosi inferiores 18. The mucous membrane of the jejunum forms, according to Eschricht, 6—8 longitudinal folds.

The Razorback inhabits the northern part of the Atlantic, the North Sea, and the Polar Sea, and runs sometimes into the Mediterranean. It may even appear further south, and in the northern part of the Pacific. It does not seem to be scarce on the coasts of Norway, although it is seldom caught. It is known to have been stranded there at least three times; at Kragerø in 1837,³ at Oster-Risør in 1857, and at Bergen in 1858.⁴ I do not know any positive evidence of its ever appearing on the coast of Sweden. The broken parts of a skull and of an anterior extremity that are preserved in the zoological museum of the University in Lund, from the same locality, and from the same skeleton as the above-mentioned atlas, viz., from Heljarp, in the vicinity of Landskrona, which have been represented as belonging to *Balenoptera musculus*, are, as before stated, of a *Megaptera*. I mentioned, at the meeting of naturalists in Copenhagen in 1860,⁵ in my discourse upon the sub-fossil whale skeleton found on Gräsö, that there is preserved, in the cathedral in Wisby, a large vertebra that is probably one of the anterior caudal vertebræ of a large *Balenoptera*. It seems, in form, completely to resemble the corresponding vertebra of *Bal. musculus*; it is, however, not a caudal, but a lumbosacral vertebra, probably one of the posterior, because the caudal vertebræ are not ridged on the lower side of their corpus, and this one has a conspicuous ridge. It is, however, not known where it is from, but it may possibly have been found near the Baltic.⁶ This whale has seldom, if ever, appeared on any

¹ [The number of vertebræ of the skeleton described by Van Beneden is 61 or 62. Their number, according to Eschricht, is 63. Add. 1865.]

² The posterior dorsal vertebræ are by this easily distinguished from the anterior lumbosacral vertebræ.

³ The skeleton of this whale was, according to Eschricht, preserved in Christiania, and was there seen by him; it has since been destroyed during a fire. It had been preserved by Professor Esmark, according to his own statement.

⁴ [There is a skeleton of this species in the Royal Zool. Museum in Stockholm, obtained from Hammerfest, in Norwegian Finmark, through Mr. Nordvi, which corresponds in every respect with that in the museum in Bergen. Add. 1865.]

⁵ 'Forh.,' p. 615.

⁶ We have one instance of its appearing in the Baltic, as the whale described by Rosenthal and

European coast during the summer season, which makes it probable that it spends the summer in the far north, and migrates towards the south when winter approaches in the polar regions.

2. B. GIGAS, *Eschricht*² Giant Whale. Swedish "Jättehval."

Dorsal fin far back, very small, and on a thick protuberance. Processus coronoideus high and conspicuous. Vertebrae 55, or probably more. Axis alone of the cervical vertebrae with the processus transversi formed like rings. Ribs 14 pairs; 1st pair with the upper end forked or "biceps." Fingers with very long and narrow phalanges.

BALENOPTERA GIBBAR? *Scoresby*. An Account of the Arctic Regions, vol. i, p. 478.³

SINE NOMINE, *Dubar*. Ostéographie de la Baleine, échouée à l'est du port d'Ostende le 14 Novembre, 1827, avec planches. Brussels, 1828.

— — *Van Breda*, in F. Cuvier. Hist. Nat. des Cétacés, p. 328.

TUNNOLIK, *D. F. Eschricht*. Undersögelser over Hvaldyrene, 5^{te} Afhandling, Kongl. Danske Videnskab. Selskabs naturvidensk. o. mathem. Afhandlinger, 12^{te} Deel, p. 375, 1846. The description partly by H. P. C. Möller. In Greenlandie *Kepokarnak*³ and *Tunnolik*.

PTEROBALENA BOOPS, *Idem*. Ditto ditto, 6^{te} Afhandling, Kongl. Danske Vidensk. Selsk. Skr. 5^{te} Række, naturvid. o. mathem. Afd., 1 Bd., p. 134, 1849.

BALENOPTERA GIGAS, *J. Reinhardt*. Appendix to 'Grönland Geographisk og Statistisk Beskrevet' by H. Rink, 1 Bd. 2 deel, p. 10, 1857.

Note.—I know this whale only from the descriptions communicated by Eschricht, Van Breda, and Dubar, in the above-cited places, and they are unfortunately very incomplete. Dubar has had the best material, having had an entire skeleton before him. Eschricht has only had a short description and some few parts of the animal, both furnished from Greenland by the late Inspector H. P. C. Möller. The skeleton described by Dubar was, according to Van Beneden, after being exhibited in several capital cities of Europe, carried to the United States of America, and has not since been the object of any scientific description or examination. Eschricht, in his 5th memoir, where he gives the description of the "*Tunnolik*" and "*Kepokarnak*," on account of the different form of the anterior

Hornsouch, obtained in April, 1825, on the coast of Rügen, which had 61 vertebrae and 15 pairs of ribs, was undoubtedly of this species, and has also been so considered by Eschricht. I have not had access to the work of Rosenthal and Hornsouch where it is described.

² Eschricht has stated to me verbally that he now calls this species *Pterobalena gigas*.

³ Scoresby states its length to be about 100', and its circumference 30'—35'. His description of the dorsal fin corresponds with this whale.

⁴ According to Capt. Holböll.

extremities, has indicated its specific difference from Rudolphi's *Balæna rostrata*, or the one here mentioned as *Balænoptera laticeps*, Gray, and that it consequently forms a distinct species.¹ He has, at the same place, also called attention to the great similarity in the form of the extremities of this whale and the *Ostend whale*, also to the more than probable similarity between them in the peculiarity of the dorsal fin, and says—"I saa Fald alltsaa turde denne bekjendte Ostender Finhval høre til en ganske anden Art end de øvrige ved de europæiske Kyster indstrandede." The reasons given by Eschricht are so striking that they seem sufficient grounds for a certainty rather than for a presumption. This certainty becomes still more corroborated by comparing Dubar's figures of the skeleton of the immense *Ostend whale* with the same figures by Rudolphi of his little *Balæna rostrata*, as we find very considerable deviations in the form of all those parts of the skeleton which Dubar has figured, even after making allowance for the indifferent manner in which his figures are executed. Eschricht has, notwithstanding this, in his 6th memoir, joined together both these whales under the name *Balæna* (*Pterobalæna*) *boops*, which name, in all old authors, is of as uncertain application as the names *Balæna physalus*, *B. musculus*, and others. There is in the museum in Bergen a skeleton (complete with the exception of the sternum and pelvic bones) of a young *Balænoptera laticeps* from Norwegian West Finmark, which in every respect fully corresponds with the figures of this *Balænoptera* given by Rudolphi. I was therefore enabled by the examination of this skeleton to establish the considerable difference existing between it and that of the *Ostend whale*, and will here briefly state them.² The skull of *Balænoptera laticeps* is more narrow and elongated, with the face part or nose narrower, and the lateral borders less arcuate. The lower jaw-bones differ materially. They are shorter in the *Ostend whale*, and apparently of equal height to the point, where they are almost abruptly truncated. They are also strongly curved. In the other, they taper considerably towards the point, which is rounded, and are but slightly curved. The number of vertebræ in the *Ostend whale* is, according to Dubar, 55, viz., 7 cervical,³ 14 dorsal, 16 lumbar, and 18 caudal vertebræ.⁴ The dorsal vertebræ are 13, and the lumbar 14, in the *Balænoptera laticeps*. The atlas, in the former, has long, obtuse, conical lateral processes, and resemble the atlas in *B. musculus* very much, but has smaller articulating surfaces and a wider corpus.⁵ The atlas of *B. laticeps* has quite short and compressed lateral processes, the height of which is greater than their length. The 1st pair of ribs differ somewhat, but correspond in having the upper end bifurcated. The anterior capitulum in the *Ostend whale* is not half as large as the other, and does not reach by far to the other; there is a rather deep notch in the lower end of the rib.⁶ The two capitula in *B. laticeps* are certainly not of the same size, but the difference is not so great, and the anterior is the larger; there is no notch on the lower end of the rib. The 2nd rib in the *Ostend whale* has at its lower end a kind of bifurcation, of which there is no sign in *B. laticeps*. The scapula of the latter is much broader, and has the acromion further separate from

¹ L. c., pp. 378 and 379.

² Eschricht had the kindness in Copenhagen to lend me Dubar's treatise, the figures of which I thus had an opportunity of copying, and the comparison is now based upon these copies.

³ The 7th cervical vertebra is considered as dorsal by Dubar, and he has consequently 15 dorsal and 6 cervical vertebræ.

⁴ One or more of the last caudal vertebræ appear to be missing, because those that now are the last in the figure seem to be too large.

⁵ I have seen a very large atlas in the museum in Copenhagen—distance between the points of processus transversi 3' $\frac{1}{2}$ "; height of atlas 1' 7"—very nearly resembling that of the *Ostend whale*. The posterior articulating areas are smaller than in *B. musculus*, and separated below.

⁶ This rib seems to be formed by two ribs grown together.

processus coracoideus. Its width is nearly twice as great as its length, while in the *Ostend whale* it is not quite $\frac{1}{3}$ of its length.¹ The os humeri is more elongated in *B. laticeps*. Its length is about twice its width at the middle. Its length in the *Ostend whale* is not twice as great as its width, according to Eschricht's figure. The difference in this is greater according to Dubar's figure; it seems, however, on the whole, insignificant. The lower arm-bones, on the contrary, differ very much in their form. Their elongate slender form is characteristic of *B. laticeps*, which in this differs from all other known *Balenoptera*. The radius is but slightly wider than the ulna. The length of the former is about 9 times its width at the middle.² The length of the latter about 11 times its width. The length of radius is about 5 times its width at the middle, according to Eschricht's figure of the anterior extremity; that of the ulna is about 6 times its width. Both radius and ulna seem to be wider in Dubar's figure than in that of Eschricht. The fingers of the *Ostend whale* are much longer than those of the *B. laticeps*, and have much longer phalanges, and differ even in the number of the latter. The 1st finger has, according to Eschricht, 5 phalanges, the 2nd 5, the 3rd 6, and the 4th 3. The 1st finger, according to Dubar, has 4, the 2nd 7, the 3rd 6, and the 4th 5.³ I counted on the skeleton of *B. laticeps* in Bergen 3 phalanges on the 1st finger, 6 on the 2nd, 5 on the 3rd, and 2 on the 4th.⁴ All these deviations evidently show specific difference; and it may be added, that the dorsal fin on the large specimens of the *Giant whale* is only 4" high, while on small specimens of the other, it is sometimes 1' 4". The elongated form of the phalanges seems to be quite characteristic of this whale; and as the Greenland *Tumolik* described by Eschricht, both in this respect and in the form of the anterior extremities generally, seems to correspond with the *Ostend whale*, I have not hesitated to consider them of the same species, notwithstanding several deviations in their external parts, according to the descriptions by Van Breda and Möller. The most remarkable deviation in these descriptions is that in the width of the pectoral fins; but as these in the Greenland specimen, both with and without flesh, according to Eschricht, corresponded most closely with Dubar's figures of these fins on the *Ostend whale*, the difference must be in consequence of some erroneous statement from either side. Such errors may be found even in the other statements, and unfortunately too often occur in the external descriptions of whales generally. The statements of the length of the body by Dubar and Van Breda, differing so widely, bear evidence of such a mistake. We have no reliable evidence of this whale appearing in the seas near the coasts of Scandinavia; but as it inhabits the North Sea and the Polar Sea, and has been obtained near *Ostend* and near *Greenland*, it is probable that it also exists near *Norway*. I was informed by the "præparator" at the zoological museum at *Bergen*, formerly a

¹ It must be noticed, however, that the skeleton of *B. laticeps* described by Rudolphi, as well as the one in *Bergen*, are from young specimens.

² The length is here taken in a straight line between the two articulating surfaces.

³ His figure, however, represents only 4 phalanges on the 4th finger.

⁴ The length of this extremity in the *Giant whale*, which Eschricht considers of importance, does not seem to be significant. It is of about equal length in the succeeding species. It is only the length of the phalanges that are distinguishing. The reason why Eschricht found the length of this extremity very different in the *Ostend whale* and the *Greenland specimen* of this whale on the one hand, and the *Herring whale* (*B. laticeps*) on the other, is, that the length of those of the latter has been estimated from the measurements given by Rudolphi, "3 fuss, 6 $\frac{1}{2}$ zoll," which were taken on the external pectoral fin before the whale was skeletonized, while those of the others have been taken from the caput ossis humeri inclusive on the pectoral fin after separation from the body. The measurement stated below of the anterior extremity of the skeleton of the *Herring whale* in the museum in *Bergen* shows that it has this extremity of equal length with the *Giant whale*.

resident of Haugesund, in Norway, that a Fin-whale, 47 yards Norwegian measure, or 49 yards Swedish measure, was once stranded at the latter place. As the species in question, according to statements about the Ostend specimen, seems to reach a larger size than the other Balænoptereæ, it is probable that this Fin-whale, stranded at Karmö, near Haugesund, was of this species. Professor C. J. Sundevall has kindly given me a figure of a shoulder-blade found by him on the sea-shore in Norwegian Finmark. This figure, on which the length is stated as 2' 8", and the width 4' 3", corresponds exactly with Dubar's figure of the shoulder-blade of the Ostend whale. It differs from the shoulder-blade of *B. musculus* in the acromion being comparatively larger, and in its direction somewhat diverging from the processus coracoideus, making the angle that it forms with the upper part of the anterior edge of the scapula smaller. On the other hand, the acromion is less separated and less diverging from the processus coracoideus than in *B. laticeps*; and this shoulder-blade has thus, notwithstanding its smaller width, probably not belonged to that species.

Measurements of B. gigas.

	The Ostend specimen according to Van Breda. Female.	The Ostend specimen according to Dubar.	The Greenland specimen according to Möller. Female.
Entire length of animal	84' 7"	105'	71'
Height of body behind the pectoral fins, about	7'	—	—
Distance from point of snout to pectoral fins	23' 4"	—	23'
" " " umbilicus	46' 4"	—	37' 6"
" " " the genital organs	55' 2"	—	48'
" " " the dorsal fin ¹	61'	—	56'
Length of pectoral fins	10' 6"	—	7' 10" ²
Width "	2' 2"	—	3' 5"
Height of dorsal fin	—	—	4"
Width of caudal fin	—	—	16' 8"
Length of the largest baleen plates	—	—	4'
" lower jaw-bones	—	22' 4"	—
Height "	—	1' 9 $\frac{1}{2}$ "	—
Width of skull	—	6' 9"	—
" atlas	—	3' $\frac{1}{2}$ "	—
" sternum	—	1' 8 $\frac{1}{4}$ "	—
Length of second rib	—	8' 4 $\frac{3}{4}$ "	—
" third "	—	9' 3"	—
" shoulder-blade	—	3' 7 $\frac{3}{8}$ "	—
Width "	—	5' 11 $\frac{7}{16}$ "	—
Length of os humeri	—	2' 4 $\frac{7}{16}$ "	—
" radius and ulna	—	4' 1 $\frac{1}{2}$ "	—
" the anterior extremity, on the skeleton, according to Eschricht	—	—	11' 8 $\frac{1}{2}$ "

¹ This distance is, in the Ostend specimen, estimated from the position of the vent. In the Greenland specimen it is calculated from the distance between the notch of the caudal fin and the dorsal fin.

² Eschricht considers this measurement too short.

It is, according to Möller, of a slender and elongated form of body; the fore part is usually the thickest, and the hind part elongated and narrow, and compressed towards the tail. The lower jaw is perceptibly both longer and wider than the upper one, about 2' longer according to Möller; Van Breda mentions that, according to information which he received, the Ostend specimen had some bristles about 1' long on the point of the snout. He had not, however, himself seen them *in situ*. The Greenland specimen was, according to Möller, without bristles, at least on the lower jaw. The pectoral fins of the Greenland specimen are, as the measurements indicate, placed near before the end of the first $\frac{1}{3}$ of the body,¹ and on the Ostend specimen considerably farther forward, probably in consequence of the rather uncertain measurement of the latter, because the distance between the fins and the point of the snout is nearly the same in both specimens. The dorsal fin, nearly above the vent, is very far back, in the Greenland specimen near before the posterior $\frac{1}{3}$ of the body, and in the Ostend specimen somewhat before the posterior $\frac{1}{3}$, according to Van Breda. It is, as the measurements indicate, very small and strongly directed backwards.

The colour is stated by Möller to be black all over, possibly somewhat lighter under the hinder part of the body, and white on the lower side of the pectoral fin. It is, according to Van Breda, above black, and white on the belly side and around the genital organs.² The baleen is dark brown.

As regards the skeleton, I have mentioned the most important of its known characters. The cervical vertebræ are all separate. The axis is the only cervical vertebra with the processus transversus ring-like. The foramen spinale of the atlas is tapering below, but the lower part is not separated from the upper part by any lateral notch. The 7th cervical vertebra is without the lower ramus of the lateral process. The sternum resembles, according to Dubar's figure, very nearly that of the skeleton of *B. musculus* from Greenland which is preserved at Copenhagen. Its width is greater than its length. Its middle part or manubrium projects somewhat forward. There is on each side of the corpus a broad wing-like process, and the posterior process is about as long and wide as these. It is thus, as Eschricht terms it, formed like a cross. The first pair of ribs are larger and wider than in *B. musculus*. There is on the anterior edge below the upper end of the second rib, a forked process, which is directed down. The carpus has, according to Dubar, 6 bones; but Eschricht, in the figures of the bones of the anterior extremity of the Greenland specimen, has given only 5 carpal bones, as usual, 3 in the upper and 2 in the lower row. One of the pelvic bones figured by Dubar resembles the same bone of *B. musculus* figured by Companyo, but with the middle shorter process shorter and more obtuse.

As I have previously stated, it is not known with certainty to have been obtained on the coast of Scandinavia, but it may be presumed that it exists there. The late Captain Holböll, according to Eschricht, observed it three times on the coasts of Greenland; and Inspector Möller (according to the same authority) saw a female that was stranded at Godhavn, August 27th,

¹ I have estimated the distance of the pectoral fins in the Greenland specimen from the point of the snout, from the distance given between them and the hinder fork of the caudal fin, adding to this the width of the pectoral fins at their base, this being subtracted from the length of the body, the distance from the nose to the pectoral fins is, of course, obtained. Möller has given the length of body in a straight line.

² Van Breda has since, according to Eschricht, told him it was of a dark colour on the belly side.

1843. As far as I know, it has only once been obtained on the coasts of Europe, viz., the 14th November, 1827, near Ostend; also a female. These are the only times that it has with certainty been observed. It seems, therefore, to be quite rare. The shoulder-blade found by Professor C. J. Sundevall, on the coast of Norwegian Finmark, may possibly belong to this species.

3. *B. LATICEPS*, Gray. Herring whale. Swedish "Sillhval."

Dorsal fin of usual size. Processus coronoideus of the lower jaw high and conspicuous. Vertebrae 55. Axis alone of the cervical vertebrae with ring-like transverse processes. Ribs 13 pairs, the 1st of which has the upper end forked or biceps. Lower arm-bones very narrow, their length being 9—11 times their width at the middle. Baleen black.

BALÆNA ROSTRATA, K. A. Rudolphi. Einige anatomische Bemerkungen über *Balæna rostrata*; Abhandlungen der Königl. Akademie der Wissenschaften zu Berlin, 1820—1821 (tr. 1822), p. 27, tab. i—v.

— — Brandt und Ratzeburg. Medizinische Zoologie, 1 Bd., p. 119, tab. xv, fig. 3; tab. xvi, figs. 1 and 2.—Ex parte.—1827-34.

BALÆNOPTERA LATICEPS, J. E. Gray. Zoology of the Voyage of the Erebus and Terror, Parts iii—v, p. 20.

SILLHVALEN (*BALÆNA PHYSALUS*, Fabric.), S. Nilsson. Skand. Fauna Däggdj., p. 636, ex parte.

PTEROBALÆNA BOOPS, D. F. Eschricht. Undersögelser över Hvaldyrene, 6^{te} Afhandling, K. Danske Vidensk. Selsk. Skr., 5^{te} Række, 1 Bd., pp. 130, 131, ex parte.

I have previously stated my reasons for giving this species the name "Sild-Qval," adopted in Norway, or in Swedish Sill-Hval (Herring whale). Notwithstanding Ström's statement, that this name is only used for smaller whales, I have myself observed that it is used for large Fin-whales, and in the vicinity of Bergen for all Fin-whales that are not Bay whales. Rudolphi considered it the same species as the succeeding, or Fabricius' *B. rostrata*, from which, however, it differs so much, according to the above-given characters, that recently they have been considered as of different genera. He even supposed that Linné's *B. boops* was of the same species. As it would be difficult to decide what species it was that Linné described under this name, I have been unwilling to give it this name, but considered that I ought to retain the one given by J. E. Gray. Brandt and Ratzeburg have included several species in their *Balæna rostrata*, at least even the *Balænoptera musculus* described above, as may be seen from their extensive synonymy for this species, which at that time probably had no synonymy at all. They have, however, increased the knowledge of it by giving a figure of the animal, viz., of the same specimen of which the skeleton is described by Rudolphi, and have informed us that the specimen was a female. S. Nilsson has, at the place referred to, under the name of "Sillhval" (*B. physalus*, Fabr.), confounded with this species at least one other, viz., the *B. musculus*, as will be seen both from the description (54—61 vertebrae, ribs 13—15, and length 65'—70'), and by the synonymy mentioned by him. Fabricius' name, *B. physalus*, cannot be given to it, as it probably is not this species that he refers to, and it is impossible to say what species it really is that he describes under this name. J. Reinhardt¹, however, has considered Fabricius' *B. physalus* to be the same species as

¹ "Rink. Grön.," &c., 'Naturhist. Tillæg,' p. 10.

Balænoptera gigas. Eschricht has, at the above-cited place, confounded this species and the next preceding under the name *Pterobalæna boops*.

Measurements of Balænoptera laticeps.

	The animal according to Rudolphi. Young female.	The skeleton in the Museum in Bergen. Young.
Length of animal	32' 4"	—
Circumference of body at the vent	9'	—
Distance from point of lower jaw to pectoral fins	9' 4"	—
" upper jaw to dorsal fin	20'	—
" lower jaw to the vent	21' 10 ¹ / ₂ "	—
Length of pectoral fins	3' 8 ¹ / ₄ "	—
Width of "	8 ¹ / ₄ "	—
Length of base of dorsal fin	1' 6 ³ / ₈ "	—
Height of dorsal fin	1' 4 ¹ / ₂ "	—
Width of caudal fin	6' 3"	—
Length of skeleton	—	30' 2"
" skull in a straight line	—	6' 7 ¹ / ₄ "
Width of skull across temporal bones	—	3' 3 ¹ / ₂ "
Length of lower jaw along the curve on outer side	—	6' 8 ¹ / ₂ "
Circumference of one lower jaw-bone at the middle	—	1' 3"
Height of one lower jaw-bone at processus coronoideus	—	10 ¹ / ₂ "
Distance from processus coronoideus to hinder edge of condylus	—	1' 0 ¹ / ₂ "
Length of corpus of last (thirteenth) dorsal vertebra	—	5 ¹ / ₈ "
Width " " "	—	8 ¹ / ₂ "
Length of processus transversi "	—	9"
Length of corpus of third lumbosacral vertebra	—	5 ⁵ / ₈ "
Width " " "	—	8 ¹ / ₂ "
Length of processus transversi of "	—	9"
Length of corpus of the last (fourteenth) lumbosacral vertebra	—	7 ¹ / ₈ "
Width " " "	—	9"
Length of processus transversi of "	—	5 ¹ / ₈ "
Length of first rib along the curve, outer side	—	2' 2 ³ / ₈ "
" sixth rib (the longest)	—	4' 3 ⁵ / ₈ "
Width " " at the middle	—	2"
Length of shoulder-blade	—	1' 2 ³ / ₈ "
Width "	—	2' 2"
Length of os humeri	—	9 ¹ / ₈ "
Width " at lower end	—	6"
Length of radius	—	1' 7 ¹ / ₈ "
Width " at the middle	—	2"
Length of ulna without olecranon	—	1' 6 ³ / ₈ "
Width " at the middle	—	1' 0 ⁹ / ₁₆ "
Length of anterior extremity from the shoulder-blade	—	5'

The skeleton of this whale in Bergen and that described by Rudolphi are of almost equal length. A third specimen of this species, No. 17 in Eschricht's list, the skeleton of which is preserved in the Zoological Museum in Leiden, was 33' 4" long, or about the same length as the

others. All these three specimens, the only ones known by me that can with certainty be assigned to this species, are thus of about the size of full-grown specimens of the Bay whale. They are certainly all young, and it is probable that they would grow somewhat larger, but the structure of the skeleton, especially of the small and slender extremities and of the ribs, seems to denote that the species does not reach any large size; and it appears very probable that this and the Bay whale are the smallest of our *Balænoptera*. Its small size must have strengthened Rudolphi's opinion of its identity with *B. rostrata* Fabricii.

We find, both from the figure by Brandt and Ratzeburg and from the form of the skeleton, that its body is elongated and slender, more so than in the succeeding species. The pectoral fins are, according to the measurements given, placed somewhat before the hinder end of the anterior third of the body,¹ and the dorsal fin about the beginning of the posterior third of the body; the latter thus not so far back as on the Giant whale. The vent is nearly under the dorsal fin. The pectoral fins are pointed and wider at the middle than at the base. The tail is compressed before the caudal fin. *The colour* is, according to the figure, above, bluish-black, beneath white, the longitudinal furrows under the fore part of the body red. The pectoral fins are on the upper and outer side black. The baleen of the skeleton in Bergen is black.

The skeleton, which is from a young specimen with loose vertebral epiphyses, which was put together under the supervision of Drs. Koren and Danielsen, is of a slender and elongated form, and corresponds fully with the figure on pl. i of Rudolphi's memoir, with the exception that the lower jaw-bones have been placed in a wrong position in the figure.² The skull is of a somewhat less elongated form than in *Balænoptera musculus*, but is more elongated than in *B. rostrata*.³ Its length is about twice its width. In regard to its form generally, it differs from the skull of both these *Balænoptera* in the processus zygomatici of the ossa maxillaria superiora being shorter and less projecting towards the sides, and in the upper jaw or beak in front of these processes being wider compared with the posterior part of the skull, so that the width of the skull is about $1\frac{1}{3}$ of the width at this point. The beak also tapers less in front than in them. The lower jaw-bones are much less curved,⁴ and there is, in consequence of this, hardly any space between them and the beak when they are in their natural position and the skull is seen from above. It differs especially from the skull of *B. musculus* by the dilated orbital part of the frontal bones having the posterior edges directed somewhat backwards instead of forwards. The lower jaw-bones are rather strongly compressed, with sharp edges above and below, particularly below. Number of vertebræ, as previously stated, 55, viz., cervical 7, dorsal 13, lumbar 4, and caudal 21.⁵ The

¹ On the figure they are placed at the end of the anterior fourth of the body.

² This has previously been observed by Eschricht.

³ The form of the skull in Rudolphi's figures, which in other respects are excellent, seems to be rather too elongated. G. Cuvier has pointed out the characteristic features of this skull in his 'Ossemeus Fossiles.'

⁴ It approaches nearest to *Balænoptera robusta* in regard to this form of the lower jaw-bones.

⁵ Rudolphi stated that there were 54 vertebræ, viz., 5 cervical, 14 dorsal, 15 lumbar, and 20 caudal. This statement has been corrected by Eschricht (who examined the skeleton in 1846) to 55 vertebræ, there being 13 dorsal vertebræ in correspondence with the 13 pairs of ribs stated by Rudolphi. It must naturally have 7 cervical vertebræ, like all other whales. This skeleton agrees consequently with the skeleton in Bergen in the number of the vertebræ. The skeleton in Leiden has, according to

cervical vertebræ all separate. Their lateral processes are generally not strongly developed. Those on the atlas are much compressed, short, and with their height greater than their length. Those of axis are larger and forming a ring, but comparatively short. The succeeding cervical vertebræ have not the lateral processes united into rings, and the 7th is without the lower ramus or parapophysis. There is a tuberculum atlantis anticum placed at the posterior margin of the inferior part of the corpus of that bone. The dorsal vertebræ are not keeled on the lower side of the corpus. The lateral processes of the 7 anterior dorsal are directed forward, those of the 8th and 9th are directed straight to the sides, and those of the 4 last ones are directed backwards, that of the last very little. All the lumbosacral vertebræ are keeled on the lower side of the corpus. The lateral processes of the first are directed out laterally, and those of the 2nd—12th are directed forwards. The lateral processes of the last two lumbosacral vertebræ and of the 1st caudal vertebra are directed straight out. Those of the succeeding caudal vertebræ are directed backwards. The lateral processes are generally shorter than those of the Bay whale. The 1st caudal vertebra had a very indistinct ridge on the lower side of the corpus. All the succeeding, which have processus spinosi inferiores, have the lower side of the corpus longitudinally concave. All the processus spinosi inferiores do not seem to be present. They are 11.¹ The sternum is missing.² Eschricht ('loc. cit.,' p. 31) has given an outline figure of the sternum of the skeleton preserved at Leiden. It differs in form very much from that of the other Balænoptæræ. It differs less, however, from the sternum of the Giant whale than from the others. It is formed like a cross, but very short, so that its width is about $1\frac{2}{3}$ its length. Its anterior middle part or manubrium is projecting and obtuse. The lateral processes are rather large, rounded at the point, and larger than either the manubrium or the posterior process, which latter is very short and obtuse. The 13 pairs of ribs are all, except the 1st pair, very slender. All the anterior ribs, except the 1st pair, are rather thick at the lower end, so that their section there is oval, and they resemble in this the sub-fossil Swedenborgian whale from Wanga, in Westergötland (Sweden), although they are narrower at the lower end than those of the latter. The 1st pair of ribs are considerably wider than the others, with the upper end, as stated, forked or "biceps," and the lower end rather dilated and much wider than the upper, with the extreme edge somewhat convex. The anterior ramus or capitulum at the upper end is both longer and wider than the posterior. Both ribs are in this respect perfectly similar. These ribs are, according to Rudolphi, united to the lateral processes of the vertebræ by their forked end. None of the ribs have the upper end united to the body of any vertebræ, but the 3rd pair have a conspicuous capitulum and collum. The 6th pair are the longest. The scapula is very wide, so that its width is nearly twice as great as its length. It is small, however, in comparison with the size of the animal. Its posterior edge is strongly concave. The acromion is far separated from the processus coracoideus, and diverges strongly from it, so that the angle that it forms with the upper part of the anterior edge of the scapula is very acute. The processus coracoideus is

Schlegel, 57 vertebræ, 14 of which are dorsal; but Eschricht says that this skeleton has now only 55 vertebræ, 13 of which are dorsal, thus corresponding with the skeleton in Bergen. It appears from this that the statements before us, except those of Eschricht, cannot be used with perfect reliance.

¹ Rudolphi says there are 14 such processes, the posterior very small.

² It is also missing on the skeleton described by Rudolphi.

conspicuous, but not half as long as the acromion. The os humeri is not particularly thick, its width at the middle is about equal to half its length. Both the lower arm-bones are very narrow, and long and somewhat curved. The radius slightly larger than the ulna. Its length is about 9 times its width at the middle. The length of the ulna is about 11 times its width at the middle. The olecranon terminates in an oblong cartilage 2" long, and slightly forked at the extremity. The carpal bones are 5; the 1st finger has 3, the 2nd 6, the 3rd 5, and the 4th 2 phalanges of medium length. These extremities, although not very short, seem very small in comparison with the skeleton. The baleen is very short.

This skeleton was procured by D. C. Danielsen, M.D., for the museum in Bergen, from Alten, in Norwegian West Finmark, where the species, according to Danielsen, is not scarce. It is probably not infrequent on the coasts of Norway.¹ Only three skeletons of this whale, however, have, as far as is known, been preserved. The whale of which the skeleton is described by Rudolphi, now in the Berlin Museum, stranded on the coast of Holstein, on 21st February, 1819; the one of which the skeleton is preserved at Leiden, stranded on the coast of Holland, on 29th August, 1811; the third is the skeleton at Bergen.²

4. B. ROSTRATA, *Fabricius*. Bay whale or Pike whale. *Swedish* "Wikhval."

Processus coronoideus of the lower jaw high and conspicuous. Number of vertebræ 48 or 49, 11 or 12 of which are dorsal. Baleen yellowish-white.

BALÆNA ROSTRATA, *O. Fabricius*. Fauna Groenlandica, p. 40, 1780.

— — *J. Hunter*. Observations on the Structure and Economy of Whales; Philosophical Transactions of the Royal Society of London, vol. lxxvii, p. 373, 1787.

BALÆNOPTERA ACUTO-ROSTRATA, *Lacépède*. Hist. Nat. des Cétacés, p. 134, tab. 8.

— ROSTRATA, *H. Krøyer*. Nogle Bemærkninger med Hensyn til *Balænoptera rostrata*, Naturhistorisk Tidsskrift, 2_Bd., p. 617. 1838, 1839.

WIK-HVALEN (BALÆNA ROSTRATA, *Fabr.*), *S. Nilsson*. L. c. p. 632; p. 640, fig. 1; p. 641, fig. 4; p. 644, fig. 8.

PTEROBALÆNA MINOR, *D. F. Eschricht*. Zoologisch-Anatomisch-Physiologische Untersuchungen über die Nordischen Walthiere, p. 169.

¹ [Dr. Koren has informed me, by letter, that a specimen of *Balænoptera laticeps* was killed in July, 1863, at Skogsvaag, near Bergen, in Norway.—1865]. I do not know what species it is that is spoken of under the name of "Sillhvalen (*Balæna physalus*, Lin.)," by the late Pastor C. U. Ekström, in his 'Förteckning öfver Däggdjur, Foglar m. m. som funnits vid Tjörn' (Götheb. Vetensk. och Vitterh. Samh. Handl., 1850).

² [A fourth skeleton, about 32' long, obtained from near the North Cape, is now in the Zoological Museum at Brussels. See "Notes on the Skeletons of Whales in the Museums of Holland and Belgium," 'Proc. Zool. Soc., Lond.,' Nov. 8th, 1864.—W. H. F.]

- PTEROBALENA MINOR, varietas BERGENSIS, *Idem*. Undersøgelser over Hvaldyrene, 6^{te} Afhandling, K. Danske Vidensk. Selsk. Skr., 5^{te} R., 1 Bd., p. 109.¹
- RORQUALUS — *Knox*. Jardine's Naturalists' Library, vol. xxvi, p. 142, pl. 7.

Note.—H. Rasch has, in 'Nyt Magazin f. Naturvidensk,' 1845, suggested the name of *Balænoptera Eschrichtii* for this species.

Note.—Eschricht mentions several peculiarities in which the Bay whale, that appears on the coasts of Norway, differs from the Greenland, or the genuine *B. rostrata*, Fabr. The latter has the lateral processes of the 5th and 6th cervical vertebræ forming rings, which is not the case with the former; it has also the dorsal fin somewhat further back. Eschricht does not consider these differences sufficient to be specific, but considers both forms as varieties of the same species, *Pterobalæna minor*, variet. *Groenlandica* and *Bergensis*. As I have not had an opportunity of making a comparison between these forms, I will follow the authority of Eschricht, although the deviations stated, if constant, might denote specific difference. Although the name given by Fabricius was founded upon an error, as he considered it the same species as Pontoppidan's *Balæna rostrata*, which, as already shown, is *Hyperoodon rostratus*, I have considered it right to retain Fabricius' specific name, as being the oldest that with certainty can be applied to this species.

This is the smallest of all our Balænopteræ. The length of the full-grown animal scarcely seems to exceed 32' or 33'. The old male may grow somewhat larger. In comparing the relation of the length of the ribs with the length of the skeleton in this and the preceding species, according to measurements here given, we find that the present species is not of so slender and elongated form of body as the last.² A similar comparison between the skull and the skeleton shows that it also has a larger head than the other. A young specimen, 15' 10" long, caught at Cherbourg, was, according to Lacépède, 10' 2" in circumference at the thickest part. A fœtus, about 3' long, was, according to Eschricht, 1' 6 $\frac{3}{4}$ " in circumference at the thickest part. Eschricht considers that the form of body of this young specimen could not with certainty be ascertained, in consequence of its loose consistence. Although an older animal, probably, is thicker than a fœtus of only $\frac{1}{3}$ the size that it will have when it is brought forth, it is likely that the thickness stated by Lacépède is too large, and was caused by the animal being distended by gas. The body is rather robust, with its greatest thickness about the middle, according to the figure of the fœtus given by Eschricht. It tapers but slightly forward to just above the eyes; from thence it is sharply pointed in front, so that the head is sharply pointed when seen either from above or from the side, with the upper and lower outlines converging about equally. The head is a little sharper when seen from the side than seen from above. The forehead on this fœtus seemed somewhat prominent and convex above the eyes. The older animal is, according to Knox's figure, without this convexity. The lower jaw projects distinctly farther than the upper

¹ The variety that occurs at Greenland is there called *Tikagulik*. Chamisso mentions a small whale, from the sea at Kamtschatka, which is there called *Tschikagluh* ('Nova Acta, Acad. Cæsar. Leop., t. xii, pars 1, p. 259), and this is considered by Eschricht to be the same as the *Tikagulik* of the Greenlanders.

² I have, unfortunately, not had access to any complete description of the external form of the full-grown animal.

one, and is much wider than the latter. The body tapers considerably backwards under the dorsal fin, and is very much compressed near the caudal fin, with sharp upper and lower edges extending between the lobes of the caudal fin. The middle furrows on the lower side of the fore part of the body extend backward to about the middle of the body. The throat in the older animals is extensible, and constitutes a kind of a bag.¹ The eyes are placed immediately above and somewhat before the angles of the mouth. The blowers are placed somewhat before the eyes, and converge somewhat forward. The orifices of the ears are very small, and on the foetus were placed $2\frac{1}{2}$ " behind the eyes. The pectoral fins, the free external part of which is in length about equal to $\frac{1}{4}$ th of the length of body, are placed somewhat nearer to the edge of the belly than to the dorsal edge, and are at the end of the anterior third of the body. They are lancet-shaped and pointed, and with smooth edges. The anterior edge is arcuate, and the posterior has an obtuse angle near to the base. The dorsal fin is placed at the beginning of the posterior third of the body, and in older specimens is of a different form from that of the foetus, in which it is lower and more obtuse. In the older animals it is rather high, obtusely pointed, and directed somewhat backwards, with the fore edge convex and the posterior one concave. It was, on a female of 26' length, 1' 3" high, and 1' 8 $\frac{1}{4}$ " long at the base, according to Eschricht. The caudal fin is rather deeply forked behind, and its width in the foetus was $\frac{1}{4}$ th of the length of the animal. It is but little wider in the adult.² The vent is under the posterior part of the dorsal fin.

The colour is above blue-black, beneath white. The pectoral fins are, on the upper side to the greater part of their length, white; and at the base, the point, and the posterior edge, black. There is a well-defined limit between the black colour at the base and the white. They are of the same colour on the lower side as on the upper. The caudal fin above is of the same colour as the upper side of the body; beneath white with black edges. The baleen is yellowish white.

The skeleton. I have taken the following measurements from a skeleton in the Zoological Museum of this University. The skeleton is of a young female with loose vertebral epiphyses, and is from the vicinity of Bergen, Norway.

Measurements.

Length of skeleton; in a straight line	23'
" skull; " " "	5' 2 $\frac{1}{2}$ "
Width of " across temporal bones	2' 11 $\frac{5}{8}$ "
" beak at the base	1' 9"
" " middle	1' 1 $\frac{1}{3}$ "
Length of " " " "	3' 4 $\frac{3}{8}$ "
" one lower jawbone along the curve on the outer side	5' 5 $\frac{1}{8}$ "
Circumference of " " " at the middle	1'
Height of processus coronoideus behind	3"
Distance from processus coronoideus to hinder edge of condylus	11"

¹ In the foetus there are some bristles (5—7) on each side of each jaw near the borders of the mouth.

² A pregnant female, the skeleton of which, 25' in length, is preserved in the museum in Bergen, had, according to Kröyer, the caudal fin 7 $\frac{3}{8}$ " wide.

Length of corpus of atlas	2
Width of atlas across processus transversi	1'
Length of its lateral processes	2 $\frac{3}{8}$ "
" corpus of axis	2 $\frac{1}{2}$ "
Width of axis across the lateral processes	1' 4 $\frac{3}{4}$ "
Length of its lateral processes	6"
" of corpus of 3rd cervical vertebra	1 $\frac{1}{2}$ "
" " 7th " "	1 $\frac{1}{2}$ "
" " 1st dorsal "	1 $\frac{3}{4}$ "
Width of " " " "	5 $\frac{1}{8}$ "
Length of lateral processes of 1st dorsal vertebra	6"
" corpus of 11th " "	5"
Width of " " " " in front	5 $\frac{1}{2}$ "
Length of lateral processes of " " "	9 $\frac{1}{2}$ " ¹
" processus spinosus " " "	9 $\frac{1}{2}$ "
" corpus of 1st lumbosacral vertebra	5"
Width of " " " " in front	5 $\frac{5}{8}$ "
Length of lateral processes of 1st lumbosacral vertebra	9 $\frac{1}{2}$ "
" processus spinosus of " "	9 $\frac{1}{2}$ "
" corpus of 7th " "	5 $\frac{7}{8}$ "
Width of " " " " in front	6"
Length of lateral processus of " " "	8 $\frac{1}{2}$ "
" processus spinosus of " " "	11"
" corpus of " 1st caudal "	7 $\frac{3}{4}$ "
Width of " " " " in front	6 $\frac{1}{2}$ "
Length of lateral processes of " " "	5"
" processus spinosus of " " "	7"
Distance between the outer edges of processus obliqui of 1st caudal vertebra	2 $\frac{1}{4}$ "
Length of corpus of 2nd caudal vertebra	7 $\frac{1}{4}$ "
Width of " " " in front	6 $\frac{1}{4}$ "
Length of lateral processes of 2nd caudal vertebra	4 $\frac{1}{4}$ "
" processus spinosus of " "	5 $\frac{3}{4}$ "
Distance between the outer edges of processus obliqui of 2nd caudal vertebra	3"
Length of corpus of 6th caudal vertebra	6 $\frac{1}{8}$ "
Width " " " in front	6 $\frac{1}{2}$ "
Length " 13th " "	1 $\frac{3}{4}$ "
" sternum	1' 2 $\frac{1}{4}$ "
Width "	9 $\frac{1}{2}$ "
Length of 1st ribs along the curve on outer edge	2' 2 $\frac{3}{8}$ "
Width " at lower end	4 $\frac{1}{8}$ "
Length of 4th " along the curve on outer side	4'
Width " at lower end	2"
Length of 5th " along the curve on outer side	4' 1 $\frac{1}{8}$ "

¹ The length of the processus spinosus is counted from the processus obliqui.

Length of 11th ribs along the curve on outer side	2' 8"
" shoulder-blade	1' 2"
Width of "	1' 11 $\frac{1}{2}$ "
Length of acromion	5 $\frac{1}{2}$ "
" processus coracoideus	3 $\frac{1}{2}$ "
" os humeri	10"
Width of " at the middle	4 $\frac{3}{4}$ "
" " " lower end	5 $\frac{1}{2}$ "
Length of radius in a straight line	1' 5"
Width " at the middle	3 $\frac{3}{8}$ "
Length of ulna in a straight line without olecranon	1' 3 $\frac{1}{2}$ "
Width " at the middle	2 $\frac{3}{4}$ "
" " across olecranon	5 $\frac{1}{4}$ "
Length of the anterior extremity from the shoulder-blade	3' 7"
" " ossa pelvis	6"
" " longest baleen	8 $\frac{1}{2}$ "

The skull is not unsymmetrical. Both the superior maxillaries, as well as the intermaxillaries, extend equally far back. Its length is somewhat less than twice its width across the temporal bones. The hinder edges of the orbital parts of the frontal bones are concave, and towards the sides directed somewhat backwards. The processus zygomatici of the superior maxillaries project rather laterally, and the notches thus formed are larger than in the preceding species. The width of the skull is $1\frac{1}{3}$ rds the width of the beak before these notches, and the length of the beak is somewhat less than twice its width. It tapers considerably forward, and is sharply pointed. Its upper outline is but slightly curved. The palate bones extend before the processus zygomatici of the upper jawbones. The lower jawbones are less compressed than in the preceding species, strongly curved, and extend distinctly before the point of the intermaxillary bones. The processus coronoideus is high. The distance from the middle of the lower jawbones to the beak is considerable, and the baleen seems therefore longer than in the preceding species. The atlas is without tuberculum anticum, and has a shallow groove along the middle of the lower side of the corpus. Its lateral processes are rather short and compressed, higher than long, with the upper edge directed obliquely upwards and forward. The axis alone has the lateral processes forming a ring. These are large and strongly directed backwards. Those of the 3rd to 5th cervical vertebræ are directed backwards, and those of the 6th and 7th are directed forward. The lower ramus (parapophysis) of the 6th cervical vertebra is longer than the same on the three next preceding cervical vertebræ, so that its point is quite near the point of the upper ramus of the same lateral process. The lower ramus of the 7th cervical vertebra appears only as a short pointed process, which is longer on the right side than on the left. There is a rudiment of this parapophysis also on each side of the 1st and 2nd dorsal vertebræ. The cervical vertebræ are all separate. The dorsal vertebræ are 11, and the lumbosacral 12. The lateral processes of the 1st-6th dorsal vertebræ are directed forward, those of the 7th are directed straight out towards the sides, and those of the 8th—11th are directed slightly backwards. These processes are compressed on the first dorsal vertebra. The point of the lateral processes on the 11th or last dorsal vertebra is thick, and differs from the same on the lateral processes of the 1st lumbosacral vertebra, having a conspicuous facet for the last rib. The lateral processes of the 1st lumbosacral vertebra are directed straight out. Those of the

2nd—11th are directed forward. Those of the 12th also forward, and those of the 1st and 2nd caudal vertebræ are directed straight out. Those of the succeeding caudal vertebræ, that have lateral processes, viz., the 3rd—6th, are directed forward. None of the dorsal vertebræ are ridged on the lower side of the corpus. All the lumbosacral vertebræ have a longitudinal keel, but it is quite low on the first four. The first caudal vertebra is ridged below, but this ridge is longitudinally furrowed. The succeeding caudal vertebræ are concave along the lower side of the corpus. The middle lumbosacral vertebræ have the longest processus spinosi. The lateral processes of these vertebræ are the longest on the anterior ones, and decrease in length towards the tail. The 8th caudal vertebra is the last that has a processus spinosus. The last 3 caudal vertebræ are missing in this skeleton. The number of caudal vertebræ is otherwise 18. Eschricht has found this number, as well as the number of vertebræ generally, constant in all specimens which he examined. Krøyer has found the same, and I counted the same number on a skeleton in Bergen.¹ It may therefore be presumed that, when a smaller number is stated, it is in consequence of a deficiency or incompleteness in the skeleton.² The processus spinosi inferiores are 9, the 2nd of which is the largest, and the 1st has the point strongly directed backwards. The sternum is somewhat oblique, and has the form of an oblong cross, with the posterior process or ramus the longest, and the lateral processes placed nearer the fore-end, where the manubrium projects considerably. The ribs are slender, but rather long. The 1st pair, which are the widest, are not forked, and their lower end is rather dilated. The 4th and 5th pairs are the longest, and almost equal. All the ribs are rather thin and compressed at their lower end. All are articulated only with processus transversi, but the 3rd and 4th pairs have a rather conspicuous capitulum and tuberculum, although their collum is not distinctly limited behind.³ The 1st ribs unite with the sternum behind its lateral processes, according to Eschricht's observations. The scapula resembles very closely that of the preceding species. Its width is not quite $1\frac{1}{3}$ its length. The acromion is far separated from the processus coronoideus, and forms a very acute angle with the fore edge of the upper part of the scapula. The radius and the ulna incline somewhat backwards, and the former is perceptibly wider than the latter. The carpal bones are three in the upper, and two in

¹ [Dr. Koren, of Bergen, had informed me, by letter, that a male of this species has been recently caught there which had 12 dorsal vertebræ, 12 pairs of ribs, and in all 49 vertebræ, and 11 processus spinosi inferiores. It was 28' in length.—1865.]

² There is a skeleton described in 'Skandinavisk Fauna,' which was obtained from the museum in Bergen through the late Acad. Adj. v. Düben, and in which there are said to be 10 dorsal, 13 lumbar, and 17 caudal vertebræ, thus, with the 7 cervical, in all 47 vertebræ. The dorsal vertebræ were considered 10, because there were only 10 pairs of ribs; but I have been informed by Dr. Koren of Bergen that this specimen had also 11 pairs of ribs, and consequently 11 dorsal vertebræ, as he particularly knew that the 11th pair of ribs belonging to the skeleton had been destroyed in Bergen. The lumbosacral vertebræ were estimated at 13, by the last dorsal vertebra having been counted among them. That the caudal vertebræ are stated to be only 17, is certainly in consequence of the last, which is very small, being absent.

³ Eschricht is of the opinion that the ribs generally in the whalebone whales are without capitulum and collum, but that these exist, even if the capitulum is not articulated with the corpus vertebræ, is quite apparent on certain ribs of some whalebone whales, for instance *Balenoptera robusta* and *Balæna mysticetus*, in which the tuberculum arises high and is separated by a long collum from the capitulum, which is almost articulated with the corpus vertebræ.

the lower row, but on the lower side of the last (opposite the end of the radius) there is, on both extremities, a 6th carpal bone, very small, and with two smooth surfaces, which I have never observed on any other specimen of this, or any other species of whales. Fingers 4; the 1st has 4, the 2nd 7, the 3rd 6, and the 4th 3 phalanges. The 1st finger has 3, the 2nd 7, the 3rd 6, and the 4th, 3 phalanges, on a complete hand of another specimen from Bergen. These are rather short and wide. The pelvic bones are quite small, as will be seen from the measurements given. If we may judge from Rudolphi's figure of one of these bones with the surrounding periosteum, they resemble very nearly those of the preceding species. Their middle process is quite small and obtuse. Both the others, one of which is about twice as long as the other, are obtuse, and of almost equal width. The longer process is, according to Eschricht, directed forward.

The mucous membrane of the jejunum is, according to Eschricht, provided with 5—6 loose longitudinal folds and indistinct transverse ones.

This species, which is the smallest of all our whalebone-whales, is also more frequently obtained on the coast of Norway, particularly on the Western Coast, than any other. Although it sometimes enters the Cattegat, and has, according to Eschricht, once been obtained in Christiania Bay, at Dröbak, and once on the eastern coast of Jutland, in the vicinity of Horsens, it is not known that it has ever been stranded or caught on the coasts of Sweden. It would appear from this that it only exceptionally runs into the Cattegat. Its home is in the northern parts of the Atlantic, and in the Polar Sea. It is only during the summer that it is found in the northern regions. Like the others, it runs south in winter. It is not seldom caught on the western and northern coasts of Norway, at Iceland, and Greenland, and it has even been seen at Spitsbergen. At Tromsö, in Norway, I saw the baleen of a specimen of this whale, that had been stranded there, having been driven aground by the pursuing ravenous "Wagnhundarne" (Whale-dogs).¹ Although a northern species of whale, it does not seem to be as northern as our other Balænopterae, appears oftenest during the summer on the western coasts of Norway, and is there, in consequence thereof, sometimes called "Summer-whale," in opposition to the Herring-whales, which appear during the winter and spring.² In the vicinity of Bergen, where it is generally known under the name of "Waagehval," it is caught in certain small bays or creeks, with narrow inlet, which is shut up by a kind of coarse net, made of cast-ropes, or sometimes by a wooden gate. The inlet is closely guarded after the whale is enclosed, and it is then killed either with harpoons or with arrows shot from bows. It finally dies from the wounds, but often lives 8—14 days after being shut up. There are several places mentioned where it is caught in this manner, for instance, Florvaag, Stegesund, Tellevaag, Skogsvaag, Qualvaag, and others. It was formerly oftener caught in these places than it is now, but some are generally caught every year. Sometimes two, seldom three, are seen together; but it generally appears alone. It is at times found on the coasts of England and France, but is said not to appear in the Mediterranean. It has also been obtained on the eastern coast of North America. The male is much more seldom caught than the female. There was only one male among eleven specimens, mentioned by Eschricht as having been caught. It feeds principally upon small fish. It is said to live upon *Osmerus arcticus*, in Davis Strait. Eschricht is of opinion that it brings forth its young during the winter. It has generally only one young, but two fetuses have, however, been found in the female.

¹ Probably *Orca Schlegelii*.

² It disappears from the coasts of Greenland during the winter.

5. B. ROBUSTA, *Lilljeborg*. Gräsö-Whale.

*Processus coronoideus of the lower jaw low and hardly perceptible. Ribs at least 15 pairs. Vertebrae about 60. None of the cervical vertebrae succeeding the axis have the lateral processes forming a ring.*¹

BALENOPTERA ROBUSTA, *Lilljeborg*: Föredrag vid Naturforsk.-Mötet i Köpenhamm, 1860; Fö.h. p. 602.

Note.—I have not seen any description that can rightly be applied to this species, which differs, in several respects, from all other known species of the genus *Balenoptera*, and presents an approach to the genus *Balena*. It differs, however, from the latter genus, in the very inconsiderable curve of the lower jaw-bones, the strongly developed and moveable cervical vertebrae, the longer corpora and shorter lateral processes of the lumbo-sacral vertebrae, and by the sternum having a long rounded process behind, and large winglike lateral processes in front. It shows an approximation to the genus *Balena*, by the slight development of the processus coronoideus, and the fully developed tuberculum, collum, and capitulum of some of the ribs, also by the processus obliqui of the anterior caudal vertebrae being directed more towards the sides. It differs from the genus *Megaptera* by the strongly developed acromion and processus coracoideus of the shoulder-blade. It approaches, by the numerous vertebrae and the elongated form of body, to the division of genus *Balenoptera* that Eschricht calls "Kæmpehvaler," and to which the three first-described *Balenopterae* belong. As I have not been able to obtain knowledge of the entire skeleton, but only of a part of it—a great part, however—which was dug up in a field on Gräsö (Grassisle), in Roslagen, Upland (Sweden), I can give only an approximate number of the missing vertebrae and ribs, and a description of the form of the missing parts only from the contiguous bones that were actually found.

The bones found in the above-mentioned field are, both the lower jawbones; the 1st, 3rd, 4th, and 6th cervical vertebrae; 7 dorsal vertebrae, viz., 1st, 3rd, 5th, 6th, 7th, and of the other two, one is probably the 13th, and the other one of the 9th—11th; 8 lumbo-sacral vertebrae,² probably the 1st, 2nd, 3rd, 5th, 6th, 9th, 10th, and 11th; 14 caudal vertebrae, probably the 1st, 2nd, 4th, 6th, 9th, 11th—17th, 19th, and 20th; 4 processus spinosi inferiores and 1 processus transversus, which probably belonged to the 4th lumbo-sacral vertebra; some pieces of the processus transversi of a cervical vertebra; the right scapula; the left humerus; the right lower arm-bones; 6 carpal bones, 4 metacarpal bones; 4 finger-bones; 1 of the cornua anteriora of the lingual bone; the sternum, and 22 ribs, some of which are incomplete, 12 belonging to the right and 10 to the

¹ At least the 3rd, 4th, and 6th cervical vertebrae.

² In the above-quoted report of the meeting of Naturalists, I have made a statement that differs somewhat from this, in regard to the lumbo-sacral and caudal vertebrae, and which may now, after renewed comparison, be corrected. The differences consist in the 9th lumbar vertebra having been considered as the 7th, the 10th as the 8th, and the 11th as the 9th; in the 1st and 2nd caudal vertebrae having been mentioned as the 13th and 14th lumbo-sacral vertebrae, the 4th caudal as the 3rd, the 6th as the 5th, and the 9th as the 8th; and in the 10th having been stated as found, and the 17th having been excluded.

left side, 16 are pairs, the 11th—14th are missing on the left side, and the 3rd and 15th on the right side.

The bones that were not found may, from comparison with other nearly allied *Balænoptera*, be determined as follows:—The head, except the lower jaw; the lingual bones, except one cornu anterius; 2nd, 5th, and 7th cervical vertebræ; 2nd, 4th, 8th, 2 of the 9th—11th, 12th, 14th, and 15th dorsal vertebræ; 4th, 7th, 8th, and 12th—14th lumbosacral vertebræ; 5th, 7th, 8th, 10th, 18th, 21st—23rd caudal vertebræ; 13 processus spinosi inferiores; the left scapula; the right humerus; the left lower arm-bones; the left carpal and metacarpal bones; the left finger-bones, except the 1st; the right finger-bones, except 3; and the pelvic bones.¹

From these determinations of the bones found and of those not found it is conclusive that this whale had at least 15 dorsal, about 14 lumbosacral, and about 23 caudal vertebræ, thus, including the 7 cervical vertebræ, about 59 or 60 vertebræ in all.

Measurements.

Approximate length of skeleton	45'—50' ²
Length of lower jaw	8' 2"
Height of " at condylus	1' 5"
" " " processus coronoideus	11
" " " at the middle	10 $\frac{1}{2}$ '
Width of atlas across processus transversi	1' 5 $\frac{1}{2}$ '
Length of corpus of atlas	3 $\frac{3}{4}$ '
" processus transversi of atlas	3"
Height of " " "	4 $\frac{1}{2}$ "
Length of corpus of 3rd cervical vertebra	2 $\frac{1}{4}$ "
Width of " " "	8 $\frac{3}{4}$ "
Distance between the points of the lower rami of ditto	2'
Length of corpus of 1st dorsal vertebra	3 $\frac{3}{5}$ '
Width " " "	9
Distance between the points of processus transversi of ditto	1 7 $\frac{1}{2}$ '
Length of corpus of the supposed 13th dorsal vertebra	7 $\frac{3}{4}$ '
Width " " "	9 $\frac{1}{2}$ '
Height behind of corpus " " "	7"
Length of processus transversi of the supposed 13th dorsal vertebra	1' 3"
" " spinosus " "	1' 1'
Length of corpus of the supposed 5th lumbosacral vertebra	8 $\frac{1}{2}$ '
Width " " " "	9"
Height " " " " behind	8 $\frac{1}{2}$ "

¹ This statement of the bones "not found," differs also somewhat from the one made in the report referred to. This is a consequence of the corrected determination of the bones that were found.

² I have stated, in the report referred to, the approximate length to be 44'—45'. It seems, after comparison with the 30' long skeleton of *Balænoptera laticeps* in Bergen, and the skeleton of a young *B. musculus* in Copenhagen, that the length cannot be estimated at less than 45'—50', although it has a comparatively shorter head.

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Length of processus transversi of the supposed 5th lumbosacral vertebra	1' 2 $\frac{1}{4}$ "
" " spinous " " " "	1' 2"
" corpus of the supposed 10th lumbosacral vertebra	9 $\frac{1}{4}$ "
Width of " " " " behind	10 $\frac{1}{4}$ "
Height of " " " " "	8 $\frac{1}{2}$ "
Length of processus transversi of the supposed 10th lumbosacral vertebra, behind	1' $\frac{1}{2}$ "
" processus spinosus of the supposed 10th lumbosacral vertebra	1' 2 $\frac{1}{2}$ "
" corpus of 1st caudal vertebra	9 $\frac{1}{2}$ "
Width of " " behind	11 $\frac{1}{4}$ "
Height of " " "	9 $\frac{1}{2}$ "
Length of processus transversi of 1st caudal vertebra	10"
Distance between the outer edges of processus obliqui of 6th caudal vertebra	4 $\frac{1}{2}$ "
Distance between the outer edges of processus obliqui of 9th caudal vertebra	3 $\frac{1}{2}$ "
Length of sternum	11 $\frac{1}{4}$ "
Width of " between the points of the lateral processes	1' $\frac{1}{4}$ "
Length along the curve on the outer side of the supposed 2nd pair ribs	5'
Width of the supposed 2nd pair of ribs at upper bend	4 $\frac{1}{2}$ "
Length along the curve on outer side of the supposed 6th pair ribs	7' 5"
Width of the supposed 6th pair ribs at upper bend	4 $\frac{3}{4}$ "
Length of scapula	2' 6 $\frac{1}{2}$ "
Width " "	3' 6 $\frac{1}{2}$ "
Length of humerus	1' 9 $\frac{1}{2}$ "
Width " at lower end	11 $\frac{1}{2}$ "
Length of radius in a straight line	2' 3"
Width " at middle	7"
Length of ulna, in a straight line between the articular surfaces	2' 2 $\frac{1}{2}$ "
Width " at middle	4"

The skeleton is not that of a very old, nor of a very young whale. The vertebral epiphyses are loose from the 3rd dorsal vertebra inclusive to the 2nd lumbosacral vertebra. They are, with the exception of the 6th lumbosacral vertebra, united on the more posterior vertebræ, also on the cervical and the 1st dorsal vertebræ.

In comparing these measurements with those of the preceding species, we find that this *Balenoptera* has very strongly developed bones. Its scapula and ribs are large compared with the size of the skeleton. It is most particularly distinguished, however, by the short, stout, and but slightly curved lower jawbones, on which the processus coronoideus is rudimentary. We find, from given measurements of other whales, that the length of the lower jaw, along the curve, is not smaller than that of the skull in a straight line, but, on the contrary, larger. We may, therefore, estimate that this whale had a skull about 8' long. As the entire skeleton would undoubtedly have been at least 45' long, the measurement of the length of the skull, relative to the length of the skeleton, shows that it had a head considerably smaller than any of the preceding species, of which the length of the skeleton was known with certainty. As regards the form of the skull it is of course unknown; but the inconsiderable curve of the lower jawbones, in

which respect *B. laticeps* approaches it nearest, may lead one to suppose that it, like this, had a skull of an elongate conical form, with a base not much wider than the facial part or beak, and

FIG. 1.¹

also with a large, wide beak, and very short baleen. The lower jawbones (fig. 1) are rather strongly compressed, as in *B. laticeps*; they are, when seen from the side, but slightly tapering at the fore end, and the hinder end at the condyle and angle is very high, considerably higher than the height of the bone at the processus coronoideus, and with the angular part projecting behind the condyle.

The cervical vertebræ are separate, and the processus transversi do not form rings on any of the four that were found; but they have, except the atlas, rather long lateral processes, and these have their points not very far separate. The atlas (fig. 2) is large and thick, and has short lateral processes, the height of which is greater than their length. It has both tuberculum atlantis posticum and anticum, and its foramen spinale is sharply pointed downwards. The articular surfaces for condyli occipitales extend upwards about equally with processus transversi, and are separate below. The hinder articular surfaces are lower, and are united below. It has altogether

FIG. 2.

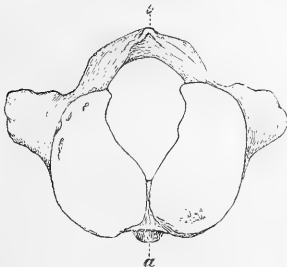
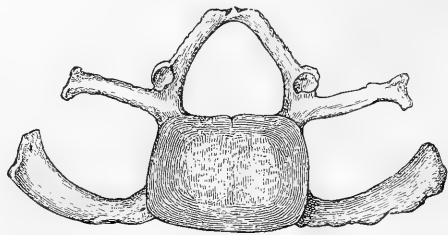


FIG. 3.



the character of the atlas of a *Balaenoptera* or *Megaptera*, and seems, in regard to the form of the lateral processes, to approach nearest that of *B. laticeps*, although these processes are less compressed than in the latter.

The lower ramus (parapophysis) of the lateral process of the 3rd cervical vertebra (fig. 3) is larger than that of the other three hinder cervical vertebræ that were found, and is nearly 3" high, and much larger than the upper ramus. The latter has a short process at the point, which is directed downwards towards the point of the lower ramus, which is bent upwards. The lateral processes of this, as well as of the 4th cervical vertebra, are directed somewhat backwards. The lateral processes of the supposed 6th cervical vertebra are directed a little forward, and under the

¹ [These figures are not in the original memoir, but are engraved from drawings sent by Professor Lilljeborg with the translation.—W. H. F.]

base of the lower ramus there is a transverse low process or projecting edge, which is directed backwards. Similar processes also exist in other *Balenoptera*, as *B. rostrata*.

This whale must have had at least 15 pairs of ribs, agreeing to the 14 pairs that were found more or less complete, except the 1st, which was not found. As these 14 pairs seem to be successive, and the appearance of the 14th pair shows it to be the last, it is probable that it has not had more than 15 pairs, and consequently not more than 15 dorsal vertebræ.

The 1st dorsal vertebra is, as usual, characterised by its smaller size, and by the lateral processes being strongly bent forward, and compressed at the point. The bodies of the succeeding dorsal vertebræ increase in length backwards, and the lateral processes are wide and concave on the lower side of the point, where the ribs have their upper end fixed; they are, on the supposed 3rd, directed forward, but are directed backwards on the supposed 5th and the succeeding dorsal vertebræ.¹

The 1st lumbosacral vertebra is singular for its lateral processes being more obtuse at the point than those of the other lumbosacral vertebræ, and by being directed more backwards, although not quite so much as the lateral processes of the posterior dorsal vertebræ. Its corpus, at the fore end, has both the upper and the lower edges convex, and forming a gradual curve, and is convex on the lower side, without any longitudinal ridge. The 2nd and 3rd lumbosacral vertebræ are also without any ridge on the lower side of the corpus, although the latter has a considerable convexity; the 5th and the succeeding ones are keeled. The lateral processes of these vertebræ do not decrease suddenly in length backwards, which denotes a large number of similar vertebræ, and that the estimated number of 14 is thus not too high, especially if the difference of form between the supposed 11th lumbosacral vertebra and the supposed 1st caudal vertebra is taken into consideration. There may possibly have been one or more lumbosacral vertebræ. The lateral processes of the 9th—11th of these vertebræ are directed almost straight out towards the sides; they are directed backwards in the preceding.

Those caudal vertebræ that have lateral processes have them directed forward, and are besides peculiar for their smaller processes generally, smaller foramen spinale, and higher corpus, with a different appearance of the lower side; the lateral processes are farther from the arcus vertebræ, and strongly directed downwards. The 1st caudal vertebra has an obtuse ridge on the lower side of the corpus forwards, and is concave behind where this terminates, and has, at the sides of this concave surface, hardly perceptible articulating surfaces for the 1st processus spinosus inferior; the 2nd caudal vertebra resembles very nearly the 1st in form, but has, on its lower side, before, a flattened ridge, which, further back, changes into a longer concave surface, that on both sides is limited by a longitudinal process, one of which is remarkably high and thin.² The hinder caudal vertebræ decrease rapidly in size backwards; the processus transversi are still conspicuous on the supposed 11th caudal vertebra, but are very feebly indicated on the 12th and 13th, particularly on the latter; the processus spinosus is very low on all three of these, and is rudimentary on the 13th, but still surrounding the foramen spinale above; these processes are not found on the succeeding caudal vertebræ. The last signs of articular surfaces for processus spinosi inferiores are visible on the 16th caudal vertebra.

¹ Three of these vertebræ were found close together, with the ends of their bodies in their natural position.

² This vertebra is described as the last lumbo-sacral vertebra in the report referred to.

The sternum (fig. 4) is very characteristic. It is concave in front, where it has on each side a large wing-like process, and terminates in a long round process or point. There is on each side, behind the wing-like process, a rough protuberance, to which probably was united the cartilage of the 1st pair of ribs. This sternum has some similarity with certain forms of the same bone in *B. musculus*.

The ribs are thick and large, almost like those of *Balæna mysticetus*; they are generally thin and compressed towards the lower end. There are, as previously stated, at least 15 pairs, and probably not more. The 1st pair are unknown. All those that have been found taper at the lower end, while, on the contrary, the 1st pair in all Fin whales and in *B. mysticetus* are wider at the lower end. Those of the supposed 2nd pair resemble very closely the same pair of the skeleton of *B. musculus* in Bergen; they have a rudiment of a collum, which is most developed on the left one, and are, in comparison with their length, somewhat wider than the succeeding ones, and more curved. The 4th—6th pairs have a strongly developed tuberculum, which is 2" high on the first two pairs.¹ The 4th—5th pairs have a longer collum, which, on the former, is 7" long, and has on both pairs a conspicuous capitulum at the point, which, however, does not reach to the corpus of the corresponding vertebra, when the tuberculum is united to the lower concave part of the end of the processus transversus. There is hardly any capitulum on the 6th pair, which are the longest of all. The hinder pairs have the upper end flattened. The 10th—15th pairs decrease gradually in length and in thickness, the latter being only 4' 2½" long, very narrow, with sharp edges towards the lower point, with an undulating curve, and with the upper end somewhat button-shaped.

The scapula (fig. 5), like the lower jawbones, is quite characteristic of the species. It seems, in its form, to be between that of *Balænoptera* and that of *Balæna*. It is narrower than that of the other species of the former genus, but wider than that of those of the latter. Its width at the upper part exceeds the length by between $\frac{1}{4}$ and $\frac{1}{3}$. Compared with the scapula of *Balæna*, it is much wider. The acromion is large (9" long), but the processus coracoideus is rather short (5¼" long). These processes are not far separate, and the acromion is directed somewhat upwards; but the angle that it forms with the upper part of the fore edge of the scapula is not very acute.

The humerus resembles the same bone in the other *Balænoptera* by its caput being subterminal and very little turned inwards.

¹ I have observed a tuberculum, as strongly developed, only in *Balæna mysticetus*.

FIG. 4.

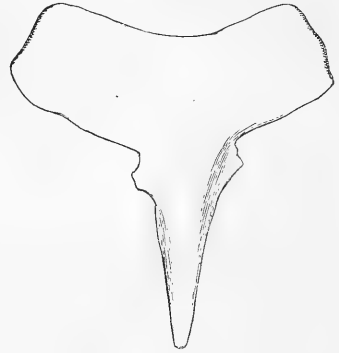
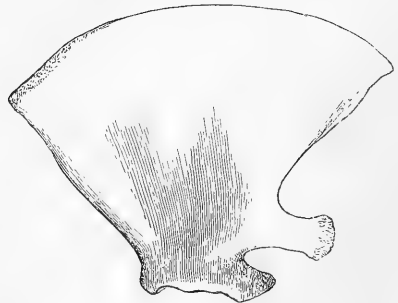


FIG. 5.



The radius and ulna seem, like the scapula, in regard to their form, to be between the same bones of *Balenoptera* and *Balæna*. They are less elongated than those of the other species of the former genus, but, on the other hand, more elongated than those of the latter. Both are somewhat curved backwards, but the radius very little. This is much wider than the ulna. The olecranon terminates above in a rather long conical point. Only 5 of the 6 carpal bones found seem to be genuine carpal bones, and have two even surfaces, an upper and a lower one. The 6th is smaller, and has only one even surface. The metacarpal bones are short and wide, 4 in number, and were lying close to each other. The phalanges found are also of an inconsiderable length, and of nearly the same form as in *B. rostrata*.

It has been stated above that these bones were dug up in a field on Gräsö (Grassisle) in Roslagen. The field is at Norreboda, on the northern part of the island. While ditching it, some 15 or 20 years ago, a caudal vertebra was found, and given to the pastor of Gräsö to be preserved in the church there as a "bone of a Giant." This vertebra was seen by Dr. J. O. von Friesen, who informed me of it, and in the summer of 1859 was induced to visit the place where the vertebra had been found, and to commence examinations and diggings for the skeleton, which possibly might remain in the field. After ascertaining the spot where the vertebra had been found in the ditch, he proceeded to dig, and found two vertebræ and a piece of a rib. The field being in cultivation, he was unable to extend the diggings, and could, therefore, only find these bones. After carrying them home and presenting them to the Zoological museum of this university, and informing me of the circumstances under which they had been discovered, it seemed very probable to me that the remainder of the skeleton might be at the same place; after harvest, in the latter part of August, I hastened thither, accompanied and assisted by Dr. von Friesen's brother, F. M. von Friesen, Med. Stud. and Conservator Hedström, to continue the digging that Dr. von Friesen had commenced. We found during these diggings all the bones described above, except the vertebra preserved in the church in Gräsö, and those that had been presented by Dr. von Friesen. The first-named vertebra was presented by Pastor Haselhuhn to the Zoological museum of this university, which, consequently, has come into possession of all the bones of this skeleton that have been found. In order, if possible, to find the remaining parts of the skeleton, more especially as such important bones as the skull were missing, I returned to the place again in the autumn of 1860, and commenced new and extensive diggings, but without finding a single bone. It is, therefore, not probable that the other parts of the skeleton remain in the field, more particularly as the field is cut through by numerous and deep ditches in almost every direction, in digging which they might have been found at other places. They have probably been carried away by the ice melting or by the washing of the sea. It seems likely that they have been carried off in such a manner from the fact that a similar vertebra was found some twenty or thirty years ago, at another place in the vicinity, some 800 or 1000 feet from the field. That place is very wet, and at the time of my visit could not be examined in consequence of being so saturated and flooded with water, that the diggings could not be carried on. The ground has not since been in such a condition that this work could be prosecuted, although I have instructed a suitable person to attend to it as early as practicable. The hope, however, of ever finding the remainder of the skeleton is very slight.

The field where the bones were found has been under cultivation for a long time, and consists of a little valley surrounded on all sides by small hills, so that there is not any convenient

ouilet for the water. The bones were in the lowest part, in three lots, generally without any order, except the three dorsal vertebræ, a couple of lumbo-sacral vertebræ, the lower arm-bone and the hand-bones which were in their natural position to each other. They were some 2'—4" deep, sometimes with the points a little higher. The distance from this place to the sea-shore is 840 feet, and the height of the field above the sea is about 12 to 15 feet. The layers of earth on this place are, first a layer of mould about 9" thick; next, deeper, a thicker layer of coarse gravel and rounded stones; under this a thin layer of fine sand (not writing sand, however); and under this a layer of fine blue clay, sometimes looser, sometimes firmer, in places so loose and deep that a bar of iron 5 feet long could easily be run down without meeting any firmer layer. This clay rested in some places on gravel and round stones, and in some on solid rock; in some places it was deeper than in others, sometimes 2' and sometimes about 4' deep. The greater part of the bones were on the top of the clay, where it was deepest below the surface. Some were partly surrounded by the clay, and were in a better state of preservation; some of the lighter bones, such as the scapula, the cervical vertebræ, the lower arm-bones, and the hand bones were at a small depth in the coarse sand. There were a great number of shells (mostly broken) of *Tellina balthica*, Linn., and *Mytilus edulis*, Linn., in the sand about the bones, and there appeared sometimes streaks in the sand of a blueish colour, from crushed shells of the latter. These shells resembled those of the same species that now live in the Baltic, from which it appears that the sea is still of the same nature as it was at the time when this whale was stranded. The shells of *Mytilus edulis* were small and thin. The shells found seem to indicate that the sea extended thus far up, at the time when the bones were covered up.

As there was no tradition in the neighbourhood about this whale, and it was believed that the vertebra first discovered had belonged to a giant, and as there were no signs on the bones to indicate that the whale had been cut up by men, it is probable that Gräsö was covered, at least in greater part, by water, and was not inhabited at the time when this whale was thrown ashore. As dead whales, in a decomposing state, always remain floating in consequence of the formation of gas within, and drift about on the seas, at least in the smaller seas, until they are thrown on some shore, it is reasonable to suppose that this whale either stranded or was thrown ashore, and that it did not sink to a bottom of any great depth after decomposition. The place where the bones were found must, in the latter case, have been the bottom of the sea at that time. The circumstance that the shells were found about and under the bones contradict such an opinion, because the molluscous animals belonging to them live in shallow water near the shore. Taking the considerable size of the whale into consideration, it is evident that it could not have swam in less than 6'—8' water. As the place where the bones were found is 12—15 feet above the usual level of the sea, the sea must, when this whale stranded, have been about 20' higher than at present, or, agreeable to other similar observations, the shore must have risen about 20 feet. A sinking of the land 20 feet will not cause any such direct communication between the White Sea and the Baltic, that sea animals like whales could pass from the one to the other. There may, however, be some mistake in the calculation of the elevation of the shore from the position of the bones. As heretofore no whale like this, as far as is known, has been found on the western or north-western coasts of Europe, I have expressed an opinion that it might have come from the Polar Sea or the White Sea. If this should be the case, this species, if yet living, must be looked for in the Polar Sea north of Russia and Siberia. But we do not require such explanations for the circumstance that an unknown species of whale was found on Gräsö.

Although our knowledge of the whales found in the northern part of the Atlantic is better than of those found in other seas, it seems, however, so incomplete that there may exist many species that are perfectly strange to us. A part of the bones were considerably decayed, and it is probable that the time of their interment is far back, but as their position was not very much above the surface of the sea, it is not at all impossible that this may have taken place after the southern junction of the Baltic and the North Sea, and that the whale has entered the Baltic this way, which still happens at times. A tradition, not very old among the inhabitants of Gräsö, informs us that the island has risen considerably within recent centuries, and that during the times of their ancestors, it was divided by narrow sounds that have since disappeared.

2nd Genus—MEGAPTERA, Gray.

(*Kyphobalæna*, Eschricht.)

The form of the body of animals of this genus is thick and robust in comparison with those of the preceding genus, with the greatest thickness about the middle. The head is larger than in the preceding, and is obtusely pointed, seen either from above or from the side, and the hinder part of the body is as usual narrower and more elongated, and strongly compressed before the caudal fin. There are deep longitudinal furrows on the lower side of the fore part of the body, but these are not so numerous as in the preceding. The pectoral fins are very long, with the front edge as well as part of the hinder edge undulated. The dorsal fin is very low, and is not as far back as in the preceding, and is farther forward than the vent. The caudal fin is very large and deeply forked in the middle of the hinder edge. The baleen is small and short like that of the preceding.

The skeleton is remarkable for the acromion and processus coracoideus of the scapula being absent, or, at least, only rudimentary. The shoulder-blade is of the same general wide form as it is in the preceding genus. The skull is, in comparison with the skeleton, larger than in the preceding genus, and is of a rather heavy build, but otherwise of the same form. Its facial portion or beak is rather large and wide, and its upper margin almost straight, when the skull is seen from the side. The intermaxillary bones are considerably narrower than the superior maxillaries, when the skull is seen from above. The vertebræ differ from those of the preceding by the corpora being shorter and wider (very nearly like those of the succeeding genus), and by the processus spinosi and transversi being shorter. The cervical vertebræ are generally separate, though two are sometimes united by their processus spinosi. Their lateral processes are shorter than in the preceding genus. The ribs are remarkably large and broad, comparatively broader than in any of the preceding genus. There is nothing distinguishing in the sternum. The os humeri corresponds with that of the preceding in the slightly oblique position of its caput. The olecranon ulnæ is conical, directed straight out, and has a cartilaginous extension of the same form. The cartilaginous part of the carpus has at the ulnar edge an axe-shaped appendage, and the hand is peculiar for the very numerous phalanges on the two middle fingers; the latter are, as usual in the whalebone whales, 4. The mucous membrane of the jejunum has, according to Eschricht, cell-

like compartments two inches in depth, which on the inside of the jejunum appear as large square openings, bounded by the transverse folds of the mucous membrane, and between each pair of their openings, by its longitudinal smaller folds. Cirripeds are found attached to certain parts of the body.

Specimens of this genus are found in the seas of both the northern and southern hemispheres, and in the Atlantic as well as in the Pacific. *M. J. G.* Gray, enumerates, in the above-quoted work, 4 species of this genus: 1st, *M. Poeskop*, Desmoulin, from the sea at the Cape of Good Hope; 2nd, *M. longimana*, Rudolphi, from the North Sea; 3rd, *M. Americana*, from the sea at the Bermuda Islands; and 4th, *M. antarctica*, Temminck, from the seas at Japan and the Antarctic Seas. Eschricht considers them all as one species. They correspond with the Balænopteræ in their habits. They emigrate like them at the different seasons of the year, and live like them upon small fish and other sea animals.

M. BOOPS, *Fabricius*. The Humpback. *Swedish* "Puckelhval."

Cervical vertebræ all separate. Scapula without acromion.

BALÆNA BOOPS, *Fabricius*. Fauna Groenlandica, p. 36.

— LONGIMANA, *Rudolphi*. Ueber Balæna Longimana; Abhandlungen d. K. Akademie d. Wissenschaften z. Berlin für 1829, p. 133, tabs. 1—5.

— — *Brandt u. Ratzeburg*. Medicinische Zoologie, 1 bd., p. 122, tab. xv, fig. 2; tab. xvi, figs. 5 and 6.

MEGAPTERA LONGIMANA, *J. E. Gray*. Zoology of the Voyage of the Erebus and Terror, parts iii—v, p. 17.

"RÖRHVALEN" (BALÆNA BOOPS, FABR.), *S. Nilsson*. Skandinavisk Fauna, Däggdjuren, p. 639.

KEPORKAK' (KYPHOBALÆNA), *D. F. Eschricht*. Zoologisch-Anatomisch-Physiologische Untersuchungen über die Nordischen Wallthiere, p. 146.

TUE-QVAL?, *Ström*. Söndmörs Beskr., p. 298.—*Pontoppidan*. Versuch einen Naturl. Historie von Norwegen, 2 Theil, p. 232.

KUGL-QVAL?, *A. Christie: Eschricht*, l. c., p. 157.

Note.—The above diagnosis has been given in order to distinguish our northern form from the southern (*Rorqual du Cap*, Cuvier), from the sea at the Cape of Good Hope. The latter has a very distinct rudiment of an acromion, which ours is entirely without; and, besides this, the axis and the 3rd cervical vertebra are united at the upper end of the arcus vertebræ (which corresponds with the processus spinosus), although the skeleton that is described by Cuvier,¹ and offers these peculiarities, was from a young specimen. As I have not had an opportunity of examining the Cape skeleton, I am doubtful

¹ 'Recherches sur les Ossemens Fossiles,' t. v, 1, pp. 381 and 383, tab. xxvi, figs. 9 and 20.

whether these two forms should be considered as distinct species or not. Eschricht¹ mentions that the skeleton in other respects "stemmede i Eet og Alt med Keporkakskellettets Former;" and states, additionally, that the acromion is larger on the right side than on the left.² Ström speaks, at the above-quoted place, of a whale that is found near Söndmör, and is larger than others, and called "Tue Qval," because it has a "Tue eller stor Pukkel paa Hovedet," which he considers to be *B. mysticetus*. We may, however, take it for granted that it is not the latter, as this never comes so far south, unless by accident.³ Pontoppidan also speaks of this "Tue Qval," and adds the name of "Plockfisch," but says it belongs to the smaller species, and has the hump on the back. Considering that the humpback whale reaches a size but slightly inferior to that of *B. mysticetus*—60 feet in length—and that Pontoppidan places the hump at its proper place, it appears probable that the name "Tue Qval" used by these authors has reference to the Humpback whale. This name, however, is not generally known on the coasts of Norway, because Eschricht quotes a statement, written by the late Governor Christie, of a Humpback whale that was stranded, in April, 1846, west of Karmö in the district of Stavanger, which is spoken of as "Sildehval."

It reaches, according to Holböll and Eschricht, a length of 55—60 feet. I have not seen any exact statement of the thickness of its body, but from Rudolphi's figure, which, according to Brandt and Ratzeburg, is executed from accurate measurements, the length of the body is equal to $3\frac{1}{2}$ its height at the thickest part, which is somewhat before the middle; this, however, seems to be rather too much. The head, when seen from above, is wider than that of *B. rostrata*. At the eyes it projects strongly towards the sides and then tapers very much towards the nose, which has an obtuse point. It is more pointed when seen from the side, with its lower margin, at the chin, strongly convex and rising up. The upper margin is almost straight and somewhat declining. Both margins converge forward, but the lower curves more than the upper one. The lower jaw is much wider than the upper one, and somewhat longer, so that it surrounds the latter, and the lower lip runs as usual outside of the upper lip, with a projecting border. The head is a little less than $\frac{1}{3}$ rd the length of the body. The navel is somewhat behind the middle of the body, and the vent (according to measurements of a fetus 36 $\frac{1}{2}$ " long, given by Eschricht), is at about the beginning of the posterior $\frac{1}{4}$ length of the body, and according to Rudolphi's figure, a little more forward. The genital organs are between the navel and the vent, a little nearer the latter. The body behind the vent or the tail is very tapering, and towards the caudal fin very much compressed, extending between the lobes of the caudal fin with rather sharp edges above and below. The lower furrows extend to the navel, and are about 24 in number (according to Eschricht), while in *B. rostrata* they are about 60. The blowers are narrow openings, converging forward. The eyes are immediately above the angle of the mouth. The pectoral fins are about the end of the anterior $\frac{1}{3}$ length of body, and are very characteristic of this whale.

¹ 'Undersøgelser over Hvaldyrene, 6^{te} Afhandling, K. Danske Vidensk. Selsk. Skr., 5^{te} Række,' 1 bd., p. 99.

² [Professor van Beneden has recently published the results of a comparison of the skeleton from the Cape of Good Hope at the Jardin des Plantes, with that of a Northern *Megaptera*. His conclusion is that they belong to different species.—*Bull. de l'Acad. Roy. de Belgique*, 2^{me} ser., tom. xviii, No. 12.—W. H. F.]

³ [Ström's "Tue Qual" may possibly be a North Caper (*Balæna glacialis*, Klein), which, according to Eschricht and Reinhardt, has a hump on its neck.—1865.]

They are very long, sword-shaped, and curved backwards, with both the anterior and the hinder edge, particularly the former, uneven, with elevations more or less prominent, and nearly corresponding with the joints of the bones within. Their length on the fœtus was, according to Eschricht, nearly $\frac{1}{4}$ th of the length of the body, and on the large specimen, according to Rudolphi, more than $\frac{1}{4}$ th, in fact, nearly $\frac{1}{3}$ rd of the same. The dorsal fin, which is before the vent, and has the anterior edge of its base somewhat before the posterior third of the body, has rather a long base, but is very low, and in old specimens has the appearance of a hump, having thereby given rise to one of the names of the animal. Its obtuse point is directed backwards, and its hinder edge runs straight down, and is sometimes somewhat curved inwards. It was $\frac{5}{8}$ " high on the above-mentioned fœtus, and $1\frac{1}{3}$ " long at the base, and was $7\frac{1}{4}$ " high on an older specimen. The caudal fin is deeply forked behind, and has the hinder edge very uneven. Its width was about $\frac{1}{3}$ rd of the length of the body on the specimen, 45' long, described by Rudolphi. It was smaller in the fœtus, being $8\frac{1}{2}$ " wide; less therefore than $\frac{1}{4}$ th the length of body. There are a number of smaller dermal tubercles, with one or two bristles, on both the upper and the lower jaw. There are 26 rather large, and 30 smaller, on the upper jaw. Most of the former are in irregular rows near the upper lip, and the latter are on the point of the snout. There are 13—19 on each side of the lower jaw. The colour is, above black, beneath, white with black spots. The pectoral fins are white, both above and beneath. The caudal fin is above black, beneath, white with black borders. The baleen is black, with brown bristles; the number of blades is, according to Eschricht, about 400 on each side.

The Skeleton.—The following are some measurements of the skeleton of a young specimen from Greenland, preserved in the Zoological Museum of the University of Lund.

Length of skeleton entire	34' 6"
" skull	10' 3 $\frac{1}{2}$ "
" lower jaw along the curve, outer side	10' 7 $\frac{3}{4}$ "
Height of " at processus coronoideus	1' $\frac{5}{8}$ "
" " " the middle	10 $\frac{3}{4}$ "
Distance between processus coronoideus and condylus	1' 6"
Length of corpus of the last (11th) lumbosacral vertebra	8 $\frac{3}{8}$ "
Width " " " " " "	10 $\frac{3}{4}$ "
Length of processus transversi of the 3rd lumbosacral vertebra, on which they are longest	9 $\frac{1}{2}$ "
Distance between processus obliqui of the 3rd lumbosacral vertebra	2 $\frac{2}{8}$ "
Length of shoulder-blade (without cartilage)	2' 2 $\frac{3}{8}$ "
Width " " " " " "	3' 3"
Length of os humeri	1' 8 $\frac{3}{8}$ "
Width " " at caput	1' 2 $\frac{2}{8}$ "
Length of radius in a straight line	2' 7 $\frac{1}{8}$ "
" ulna	2' 2 $\frac{5}{8}$ "

[Additional Measurements, 1865.]

Greatest width of skull across ossa zygomatica	5' 7"
Length of corpus of 1st dorsal vertebra	2½"
Width " " "	8½"
Length " 7th " "	5"
Width " " "	8½"
Length " 14th (the last) dorsal vertebra	5⅓"
Width " " " "	10"
Length of processus transversi of " "	10"
" " of 11th lumbosacral vertebra	6⅝"
" corpus of 3rd caudal vertebra	6⅝"
Width of " " "	10"
Length of processus spinosus of the 6th lumbosacral vertebra from the upper edge of foramen spinale	12"
Length of the anterior extremity from caput ossis humeri inclusive	10' 6"]

It will be observed from these measurements that the length of the body is between three and four times the length of the skull, and as the length of the skull is not quite $1\frac{1}{3}$ ths its width, which latter is considerable, it is evident that this whale has a larger head than the *Balænopterae*. The beak is $1\frac{1}{3}$ ths or near twice the length of the posterior part of the skull; and its length is about $1\frac{1}{3}$ ths its width at the base (according to Rudolphi's figure). It is quite wide, but the processus zygomatici of the superior maxillaries, and the orbital parts of the frontal bones, project considerably beyond the base of the beak, in consequence of the considerable width of the hinder part of the skull. This very much resembles in other respects the skull of *B. rostrata*, but the orbital parts of the frontal bones are more tapering outwards, and their fore edges directed somewhat more backwards, while their hinder edges are directed almost straight out towards the sides.¹ The lower jawbones are strongly curved, and the distance between their middle and the upper jaw is consequently rather large. They are, when seen from the side, somewhat tapering forward, but not very much. The processus coronoideus is low, but conspicuous. The atlas is remarkable for its lateral processes being short, somewhat compressed, and directed obliquely

¹ Professor Nilsson has kindly furnished me with figures of the sub-fossil whale bones found at Heljarp, near Landskrona (according to Ofversigten K. Wetensk. Akad. Forh. 1860, p. 105). I have also compared these bones with the above-described skeleton of the *Megaptera boops*, preserved in Lund, and procured by Professor Nilsson. There is only the hinder part of the skull. This, as well as the atlas, corresponds so nearly in the form with the same parts of *M. boops* that there is no doubt that they belong to the same species, or at least to the same genus. The lateral parts of the skull project as much as in this, and denote a larger width of the skull than in *Balænoptera musculus*, and the lateral parts of the occipital bone do not extend further back than the occipital condyles, which they do in the latter; and the atlas shows important deviations from that of *Balænoptera*, by having shorter and higher lateral processes, and it is without tuberculum anticum. It is remarkable, however, that in regard to the form of the foramen spinale, and the smaller size of the anterior articulating surfaces, it seems to correspond nearer with G. Cuvier's figure of this bone of the Humpback whale of the Cape than with the atlas of the skeleton in Lund. But the bones from Heljarp denote a small and yet younger specimen than the skeleton in Lund, and such is also the case with the skeleton of the Humpback whale from the Cape of Good Hope in the Paris Museum.

upwards, their height being considerably greater than their length. They are without perforations. The corpus has not any tuberculum anticum. The foramen spinale seems to be of a rather variable form. On the skeleton in Lund it tapers downwards, and has indistinct lateral projections. On the atlas found at Heljarp it is wider below, and with distinct projections between the lower and the upper part. The anterior articulating surfaces are separated even below, are large, and extend higher up than the upper edge of the lateral processes. The axis has the lateral processes shorter than in the *Balænoptera*, possibly with the exception of *B. robusta*, in which they are not known. They do not form rings. They consist, however, of two rami, an upper and a lower one, which are united at their points by cartilage. Neither do the lateral processes of the succeeding cervical vertebræ form rings. The last cervical vertebra is entirely without the lower ramus of the lateral processes, and the one next to the last (the 6th) has this ramus only indistinctly indicated. There are 14 dorsal vertebræ; 11 lumbo-sacral vertebræ; 21 caudal vertebræ; thus, with the 7 cervical, in all 53 vertebræ.¹ There is on each side of the corpus of the 2nd dorsal vertebra, near the hinder edge, a tuberculum or articulating surface covered by cartilage, which seems to have been for the attachment of the capitulum of the 3rd pair of ribs, although the collum of these ribs is so short that the capitulum does not reach all the way to the articulating surface. The 1st lumbo-sacral vertebra is without a ridge on the lower side of the corpus, but the succeeding vertebræ of this series are ridged at this part; the ridge on the last is divided by a longitudinal furrow. Some of the posterior dorsal vertebræ have a similar low ridge on the lower side of the corpus. The processus transversi of the 8 anterior dorsal vertebræ are directed forward, although hardly perceptibly on the 8th. They are directed laterally on the 9th, on the 10th—14th, backwards, although very little on the 10th and 14th. They are directed straight out towards the sides on the 1st lumbo-sacral vertebra, forward on the 2nd—7th, straight out towards the sides on the 8th and 9th, and backwards on the 10th and 11th. The lateral processes are directed straight out towards the sides on the 1st caudal vertebra, and forward on the succeeding ones. There are 10 processus spinosi inferiores. The sternum is formed like a cross, but the vertical part of the cross, as well as its side branches, are short and obtuse, and it has often a perforation in the corpus, and sometimes a longitudinal ridge on the lower side. Its width is generally, but not always, greater than its length. The anterior part or manubrium is short and broad, and the side branches, or wing-shaped processes, sometimes longer and obliquely truncated at the points. The ribs are very thick and broad, particularly the anterior, and are very long. The 1st pair are somewhat dilated at the lower end, which is fixed behind the lateral processes of the sternum (Eschricht); the others are tapering at this part. The 3rd pair have a conspicuous tuberculum, collum, and capitulum, but none of the ribs seem to articulate with the corpus of the vertebra. There is, in addition to the usual two ossa pelvis, a smaller rounded bone, united by a ligament to each of these; thus there are two pairs ossa pelvis (Eschricht).²

¹ Rudolphi gives 54 vertebræ, 22 being caudal; thus one caudal vertebra more than the number given above, following Eschricht. The latter author states that the last two caudal vertebræ on the skeleton described by Rudolphi are of wood, and that probably one too many has been added. I counted only 20 caudal vertebræ on the skeleton in Lund, making in all 52 vertebræ, but the last caudal vertebra was probably missing.

² Eschricht considers that the smaller pelvic bones show the strongest analogy with the ossa marsupialia of the Marsupial Mammalia; but it is probably more correct to consider them as rudiments of the hinder extremities.

The larger pelvic bones are long and narrow, and very much resemble those of *B. rostrata*. They have, however, the hinder process somewhat longer. There is an obtuse angle at one side of their middle piece, or corpus, and their anterior and posterior processes bend towards the opposite side, so that the bone thereby becomes concave. The anterior process is somewhat longer and narrower than the posterior. They were, on the skeleton of 42' length described by Rudolphi, 9½' long in a straight line, without the cartilage at the ends. The scapula is very considerably broader than long, with the upper edge strongly arcuate, and the anterior and posterior corners obtuse. The acromion is altogether wanting, but there is sometimes a rudiment of a processus coracoideus.¹ The os humeri has the caput almost terminal, and in a but slightly oblique position. The ulna is perceptibly both narrower and shorter than the radius. Its olecranon has a projecting short, truncated, conical form, with a conical extension of cartilage. Both radius and ulna are curved somewhat backwards, particularly the latter.² The carpal bones are 5. The two middle fingers, which are of an unusual length, have, according to Eschricht, 9 phalanges each, and the 1st and 4th each 3 phalanges.

This whale has, as far as is known, very seldom been obtained on the coasts of Scandinavia, and generally very seldom near Europe. It is oftener found on the coasts of Greenland. According to the statement of Governor Christie, mentioned by Eschricht,³ in the early part of April, 1846, a pregnant female, about 47' long (45' Norwegian measure) was stranded on an Island east of Faö and Karmö, in Stavanger district (Norway). It had commenced bringing forth the fœtus, which was 14½' long, and had probably died from the difficulties connected with parturition, and afterwards floated ashore. It was accompanied by two other whales, probably the male and a young one. I know, with the exception of this specimen, only one that has been stranded on a Scandinavian coast, viz., the one to which the bones found in the sand at the mouth of the Heljarp river,⁴ in Scania, belonged, if they, as they probably do, belong to this species, and not to that of the Cape, supposing the latter to be really distinct. Eschricht mentions, besides the above, two others obtained on the coast of Europe, viz., the one described by Rudolphi, which was stranded in November, 1824, at Vogelsand at the mouth of the Elbe, and one that was stranded at Berwick, in England, in

¹ Eschricht says in his "5th Afhandling," p. 534, that "Spina scapulæ og Akromion ere kun meget svagtantydede (i mange Individer mangler den sidste endog ganske); Processus coracoideus findes ikke." The figure of the shoulder-blade of this whale given by him in the same 'Afhandling,' p. 316, does not show any sign of acromion, but a conspicuous rudiment of the processus coracoideus. By comparing this with what is stated by the same author in his 6th 'Afhandling,' p. 99, in saying: "og at paa Skulderbladet ikke alene findes det sædvanlige lille Spor af processus coracoideus," &c., we see clearly that there must be a mistake in the first-quoted paragraph.

² The lower arm-bones found at Heljarp differ somewhat, by their more narrow and elongated form, from the same bones of the skeleton of *M. boops* in Lund; but as, according to Nilsson, they belonged to the same skeleton as the before-mentioned fragment of the skull and atlas, they must belong to this species, or at least to a species closely allied. They are so broken, and their edges so decayed by the air, that their original form is partly lost. The olecranon seems to have resembled the same part of *Megaptera*. The lower arm-bones of the skeleton of the Humpback whale from the Cape seem, from G. Cuvier's figures, to have been more slender than those of the skeleton at Lund, and we find in this more correspondence with the bones from Heljarp.

³ 'Zool. Anat. Phys. Untersuchungen über die nordischen Walthiere,' p. 157.

⁴ These bones were first mentioned by A. J. Retzius in his 'Fauna Suecica,' p. 50.

1829. A dead specimen of this whale was found floating in the sea off Revel in 1851.¹ The humpbacked whale, which in Greenlandic is called Kepokak, is, according to Eschricht, the most common of all the whalebone whales in Davis Strait. It appears there and off the coast of Greenland during the latter part of April, and migrates generally in November. It goes south during the winter. When near the coasts it generally feeds upon *Osmerus arcticus*, *Gadus agilis*, *Ammodytes tobianus* and *Limacina arctica*, and the smaller Crustaceans (Copepods). It is said to spout out the vapour from its blow-holes with less force than the *Balænoptera* and the Greenland whale. While swimming about and not searching for food, it dives often, but comes soon up again; but when it dives in search of food it remains under water much longer. It often, during calm weather, rests quietly on the surface of the water, sometimes lying on one side, beating itself with its pectoral fins, as if trying to rub away something that annoyed it. It sometimes jumps quite out of the water, turns round in the air, and falls on its back, beating itself with the pectorals. It appears, at times, quite fearless, and swims round about the boats quite near to them, as if they were its comrades. The young follows the mother until she brings forth another, which is said not to take place every year, as very large young ones are sometimes seen with the mothers. They protect their young with the greatest care, and are then more daring and more dangerous than usual. In order to induce the young to dive when a boat approaches, the mother strikes hard on the water with the tail, and may then easily upset a boat if too near. The mother often succeeds in taking the young down with her, even if it is severely wounded, and she then grasps it with her pectoral fins. A young one was once caught at Gotthaab (Greenland) which still followed the mother, although it was much larger than *B. rostrata* ever grows. The mother was for several days seen swimming about in the same bay with the greatest anxiety, and often running into the narrow sound, where the blubber had been taken from her young. Her sudden jumps and a peculiar way in which she spouted, often with an audible bellowing sound, plainly indicated her grief. The Greenlanders hunt it by creeping close to it, while it lies quietly, and stab it with lances, trying to pierce the heart. It sometimes dies immediately if they succeed in this. If not it dives directly, but comes soon up again, when the hunters again pursue it, and wound it with lances until it dies. These attacks are made in the bays. When it tries to escape efforts are made to prevent it from getting out into the open sea,² and when killed it is towed ashore by several boats. It happens sometimes that, when killed, it immediately sinks to the bottom, in which case the body again rises to the surface in a few days, if not devoured by the large and ravenous sharks (*Scymnus microcephalus*, Bl.), according to Fabricius and Holböll (in Eschricht). It is infested with external parasites of the order of Cirripeds, which are not found on the *Balænoptera*. These are the *Diadema balænaris*, and on this is the *Otione auritum*. It has also a peculiar species of *Cyanus* (Lütken). These Cirripeds are found in the folds under the throat, at the navel, and on the tail. The Greenlanders are of the opinion that it is even born with similar parasites (Eschricht).

¹ [A young female, 31' long, was stranded in the estuary of the Dee in 1863. The skeleton is now preserved in the Derby Museum at Liverpool. See J. E. Gray "On the British Cetacea." 'Proc. Zool. Soc.', 1864, p. 211.—W. H. F.]

² This seems to denote that it is less active than the *Balænoptera*, as would also appear from its thicker and heavier form of body.

3rd Genus—BALÆNA, Linné.

(Leibalæna, Eschricht.)

Lower side of body without longitudinal furrows, and the back without fin. Whales of this genus are, like those of the preceding, of a thick and robust form of body. The head is large and blunt, and the mouth strongly arched. Body tapering greatly towards the tail. The caudal fin very large, and deeply notched in the middle of the posterior edge.

The skull differs very much from that of the preceding genus; the nose is longer, considerably narrower, and strongly arched. The intermaxillary bones are, when seen from above, wider than the superior maxillaries, and partly cover them. The processus zygomatici of the superior maxillaries and the orbital parts of the frontal bones are comparatively longer and narrower. The superior maxillary bones are wide on the palate side, and have there, in their posterior edge, outside of the palate bones, a deep and narrow notch, which is not found in the preceding. The lower jawbones are more or less strongly curved, and have no distinct processus coronoideus, although their upper edge sometimes projects considerably.¹ The facial region being narrower than in the *Balænoptera*, the distance from the middle of the lower jawbones to the upper jawbones is consequently larger than in those; and as this space is occupied by the baleen, the blades are longer in all the species of the genus *Balæna* than in the preceding genera; and they are, in certain species, for instance the Greenland whale, in which the beak is very long and arched, and the lower jawbones very much curved, much longer, indeed several times longer, than the baleen of the preceding. The fibres in which they end, at the point and on the inner edge, are finer, and the baleen is not twisted, as in them. The vertebræ are, like those of the genus *Megaptera*, generally shorter and wider than in the *Balænoptera*; but their processes are strongly developed, particularly the lateral processes of the lumbosacral vertebræ. The processus obliqui of the posterior lumbosacral vertebræ, and of the caudal vertebræ, are further separate than in the preceding genera. The cervical vertebræ are less developed, and at least the greater part of them are firmly ankylosed. The sternum is of a simple form, and seems to be subject to variations, even in the same species. The ribs are generally thick and large, and some of them have a conspicuous tuberculum, collum, and capitulum, and seem to be articulated to the corpora vertebrarum. The scapula is large, but not so broad as in the preceding genus; the breadth does not much exceed the length. It has always an acromion, but is most often without a processus coracoideus. The os humeri is short and with a large caput, strongly directed inwards, almost to the side of the upper end of the bone, and is, consequently, not terminal. The lower arm-bones are very large and broad, and comparatively shorter than those of the preceding genera. The fingers are 5, and the hand broad.

Species of this genus inhabit all seas. J. E. Gray ('Zoology of the Erebus and Terror') mentions 5 species, and besides these one doubtful; viz., *Balæna mysticetus*, Linné, from the northern polar sea; *B. australis*, Desmoulin, from the sea at the Cape of Good Hope and the Southern Sea, *B. japonica*, Gray, from the sea at Japan; and *B. antarctica* and *marginata*

¹ See, for instance, G. Cuvier's figure of the skull of the young of *Balæna australis*.

from the Australian Sea;¹ and the doubtful *Balæna gibbosa*, Brisson.² There is also mentioned a variety of *Balæna mysticetus*, or "probably different species," with a larger head, from statements by Guerin, who was surgeon on board a whaler. To these species may be added the North Caper of the old authors (*Balæna glacialis*, Klein, *Balæna islandica*, Brisson, or *Balæna Nordcaper*, Lacépède), which, through the investigations of Professor Eschricht and Reinhardt, as before stated, has proved to be a distinct species from the others, and still, though rarely, appears in the Atlantic, where it formerly was more abundant towards the north. Two species of this genus formerly existed in Scandinavia, to judge from the parts of their skeletons that have been dug up at more or less great distances from the sea. One of these species still exists in the Polar Sea, and probably appeared here during the so-called glacial period; the other may still be living in the Southern Seas, and has most likely visited Scandinavia during the milder period before the glacial epoch. At least one of them has wandered into the Baltic, and stranded on the coast of Sweden, as late as during the historical period.

1. THE SWEDENBORGIAN WHALE.

In Emanuel Svedberg's (since ennobled under the name of *Svedenborg*) treatise 'Of the height of the waters and the strong tide of the former World: Evidences from Sweden,' dedicated to her Majesty the Queen Ulrica Eleonora, March the 17th, 1719, the 4th evidence has the following title:—"Of large Fish-bones and Ship Materials found in the interior of the country." In this is mentioned, among others, "And there was found, some years back, in Westergöthland, in the parish of Waga, 2 miles from Skara and 10 from the Western Sea, a skeleton of legs, vertebræ, &c.; and if the skull had been found there, it would have been believed that it was a Swedish Polyphemus or Cyclops, who had forged the arms of Vulcan here for the god Mars, or some other Gothic giant. It was carried to Upsala, and all that could be fitted together was united; but when the jointed bones were closely examined, it was a whale or some other large fish, that had run far into the country when the water stood high, and had been compelled to remain when the water fell, as the escape for such animals was then made impossible. It is still in the Nosocomium, in Upsala, under the care of Professor Roberg, M.D., and will serve as a monument of the general flood, and the overflowing of the great ocean over all Europe." This was printed in Upsala. There is, in another edition of this remarkable treatise, printed in Stockholm 1719, a little deviation from the one quoted, as this "evidence" is mentioned as the 12th, and it reads "12 mil.² from the Western Sea" in place of 10.

C. G. Styffe, Phil. Doct. and Librarian of the University, has kindly furnished me with extracts from some letters of the beginning of the last century, which are preserved in the collection of manuscripts in the library of the college at Linköping, and which have reference to the above-mentioned bones, one of which particularly is of great interest, as containing the most complete account that we have of their discovery. It is dated Brunsbo (the episcopal residence

¹ He has here, for the first time, called attention to and minutely described the different form of the baleen in the different species. The species *B. marginata* is known only by the form of its baleen.

² [One Swedish "mil" is equal to 6.6423 English miles.]

at Skara), November the 21st, 1705, and is written by J. Moræus, M.D.,¹ to E. Benzeli-
lius, jun., then librarian, afterwards appointed archbishop, and runs thus:—"I had forthwith
an opportunity of going to Wanga to examine closely ossa gigantis, all of which were not yet dug
up, but only 8 or 9 vertebræ, both shoulder-blades, one side bone, and one broken shin-bone.
The joints of the back bone were each more than 6 inches wide, and fully 3 thick; the side bone was
as thick as the arm of a child 3 or 4 years old; and the shin bone, although it was broken, would
reach me almost to the navel. As soon as the entire skeleton is dug up it will be carried from
here to the cathedral in Skara, and I will then have an opportunity of examining it closer, and
give a minute description of the same;² but we can find from the vertebræ, which generally
are only 2 inches wide, and from the shin bone, that it was an immense body."

The other extract is from a letter from Emanuel Svedberg to the same Erik Benzelius, dated
Brunsbo, 6th March, 1710, and reads:—"The giant bones were sent some 4 or 5 weeks ago,
and have probably reached their destination." It seems from both the letters, as well as from
the treatise quoted, that they were at first considered to be giant's bones. It was not discovered
until after closer examination that they were "of a whale or some other large fish."³ It is not
mentioned who made this determination, but it was probably Professor Roberg or E. Svedenborg.
The former letter informs us more particularly about the time of the discovery, and gives a
very important statement about the number of bones, &c., and that they were to be carried
to the cathedral in Skara, where they were probably kept until, according to the latter letter,
they were in 1710 removed to Upsala, thus about 5 years. Although the digging up of
the bones was not completed when Moræus sent his communication to Benzelius, he mentions
a bone in it that is not now to be found among those that are preserved here. He speaks of
both shoulder-blades, and there is only one here. It seems from this that either a part of the
bones were not carried to Upsala, perhaps were not all carried even to the Cathedral at Skara,
or else that a part of them have in the course of time been destroyed; the first seems to me most
likely. Major L. Gyllenhal presented in 1823, according to the 'Acts of the Royal Academy of
Science' for that year, p. 373, to the academy, a vertebra of a whale, "found in a deeper excava-
tion, in a brook at the village of Wanga, in Westergöthland," probably at the opening of a spring
there.⁴ The late Dr. Marklin told Dr. Styffe that he was informed by Gyllenhal, that the
whale skeleton mentioned by Svedenborg was found in the excavation of a brook near a place
called Glättestorp. They were, according to Svedenborg's treatise, sent to Professor Roberg,
in this place, and were preserved in the Nosocomium in 1719, when the treatise was written.
Professor F. Sundevall has been kind enough to inform me that they remained in the Nosoco-
mium until, in consequence of some considerable repairs being carried on on this building, they
were removed to the Anatomical Museum in 1840-50. Professor Sundevall, after being appointed

¹ He was at that time Medicus Provinciæ for the province of Skaraborg, and became afterwards
City Physician and Assessor in Fahlun, and father-in-law to the Archiator v. Linné.

² I do not know whether Moræus ever gave any more minute description. The 'Catalogue of
the Collection of E. Benzeli-
lius' Letters' does not mention any other letter to him from Moræus than the
one referred to.

³ It should be stated, that whales were always classed with fish until Linné separated them,
and included them in the class of mammalia.

⁴ I have since seen this vertebra, and I am convinced that it belongs to the same skeleton as
that mentioned by Svedenborg.

prefect of this institution, transferred them, in 1848, to Professor Wahlenberg, to be preserved in the Museum for Natural Products in the Botanical Garden. They have since been removed to the Zoological Museum of the University in the Gustavianum, where they are now preserved.

The number of the different pieces of bone is in all 51. Eleven of these are vertebræ, all of which seem to belong to the caudal section, and to follow in succession; 16 vertebral epiphyses, two of which do not belong to the caudal section, but seem to have been united to the lumbosacral vertebræ; the sternum, 1 shoulder-blade, and 22 pieces of ribs. The ribs are all broken, and it has only been possible to restore three, and one of these is rather damaged at the lower end. Besides these there are two pieces that form a part of a rib. It has not been possible to fit any of the other pieces together. The loose vertebral epiphyses, the very porous lower ends of the ribs, the thick and very porous upper edge of the shoulder-blade, the obtuse and porous points of the processes of the vertebræ, and the comparatively small size of the bones, all show that these bones were from a very young specimen; the arcus vertebræ is, however, like the processus, fully developed, and remains united. The bones are not petrified, but are hard and heavy, heavier than they would have been, being very young and very spongy, if they had not remained for a long time in damp and wet earth.

Measurements.

Entire length of the eleven vertebræ, after placing the epiphyses that are present between them, and observing the necessary space for those that are missing			4'	2''
Length of corpus of the 1st vertebra without epiphyses			.	3 $\frac{1}{8}$ ''
"	"	2nd	"	3 $\frac{1}{8}$ ''
"	"	3rd	"	3 $\frac{1}{8}$ ''
"	"	4th	"	3 $\frac{1}{8}$ ''
"	"	5th	"	3 $\frac{1}{8}$ ''
"	"	6th	"	3 $\frac{1}{8}$ ''
"	"	7th	"	2 $\frac{3}{8}$ ''
"	"	8th	"	2 $\frac{3}{8}$ ''
"	"	9th	"	2 $\frac{3}{8}$ ''
"	"	10th	"	2 $\frac{1}{2}$ ''
"	"	11th	"	1 $\frac{3}{4}$ ''
Width of	"	1st in front	.	7 $\frac{1}{2}$ ''
"	"	2nd	"	7 $\frac{3}{8}$ ''
"	"	3rd	"	7 $\frac{1}{2}$ ''
"	"	8th	"	6 $\frac{1}{2}$ ''
"	"	11th	"	4 $\frac{3}{4}$ ''
Height of	"	1st	"	6''
"	"	2nd	"	6''
"	"	3rd	"	6 $\frac{1}{2}$ ''
"	"	8th	"	6
"	"	11th	"	4 $\frac{5}{8}$ ''

Length of processus spinosus of the 1st vertebra	.	.	.	.	.	3''
„ „ „ 2nd „	.	.	.	.	.	2 $\frac{3}{4}$ ''
„ „ „ 3rd „	.	.	.	.	.	2''
„ processus transversi of the 1st „	.	.	.	.	.	3 $\frac{3}{4}$ ''
„ „ „ 2nd „	.	.	.	.	.	3 $\frac{3}{4}$ ''
„ „ „ 3rd „	.	.	.	.	.	3 $\frac{3}{4}$ ''
Distance between the extreme edges of processus obliqui of the 1st vertebra	.	.	.	.	.	3 $\frac{1}{2}$ ''
„ „ „ 2nd „	.	.	.	.	.	3 $\frac{3}{8}$ ''
„ „ „ 3rd „	.	.	.	.	.	4 $\frac{1}{2}$ ''
„ „ „ 4th „	.	.	.	.	.	5 $\frac{1}{4}$ ''
„ „ „ 5th „	.	.	.	.	.	5''
„ „ „ 6th „	.	.	.	.	.	4 $\frac{3}{8}$ ''
„ „ „ 7th „	.	.	.	.	.	4 $\frac{1}{8}$ ''
„ „ „ 8th „	.	.	.	.	.	3 $\frac{1}{2}$ ''
Length of sternum	.	.	.	.	.	6 $\frac{3}{8}$ ''
Breadth of „	.	.	.	.	.	4 $\frac{1}{2}$ ''
Thickness of sternum at the middle	.	.	.	.	.	1 $\frac{1}{4}$ ''
Length of one of the ribs fitted together (probably the 3rd or 4th) along the curve	.	.	.	.	.
on the outer side	.	.	.	.	.	3' 8 $\frac{1}{2}$ ''
of the supposed 4th or 5th	.	.	.	.	.	4'
„ of the longest piece of a rib	.	.	.	.	.	3'
Width of the first mentioned, at the lower end	.	.	.	.	.	3 $\frac{1}{8}$ ''
Length of scapula	.	.	.	.	.	1' 2''
Width of „	.	.	.	.	.	1' 3 $\frac{3}{4}$ ''
„ „ above the base of acromion	.	.	.	.	.	5 $\frac{3}{8}$ ''
„ collum of „ „	.	.	.	.	.	4 $\frac{3}{8}$ ''
Length of acromion	.	.	.	.	.	1 $\frac{3}{4}$ ''
Thickness of the upper edge of the scapula	.	.	.	.	.	1''

We find from these measurements that the vertebræ, even after increasing their length with the thickness of their epiphyses, have a greater width than in the preceding genera. We also find that the distance between the outer edges of the processus obliqui, or the width across them, is likewise greater. In comparing these latter measurements with those of the skeleton of the *B. robusta* in our museum, which, however, has this width greater than in the other *Balænoptera*, and was of more than double the size of the whale in question, we see that the width across the processus obliqui of the caudal vertebræ in the former is in some cases absolutely smaller than in the latter. These proportions distinctly characterise these caudal vertebræ as belonging to a *Balæna*. It cannot be determined which of the series of caudal vertebræ they are, without comparison with a complete skeleton of the same species. There is certainly a great difference between the 2nd and 3rd in regard to the width of the processus obliqui, but they correspond so nearly in regard to the other processes and to the corpus that they seem to be next to each other.¹ The last two (10th and 11th) only are without processus spinosi. This is directed backwards on all, and is on the anterior ones wide and rounded at the point. It is entirely rudi-

¹ The vertebra mentioned as being in the Zoological National Museum in Stockholm was probably placed between this and other vertebræ.

mentary on the 9th. The processus transversi are on all directed forwards and downwards, and are on the anterior wide, with the point obliquely rounded, and with the fore edge concave at the base. There is on the 6th—8th vertebræ a perforation from above downwards, through the base of these processes. The last three are without processus transversi, which are very small on those next preceding. The articulating surfaces for the processus spinosi inferiores are but little developed on the two foremost, and their corpus is transversely concave on the lower side. There are also signs of a longitudinal concavity, though its borders are hardly perceptible.

The sternum is of considerable thickness, is convex on the lower side and concave on the upper, is of a very simple form, and resembles most that of *B. mysticetus*, that is, one of the forms of this which I have seen at the museum in Copenhagen. It is, as will be seen from the measurements, longer than wide, of an oval form, and has the anterior part or manubrium rounded, and with a shallow concavity in the right edge near the point. The hinder end is obtusely pointed, and the lateral edges of the corpus are convex, and have an uneven, somewhat projecting, thinner convexity about the middle. The bone is now of a considerable hardness and firmness, but the thick and porous edges denote that it has been surrounded by cartilage. This bone also shows that it is a *Balæna*.

The ribs are different in form from those of any other whale that I have seen. *B. laticeps* approaches it nearer than any, but they are much larger and wider than in this. The anterior ones are strongly curved, and indicate thereby a broad and thick form of body. One of these, the shortest, is $3\frac{1}{2}$ " long along the curve on the outer side, but has the lower end incomplete, and shows, at its upper end, a great similarity with the 2nd pair of ribs of the skeleton of a young *B. mysticetus* in Copenhagen. This end is strongly bent, compressed, and almost suddenly truncated at the point. The other anterior ones have the upper end, which is the most curved, strongly compressed, rather thin, uneven and obliquely truncated, and with an indication of a collum on the longer of the two, the size of which is stated in the table; they are much thicker at the middle, and wider towards the lower end, particularly the shorter ones, which probably are the 2nd and 3rd pairs, but retain, even there, a considerable thickness, so that their section is oblong-oval. The section is oval of those that are not quite so wide at the lower end; they are not tapering at the extreme lower end, but are almost suddenly truncated, with a somewhat convex and porous area in the middle of the end. There are some rather conspicuous longitudinal shallow furrows on the surface near this, particularly on the inner side. The number of pieces of which the three ribs are fitted together are three for each. This form deviates considerably from that of *B. mysticetus*, in which they are comparatively thin and flat at the lower end, and, with the exception of the first two pairs, somewhat tapering. Neither have these any longitudinal furrows. The ribs seem large in comparison with the other parts of the skeleton. The posterior ribs were apparently somewhat rounded above the middle. The upper end of one of the hinder ribs is not so strongly bent inwards, and is somewhat flattened; the longest piece, 3' long, as stated, belonged to a rib much longer than the longest of the three that are cemented together, and it is probably this piece that Moræus mentions as being a broken piece of a shin-bone, and as reaching him almost to the navel. Even Svedenborg speaks of these bones as "legs" or "shin-bones;" but he does this in a humorous way, which seems to indicate that he ridicules this first determination.

The scapula is one of the bones of the greatest importance for the determination of this whale. We find at once, from its measurements, that it has not the form of the scapula of any

of the preceding genera. Its length and width are almost equal. Both the fore and the hinder edges are concave. It is of an unusual thickness, and differs in this from that of *B. mysticetus*. It also differs from the same in not having a processus coracoideus. Its acromion is thick, directed somewhat downwards, and has had cartilage on the point. A conspicuous spina scapulae extends a little way up from the acromion. The caput forms, where the processus coracoideus would have been, an acute angle directed inwards, on which apparently there was formerly cartilage. It may therefore possibly have had a cartilaginous, rudimentary, or not developed processus coracoideus. This whale approaches, by not having this process, the same group as the "Baleine du Cap" described by G. Cuvier,¹ or *Balæna australis*, Desmoulin. The Nordcaper, or Biscay whale, belongs, according to Eschricht,² to the same group, and it is, therefore, with these two that it should be compared. As the Biscay whale, as far as we know, belongs only to the northern hemisphere, and *B. australis* only to the southern, it seems from this fact alone that it probably is nearest to, if not identical with, the Biscay whale.³ This is my reason for the above-stated opinion, that one of the species of the genus *Balæna* found in Scandinavia may yet exist in more southern seas, and has probably visited our shores in a period less inclement than that in which *Balæna mysticetus* lived among the ice in the seas of Scandinavia. As we may, from what Eschricht says at the place quoted, soon expect from him and Professor Reinhardt a minute and complete description of the Greenland whale and the Nordcaper or Biscay whale, we hope soon to have this question solved. It has been estimated that the place where the Svedenborgian whale bones were found is 330 feet above the level of the sea.⁴

I have mentioned, in the above-quoted discourse, at the meeting of naturalists in Copenhagen in 1860, that I have had the opportunity of examining a vertebra which is preserved in the Edbo church in Roslagen (Sweden), and which belonged to the whale that, according to Radloff's description of the 'Administrative District of Stockholm,' and a citation from the "Rimkrönika," in the same work, was stranded in a bay of the sea at Edbo, in 1489, and was cut to pieces by the inhabitants; this vertebra is, as far as is known, the only remaining part of this skeleton. I have, however, at the same place, mentioned that some whale bones, from an unknown locality, have for a considerable period been preserved in the zoological museum here, among which there is a large shoulder-blade, which, from the similarity of the bone, in regard to the state of preservation with that of the Edbo vertebra, I consider may have belonged to the same skeleton. I supposed, then, that this shoulder-blade was not from a *B. mysticetus*, but from some species nearly related to it; but I have since been convinced that it corresponds in every respect with the shoulder-blade of that species. The form and dimensions of the vertebra show very plainly that it is one of the anterior lumbosacral vertebræ of a *Balæna*, but, as it is without processes, it will be impossible to decide to which species, in the genus, it has belonged. Its length is 10½",

¹ 'Recherches sur les Ossemens Fossiles,' t. v, 1, p. 374, &c.

² 'Oversigt over det K. Danske Vidensk. Selskabs Forhandling,' 1858, p. 225.

³ [I may now add that I have seen the skeleton of a new-born young of the Biscay whale in the Physiological Museum at Copenhagen, presented by the Spanish government, and that it had the ribs of quite the same form as the Swedenborgian whale, but that its scapula was rather broader, probably because it was younger.—1865.]

⁴ Nilsson's 'Föredrag vid Naturforskare-Mötet i Stockholm,' 1851, Forh., p. 60.

its width $15\frac{1}{3}$ " and its height $9\frac{2}{3}$ ", and it must, therefore, have belonged to a whale of unusually large size. If it was from the same animal as the shoulder-blade, it belonged to a *B. mysticetus* that had strayed into the Baltic, but it may possibly have belonged to a North Caper.¹

The case is similar with the vertebra that Professor C. J. Sundevall, according to 'Ofversigt af Kongl. Vetensk. Akad. Förhandlingar' for 1861, p. 157, exhibited in that academy on 17th April, 1861. It is one of the caudal vertebræ provided with processes of a large *Balæna*. It was found in the ground in digging at the Ladugårdsland,² in Stockholm, and is preserved at the National Zoological Museum there, where I have had the opportunity of seeing it. It is not known whether it had been carried to the place where it was found or not.

Professor S. Lovén, in his remarks on Crustaceæ³ found in Wettern and Wennern, mentions a rib preserved in the Orberga church, in Ostergöthland, near Wettern, which is said to be from a whale that, according to an old tradition, was stranded in the vicinity. I have received some information in regard to this rib through Dr. H. Widegren. It is only a part of a rib, about 3' long; its circumference, at the lowest end, is $6\frac{1}{2}$ ". It is of a light grey colour, and very well preserved, so that its surface, on the inner side, and below partly on the outside, is smooth and shining. It is somewhat decayed by the air on the upper part of the outside; its appearance also indicates that it has not been in the ground for any great length of time, but that it may have been in the water for a considerable period. As both the upper and the lower end are missing, it is difficult to say to what species of whale it belongs. Its small calibre and more rounded form, and its nearly equal width at both ends, seem to show that it is not one of the anterior ribs, but probably one of the middle ones, as it is rather strongly curved. It approaches, by its rounded form, most to the Swedenborgian whale; its upper end denotes that the rib has been more compressed and bent there than in the *Balænoptera*. It probably belonged to a *Balæna*, and possibly to the same species as the Swedenborgian whale.

Linné mentions, in his 'Westgötha Resa,' p. 19, that there had been some "shin-bones of 3 feet in length in Forshem church;" but they were not there when he visited the place. These "shin-bones" were probably pieces of ribs of some whale.

An os petrosum of a "large species of whale" was, according to Professor A. Retzius,⁴ found in the ground near Kinnekulle, in Westergöthland, in 1853.

It is not known to what species the whale belonged that, according to E. Alrot's description of Gestrikland, was stranded at Nätra, in Angermanland, in 1658. Part of the bones were, at the time when the description was written, preserved in the parish of Gefle; but I am informed that they were destroyed during the fire in 1728.

¹ As the Nordcaper is described by older authors, for instance Martens, as smaller than the Greenland whale, it does not seem probable that it has belonged to that species.

² One of the suburbs of Stockholm.

³ 'Ofversigt af Kongl. Vetensk. Akad. Förh.,' 1861, p. 305.

⁴ Id., 1854, p. 111.

2. *B. MYSTICETUS*, Linné. The Greenland whale.

Ribs 13 pairs, 1st pair not forked,¹ and, as well as those nearest succeeding, flat at the lower end. Vertebræ 54—55. Cervical vertebræ all united. Scapula with both acromion and coracoid process. Zygomatic process of the superior maxillaries and the orbital parts of the frontal bones very narrow and directed much backwards, and the temporal bones as well as the lateral parts of the occipital bone extending further back than the occipital condyles. Head very large, being about one third (more or less) of the entire length of the body.²

- BALÆNA MYSTICETUS*, Linné. Fauna Suecica, p. 16.
 — — — *O. Fabricius*. Fauna Groenlandica, p. 32.
 — — — *Lacépède*. Histoire Naturelle des Cétacées, p. 1.
 — — — *W. Scoresby*. An Account of the Arctic Regions, vol. i, p. 449, 1820.
BALEINE DE GROENLAND, *G. Cuvier*. Recherches sur les Ossemens Fossiles, t. v, 1, p. 375, pl. xxv, figs. 9—11; pl. xxvi, fig. 8.
BALÆNA MYSTICETUS ARCTICA, *H. Schlegel*. Abhandlungen aus dem Gebiete der Zoologie und Vergleichenden Anatomie, 1 H., p. 36.
 — — — *J. E. Gray*. Zoology of the Voyage of the Erebus and Terror, parts iii—v, p. 47, pl. i, fig. 4.
 — — — *S. Nilsson*. Skandinavisk Fauna, Däggdjuren, p. 642.

The size, and particularly the length, of this whale has often been exaggerated. According to Scoresby, it scarcely reaches 70' (English). The greatest certain length that he has ever heard of is 67'. Among 322 specimens that he has seen caught there was none exceeding 60' in length. Scoresby also is of opinion that it has not been larger in former times. Its greatest circumference is larger than half its length, but is variable; it was 35' in a specimen about 65' long. He gives among others the following measurements of a specimen 50' (Eng.) long.

¹ The *Bal. mysticetus antarctica* of Schlegel, from Japan, which he considers to be the same species as *B. australis*, has, according to him, 15 pairs of ribs, of which the 1st pair are forked, both at the upper and the lower end.

² The osteological characters are partly derived from observations on the above-mentioned skeleton in Copenhagen, which was mounted under the direction of Professor Eschricht. I have also there had the opportunity of examining a younger skeleton. I have noted but little in regard to these skeletons, in expectation of the treatise by Eschricht and Reinhardt already alluded to, which will throw a new light upon this part of the Cetology. The former skeleton is now in Brussels, but another one of similar size was being put up in Copenhagen at the time of my visit last summer. This one, like the others, is from Greenland.

	English measure.
Length of head	15' 6"
Width of „ below	9' 6"
Distance from point of snout to pectoral fins	18'
Greatest circumference	34'
Circumference near caudal fin	6' 8"
Length of pectoral fin	6' 4"
Width of „	4'
„ caudal fin	17' 6"
Length of longest baleen	11' 2"

We find from this that it is of a thicker form of body than the *Balaenoptera*. Its greatest thickness is a little behind the pectoral fins or about the middle of the body. The fore part of body is but slightly tapering, and the head is obtuse in front. The body tapers considerably backwards, and is of a conical form until somewhat before the caudal fin, where it is almost square, in consequence of its having four longitudinal ridges—an upper one, a lower one, and one on each side. The upper one of these is the largest,¹ and extends backwards almost over the middle of the entire caudal fin. The upper border of the head, seen from the side, has, a little in front of the angle of the mouth, a rather large obtuse prominence, on which the nasal openings are situated. In front of this it is strongly curved downwards. The mouth is also strongly arched in about the same direction as the upper margin of the head, with the strongest curve in front. The lower side of the head is flat and but slightly convex. The lower jaw is considerably wider than the upper one, and even longer, with lips about five or six feet high, which surround the sides of the upper jaw and the baleen when the mouth is closed. The margins of these lips descend somewhat obliquely to the point of the lower jaw, where at the junction they are quite low. They are low also at the angles of the mouth, but in other parts they are of almost equal height. There are a few small and scattered white hairs on the point of both jaws. The eyes are very small and are immediately behind and a little above the angles of the mouth. The blowers are two longitudinal openings 6"—8" long. The orifices of the ears are so small that Scoresby did not discover them until after the skin was removed. Fabricius says that they are of the size of a quill. The head, when seen from below, seems wider and more blunt than when seen from the sides, and the lower jaw has a shallow depression in front. The navel is, according to the drawing given by Scoresby, somewhat behind the middle of the body, and the vent is farther back, somewhat behind the beginning of the posterior third of the body. The pectoral fins, the length of which is about $\frac{1}{3}$ of the length of the body, are just behind the anterior third of the same, and seem rather short, but are wide and obtuse. Their hinder edge is rounded, and more convex than the fore edge. There is a small hollow on this edge, behind their short and almost blunt point. The caudal fin is very large, and its width sometimes exceeds $\frac{1}{3}$ of the length of body. Its hinder edge is convex in the middle, and there is, as usual, a deep notch in this convexity. It is said sometimes to reach a width of 26'. The long and rather thick blades of baleen, which in the middle of the upper jaw sometimes reach a length of 15', are not wide at the base, and decrease very gradually in width towards the point, retaining about

¹ It seems, therefore, here somewhat compressed, according to Scoresby's figure, because the height is greater than the width.

the same thickness from one end to the other. Their sides are even, with the outer edge slightly convex, while the inner edge is concave. The fibres on its inner edge are very fine and of a black colour. The internal fibrous layer, of which these fibres form a continuation, occupies only a small part of the substance of the blades, and is of a fine uniform texture. The harder and closer layer, which covers the fibrous one and forms the greater part of the substance, is generally blackish, and is externally covered by a polished grey or greyish-black enamel (J. E. Gray). They decrease in length towards the anterior as well as the posterior part of the upper jaw, and both the hinder and the fore ones are very short. They are less wide at the base than those of the *Balænoptera*, the greatest width being 10"—12", a natural consequence of the upper jaw-bones being narrower than in the latter, but they are thicker.¹ Scoresby counted more than 300 transverse series of whalebones on each side. The *colour* is above, on the greater part of the lower jaw, and on the pectoral fins and the caudal fin, black. The front part of the lower jaw, sometimes a small part of the point of the upper jaw and a part of the belly, are white. The eyelids, the tail before the caudal fin, and the axillæ, are grey. The older specimens have sometimes white spots.

The skeleton is chiefly remarkable for the length of the head and ribs, for the long lateral processes of the lumbosacral vertebræ, for the vertebræ generally being short, for the size of the scapula and humerus, and for the large, but short and wide, lower arm-bones. The head is of a comparatively slender structure, although each bone by itself seems large and massive in consequence of its colossal dimensions. The skull is remarkable for the beak or facial region being elongated, narrow, and strongly arched, and about three times as long as the hinder part of the skull. Moreover, the posterior part of the skull is not wide in consequence of the narrow processus zygomatici of the superior maxillaries and the orbital parts of the frontal bones being directed strongly backwards. The posterior margin of the occipital bone has a rather deep concavity, so that the lateral parts of the occipital bone as well as the temporal bone extend further back than the articulating condyles of the occipital bone. The temporal bones are dilated at their outer end, both backwards at the processus articularis and forward at the processus zygomatici, and are there almost irregularly square. Each frontal bone forms a projecting point above the nasal bone. The intermaxillary bones from above do not seem much wider than the superior maxillaries. The palate bones on the lower side of the skull are short and do not extend as far as the base of the nose. The cleft in the hinder edge of the superior maxillaries is very narrow and deep.² The lower jaw-bones are large, but are of such an immense length that they do not seem thick when compared with those of the *Balænoptera*. They are strongly curved, and a slightly elevated ridge is the only indication of a processus coronoideus. The lower margin is somewhat convex, particularly in front of the angulus. Its greatest height is above the condylus. The lower jaw-bones were about 22' long along the curve on the outer side, and 2' 4" high at the condylus on the first-named skeleton in Copenhagen, which seems to have been about 50' long. One of a pair of lower jaw-bones, that for a long time have been preserved in the hall of the Royal Scientific Society here, is 18½' long along the curve, and 21" high at the place where the processus coronoideus is indicated, and 11" at the middle. I counted 54 vertebræ

¹ The whalebone of the Greenland whale is considered to be the best, as being more even, longer, and of a finer structure.

² These characters of the skull are from G. Cuvier.

on the skeleton at Copenhagen previously mentioned, viz., 13 dorsal, 12 lumbosacral, and 22 caudal. All the cervical vertebræ were ankylosed, and there was no suture between the atlas and axis. It seems that the atlas has an upper and a lower ramus in the lateral process, and, according to G. Cuvier's description of the cervical vertebræ of "Baleine du Cap," it appears that he considered the latter to be formed by a junction of the same ramus of the 1st—3rd vertebræ. But as the atlas in the preceding genera, where it is separate from the axis, has not any such lower ramus, but the axis, on the contrary, has it strongly developed, it seems more correct to consider this ramus in *Balæna*, at least in *B. mysticetus*, as belonging only to the axis, which is united with the atlas, which otherwise would be without such ramus. The 3rd—6th cervical vertebræ are very small and thin. The anterior lumbosacral vertebræ are without a ridge on the lower side of the corpus. The first of these has the corpus 11" wide. The processus transversi of one of these vertebræ were $21\frac{1}{2}$ " long. The processus spinosi inferiores were 9, but should be, according to Eschricht and Reinhardt, 14 in number. The body of a caudal vertebra, with short processes, preserved in the zoological museum here, and which seems to be from this whale, is $7\frac{1}{4}$ " long, $1' 1\frac{1}{2}$ " wide, and $1' 2\frac{1}{4}$ " high. The processus spinosus is 5" long. The sternum seems to be variable in its form. It is generally simple, without wing-shaped lateral processes, and is not formed like a cross. The form of the three sterna which I saw in Copenhagen was different in all, although it was in all more or less oblique. One was formed like a heart, with the obtusely pointed end directed backwards and the wider end forwards, and with a small hollow about the middle of the sides for the attachment of the first pair of ribs. The 2nd resembled the first, but had no hollow in the fore edge, and had the hinder end but slightly narrower than the fore one, and obliquely truncated with a small hollow. The 3rd and smallest was rounded before and obtusely pointed behind, and had its sides somewhat projecting and uneven at the middle, presenting an indication of the form of a cross. The length was generally greater than the width. The largest (on the skeleton) was $2' 2''$ long. The ribs are thick and large, long and strongly curved, and the anterior ones are of a considerable width, and flattened at the lower end. The upper end of the anterior ribs is strongly compressed and bent inwards. The lower end is on the first two, particularly on the first, wider than the rest of the rib. The extreme point, however, is not dilated even on the first pair. The 7th—10th pairs have a longer and more conspicuous collum than the other ribs, this collum being so long on the 8th and 9th pairs that its capitulum extends almost to the corpus vertebræ and seems to be united to it by ligaments.¹ The scapula seems to be a little variable, partly in its form, as it sometimes appears to be narrower,² and partly in regard to the processes, as it sometimes has the processus coronoideus longer and sometimes shorter, and sometimes it has the acromion directed straight out and sometimes bent upwards. Its hinder and fore edges are concave, sometimes only at the collum. The spina scapulæ is only slightly indicated close to the acromion. The largest scapula that I have seen was 4' long and 4' 7" wide; the os humeri is short and very wide at its upper end, and has there a strongly projecting tuberculum majus, the upper edge of which is almost equal in height with the upper edge of the caput. This is inside of the tuberculum majus, and is directed obliquely inwards. It is very large and hemispherical. The bone was 2' long and 1' 4" wide across the caput on the before-mentioned skeleton. The radius and ulna are wide. The olecranon is wide and rising obliquely, and at the point obliquely truncated. The radius

¹ From observations on the skeleton at Copenhagen.

² Fig. 8, pl. xxvi, in G. Cuvier, in 'Recherches,' &c., t. v, 1.

was 2' 4" long, and the ulna 2' 5" to the point of the olecranon. The length of the former was only $3\frac{1}{2}$ times its width at the middle, and that of the latter about $6\frac{1}{2}$ times its width. The ulna is thus considerably narrower than the radius. The hand is broad, and the number of fingers 5.

It is, according to Scoresby, free from Cirripeds.

The Greenland whale, like the Narwhal, belongs to the northern parts of the Polar Sea, and appears on the coast of Greenland only during the winter, and then generally not south of 65° North latitude. According to Martens, in his time (1671) it inhabited the western part of the Polar Sea, in the spring about Jan Mayen and Greenland, but during the summer the seas east of Spitzbergen. It remains near the polar ice, and does not generally appear out of the polar region, except when some single specimen may have strayed further south. It does, therefore, not strictly belong to the existing Scandinavian fauna; but during a former period, when this fauna was a North-polar fauna, it probably normally existed here, as is proved by the remains of its skeleton that are now at times dug out of the ground. A scapula of a young specimen was, according to Nilsson,¹ found in the ground in digging out a milldam at Gammelstorp, in the parish of Farstorp, in the district of Western Göinge, in Scania, five miles (Swedish) from the sea. A whale was stranded, according to Retzius,² near Ystad, in Southern Scania (Sweden), in the early part of last century, of which some of the bones were preserved in the Museum in Lund in the time of Retzius. Nilsson, in 'Skandinavisk Fauna,' has given more particulars of these bones (under the name of *B. prisca*), and states that they were found in the sand near Ystad, in 1722; he has also given an outline figure of the scapula. This has all the characters of the scapula of *B. mysticetus*. It is 3' 4" long, and 3' 9" wide, and the processus coracoideus is conspicuous, although rather short. The same author³ has since stated that this shoulder-blade, as well as some ribs of the same skeleton, preserved in the Museum at Lund, belonged to a *B. mysticetus*. We have, therefore, in this an evidence that this whale, during a comparatively recent period, has strayed into the Baltic, and that it has been stranded on a Scandinavian coast. This would seem to strengthen the probability that the whale which was stranded at Edbo; in Roslagen, in 1489, was also of this species, more especially as the before-mentioned vertebra, by its size, seems to afford grounds for such an opinion. A scapula, two vertebræ, and two ribs, of *B. mysticetus*, are preserved at Skokloster, in Upland (Sweden), and are said to have been found at Lyckas, in Smaland; their mouldered appearance seems to indicate that they have been in the ground for a considerable length of time. I have, in my before-quoted discourse, at the meeting of naturalists in Copenhagen, in 1860, mentioned a whale bone, which, with some others, is preserved in the Cathedral of Wisby,⁴ and of which Mr. P. A. Säve has been kind enough to furnish me a figure. This bone is probably a lateral process of a lumbosacral vertebra of a *B. mysticetus*. It is 1' 7" long, although it is somewhat mutilated at the point; it is thus too

¹ 'Fauna, Däggdjuren,' p. 645. This bone is here mentioned under the specific name *Balæna prisca*. It is, according to Nilsson, of the same species as another scapula preserved in Lund, which is of *B. mysticetus*, viz., the one found at Ystad, although the former is incomplete and somewhat smaller.

² 'Fauna Suecica,' p. 50.

³ 'Öfversigt. af Kongl. Vetensk. Akad. Förh.,' 1860, p. 105.

⁴ These bones are mentioned by Linné in his 'Oländska och Gotländska resa,' p. 165.

large to have belonged to any species of the preceding genera. It is not known where it was found, but probably in some locality near the Baltic. More bones of this whale have probably been found in Sweden, of which no note has as yet been taken.

This whale has, as is well known, been the object of the whale-fisheries that for centuries have been carried on with so great profit. The Basques, and probably even the French in the vicinity of the Bay of Biscay, had already before the twelfth century¹ occupied themselves with whale-fisheries, and finally extended them to Newfoundland, and perhaps to South Greenland. Although they principally devoted their attention to catching the Nordcaper in the Northern Atlantic, it is not impossible that at Greenland they also caught the Greenland whale. The Dutch and English commenced, in the sixteenth and seventeenth centuries, to devote their attention to whaling, having been instructed by the Basques; the consequence of this was that the latter were finally excluded from the pursuit. After the Dutch in the sixteenth, and Hudson in the seventeenth century, had discovered Spitzbergen, and the abundance of whales in that vicinity, the attention of the whalers was soon drawn to these regions, and the fisheries there were very profitable in the seventeenth and eighteenth centuries, and sometimes in the nineteenth.² The vessels of other nations, Russian, French, Danish and Norwegian, Swedish, and those from Hamburg and Bremen, participated in this. The consequence was that the whales were almost exterminated in the seas of Spitzbergen, and the whalers commenced, as early as the first part of the eighteenth century, to leave this sea for that of Greenland and Davis Strait. Since the whale-fishery there has gradually decreased, it is now carried on by only a small number of vessels, mostly English and American, but it is not profitable, unless they succeed in finding places that have never before been visited. The whale-fisheries of the Danish colonies in Greenland have, according to Rink,³ decreased considerably since 1827. Six whales were caught during 1849-51, none in the three succeeding years, and only three during 1855-56. The Greenland whale is caught for its blubber and baleen. The former forms a layer some 8"—20" thick (varying in the different parts of the body), which surrounds the body under the skin. It amounts, according to Melchior, in a large whale, from 140 to 170 barrels. The weight of the whalebone in such a whale is, according to Scoresby, sometimes $1\frac{1}{2}$ ton. It is generally shy and timid, and seldom makes resistance when attacked. When struck by the harpoon it generally rushes towards the bottom, and keeps under water as long as it can—generally thirty minutes, sometimes an hour and a half (Scoresby)—and is, when it returns to the surface of the water, very much weakened, the more so the longer it has been under water. It then receives one or more harpoons, rushes down again, but comes up in a few minutes. It is then pierced with lances, and efforts are made to hit the heart. When death approaches, it generally spouts blood from the blowers, colouring the water with blood for some distance. The belly side turns up as soon as the whale is dead, and it is then speedily towed to the vessel which is near at hand, and made fast to its side; after the blubber and baleen have been taken from it the remainder of the body is let go to the bottom. The great difficulties in securing and preparing the skeleton on such occasions, unless there has been an opportunity

¹ Lacépède, 'Hist. Nat. des Cétacées,' pp. 75 and 76. Scoresby, 'An Account of the Arctic Regions,' &c., contains a detailed history. F. Cuvier, 'Hist. Nat. des Cétacées,' p. 43.

² Scoresby caught several whales near Spitzbergen in the earlier part of this century. He took part in catching 123 whales there during a period of eight years.

³ 'Grönland, Geographisk og Statistisk Beskrevet,' 1 Bd., p. 207.

of towing the whale ashore, have probably been the reason that an entire skeleton has never been preserved during the fishery.

According to Scoresby, its copulation has often been observed, in the latter part of the summer, to take place in an upright position, with the head out of the water.¹ After a pregnancy of 9—10 months it brings forth only one young, in February or March, according to Scoresby's opinion. The mother shows the greatest care of her young, and risks her life for its protection in a similar manner with the hump-backed whale. The young is said to be from 10'—14' long when it is brought forth. It probably follows the mother until its baleen is sufficiently developed to enable it to procure its own food. Scoresby estimates that at the age of 12 years it has the whalebone 6' long, and that it is full-grown at the age of 20—25 years. It lives exclusively on such smaller sea animals as abound in the North Polar Sea, as Pteropods of the genera *Limacina* and *Clio*, and smaller Crustacea, principally Copepods of the genus *Calanus*; Stomatopods, such as *Thysanopoda*; possibly even smaller Coelenterates, &c. &c., but not on fish. They remain generally only a couple of minutes at the surface of the water to breathe, during which time they spout eight or nine times, and they then stay under water five to ten minutes, sometimes fifteen or twenty (Scoresby), when they procure their food. The long cessation of inhaling air is the cause of their becoming so weakened when they return to the surface after having been struck by the harpoon; and when they swim and exert themselves much their blood sometimes becomes so impure that the whole body has a nauseous odour (Martens). The air that they exhale is of a disagreeable odour. Their hearing and sight are said to be less acute above water than when they are under water. The *Orca gladiator* and *Schlegelii*, or possibly only the former, are, except man, their worst enemies. They do not generally wander about in herds, although several may sometimes be seen near each other when they find some suitable place, for instance, in bays covered by thin ice, that they can raise and break when they are going to breathe; they generally appear alone, or sometimes one or two together.

Note.—The North Cape or Biscay whale, which also belongs to the genus *Balæna*, formerly approached the coasts of Scandinavia, but is said to have now gone further south, and does not appear here. The description of this species by Professors Eschricht and Reinhardt was expected, as I have previously remarked, and, although delayed by the lamented death of the former, we may still hope to be gratified with this description by Professor Reinhardt.

Addenda.

It may be added to the statements of the habitats of the Beluga that V. Baer² has stated that it exists in the White Sea, and is caught by the Samojedes, at Golaja Koschka, on the

¹ The female of *Phocæna communis*, the skeleton of which has been described, was shot during copulation, which, according to the statements of the man that shot her, took place in a similar manner with that of the Greenland whale. Nilsson mentions in 'Skand. Fauna, Daggdj.,' 1st edit., p. 409, a corresponding observation of two "stora hvalars" pairing in the sea off Nordland in Norway.

² A. Th. v. Middendorff's 'Bericht über die Ornithologischen Ergebnisse der Naturhist. Reise in Lappland,' 1840, p. 76. ('Beiträge z. Kenntn. des Russ. Reichs.,' Bd. vi, 1.)

eastern shore of that sea, not far from the mouth of the river Dwina. Dr. A. J. Malmgren, of Finland, says that he has seen it in July, in 1856, in great numbers, in the White Sea, between Kem and Solowetzkoï.¹ It may also probably exist in the sea near the coasts of East Finmark.

I will add to the description of the skeleton of *Balænoptera rostrata*, preserved here, that its lingual bone is of the usual form peculiar to the species. Its corpus and cornua posteriora or majora have the upper side concave and the lower convex, and the transverse measurement is much larger than the longitudinal. The corpus is 6" long, and the distance between the points of the hinder cornua or the width of the lingual bone is 1' 5". The corpus projects forwards with a narrow notch, 1¼" deep, and has behind two obtuse tubercles, which are but slightly directed backwards. At the sides it is united with the hinder cornua, without any limit or sutures. These are rather long and tapering towards the point, and directed almost straight out from the sides of the corpus, so that their hinder edges are almost linear, although slightly curved. Its anterior edges slope somewhat backwards. The anterior cornua, which are large and in a straight line 10¼" long, are irregularly curved, with their fore edges concave and their hinder ones convex. At the inner end, which is somewhat the thickest, they are each united by a long cartilage to the projecting part of the corpus, at the sides of the notch. There are cartilaginous processes at the external end of the anterior as well as of the posterior cornua. The anterior cornua, with their processes, are, in the fœtus, united between the lateral parts of the occipital bone and os petrosum (Eschricht), and in older specimens probably united only to the former bone.

¹ "The sea there was literally thick with *Limacina arctica*, *Clio borealis*, *Cydippe*, *Beroë*, *Medea*, &c., *Ctenophoræ*, and (*Medusæ*" Malmgren in letter).

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Fig. 5.



Fig. 7.

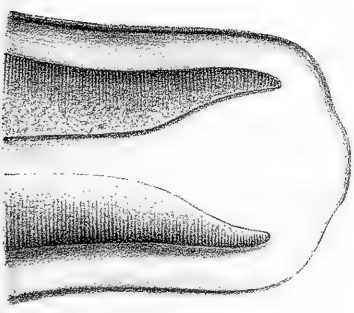


Fig. 6.



Fig. 1.

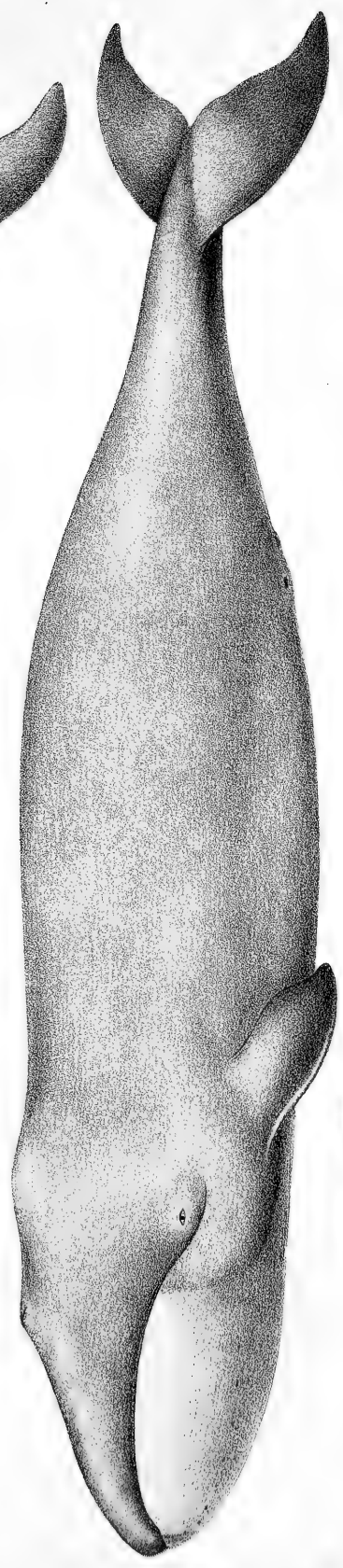


Fig. 2.

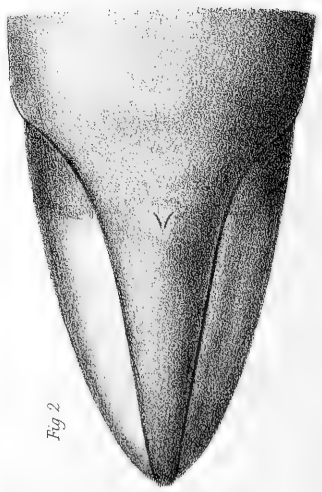


Fig. 4.



Fig. 3.

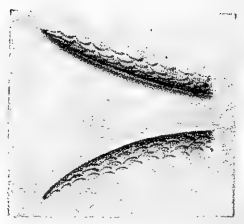




Fig 1

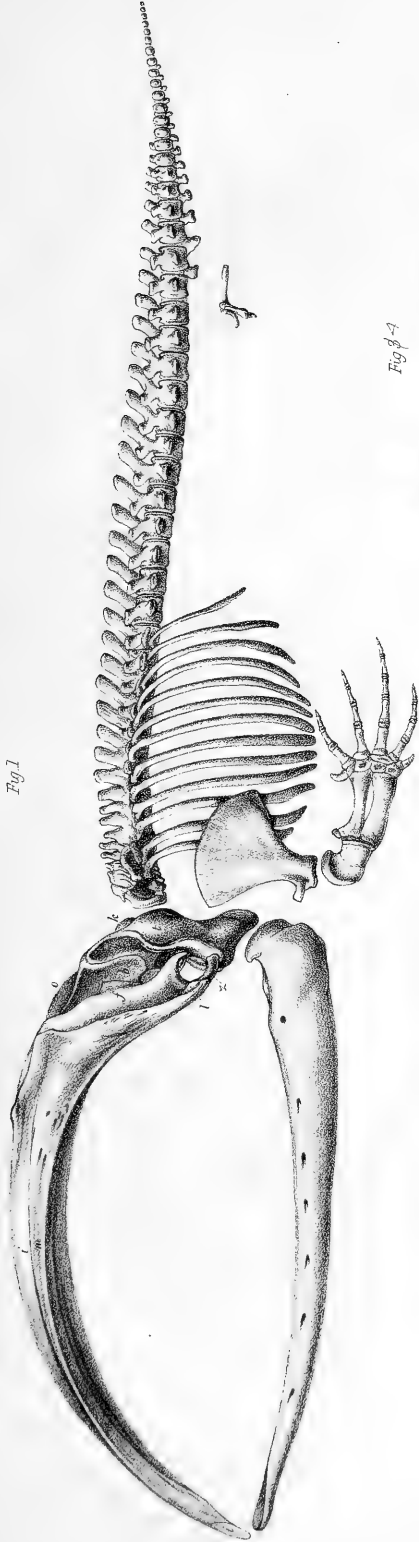


Fig β-4

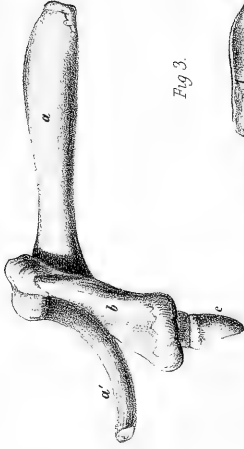


Fig 2

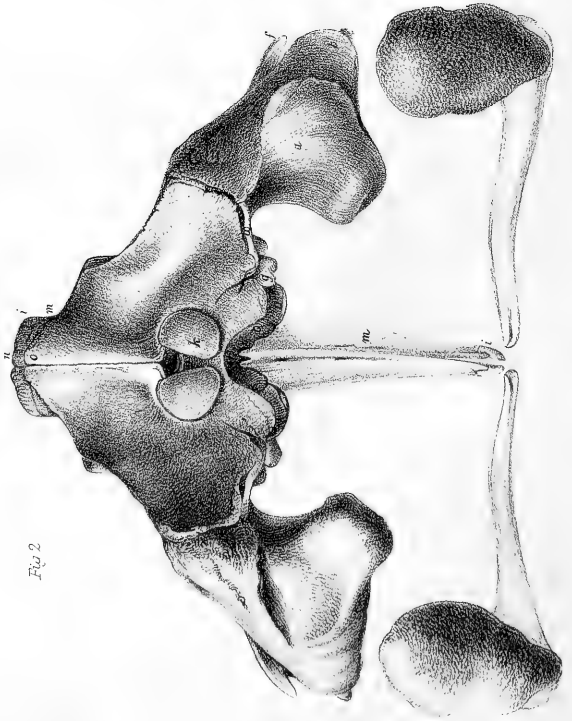


Fig 3

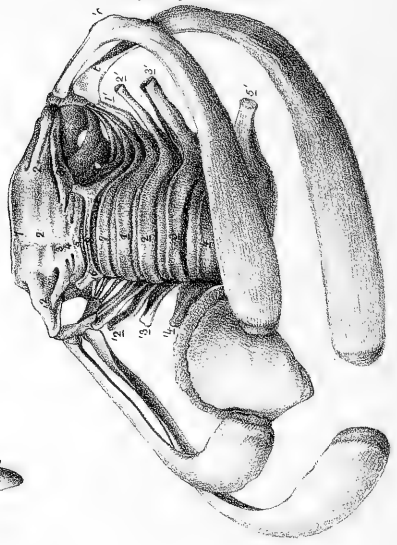
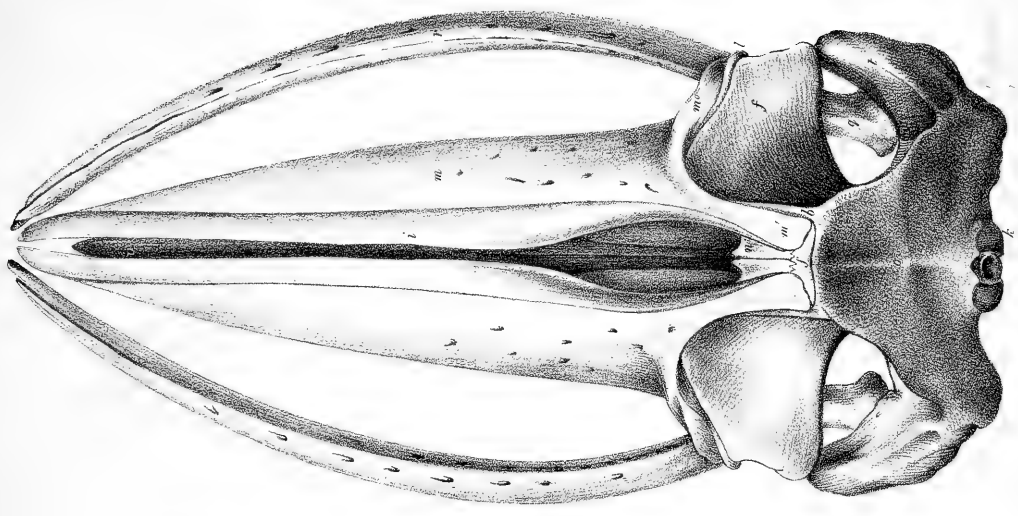


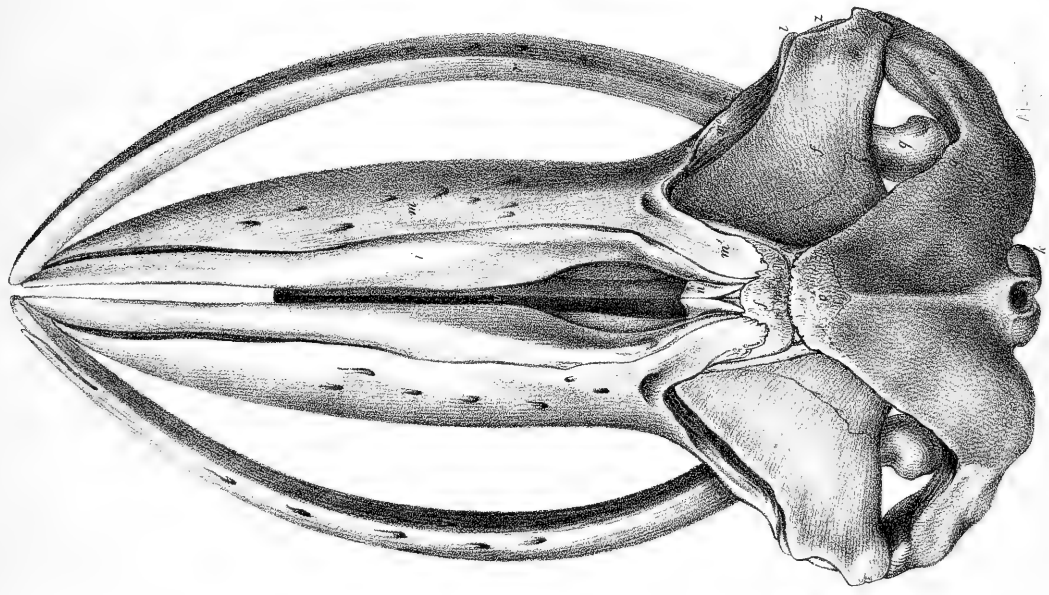


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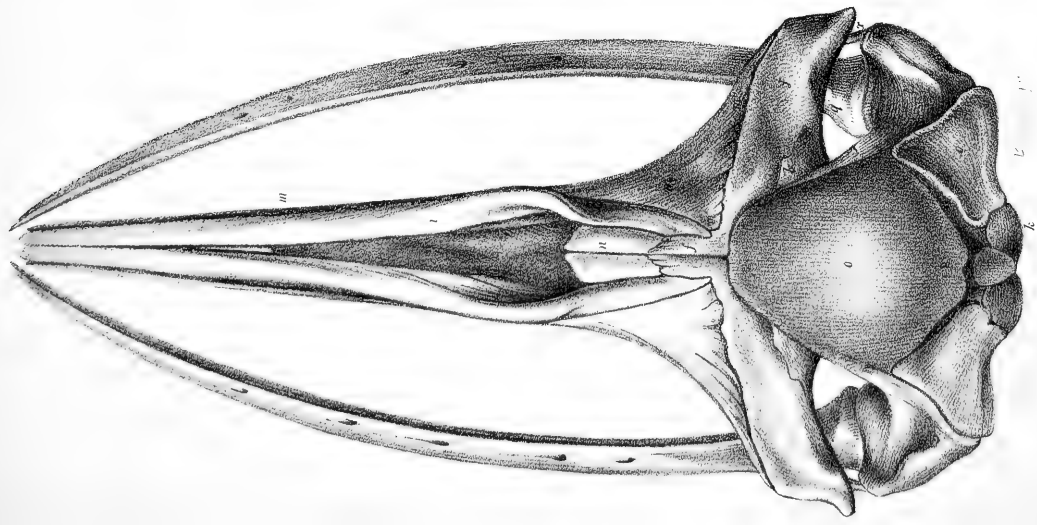


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Fig. 2.



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Fig. 1

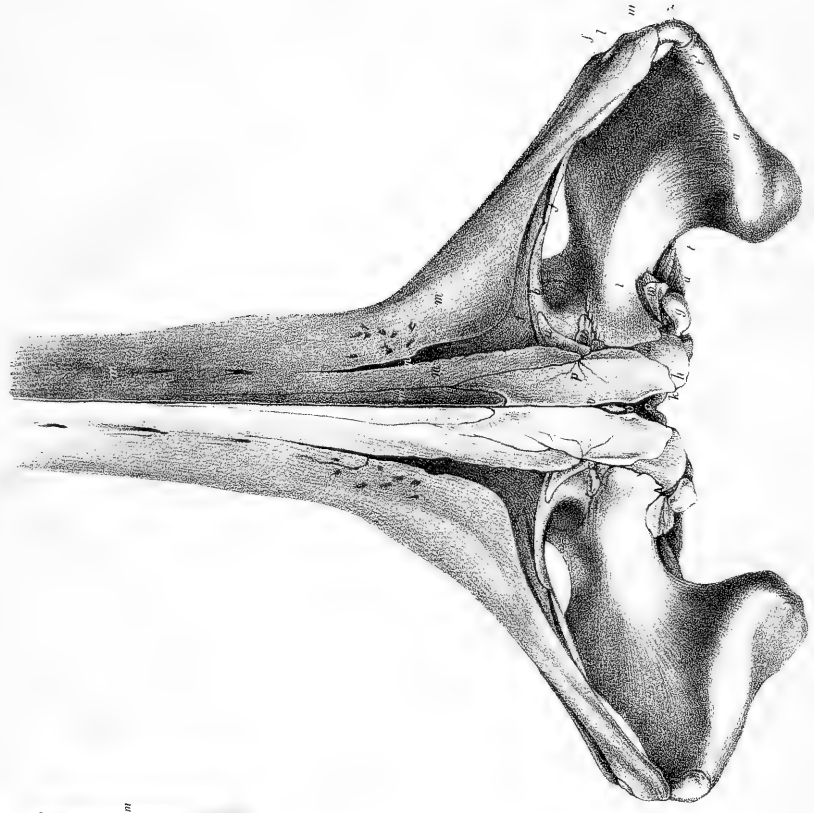


Fig. 3

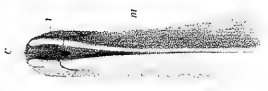


Fig. 2

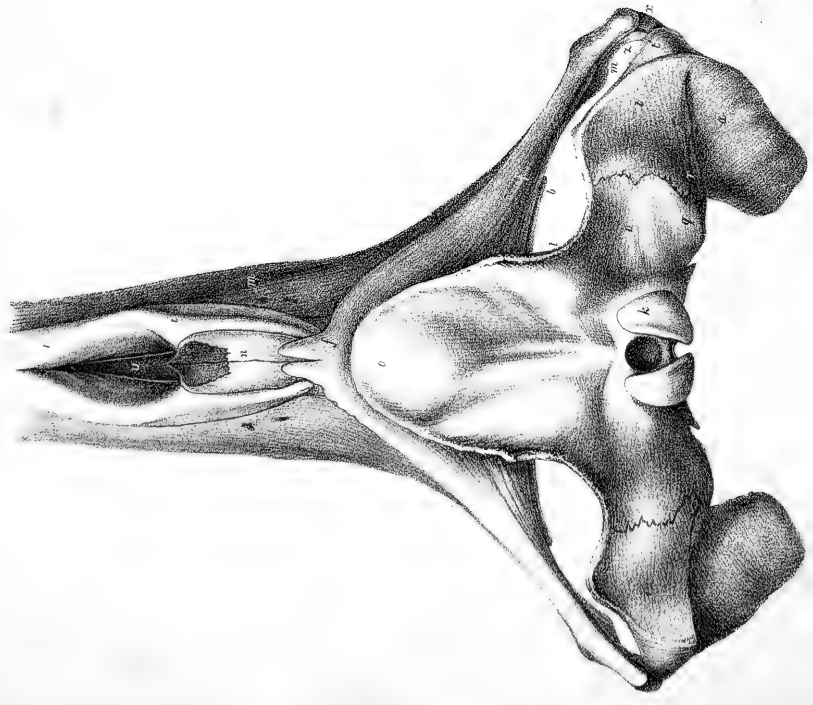




Fig. 1.



Fig. 3.



Fig. 2.

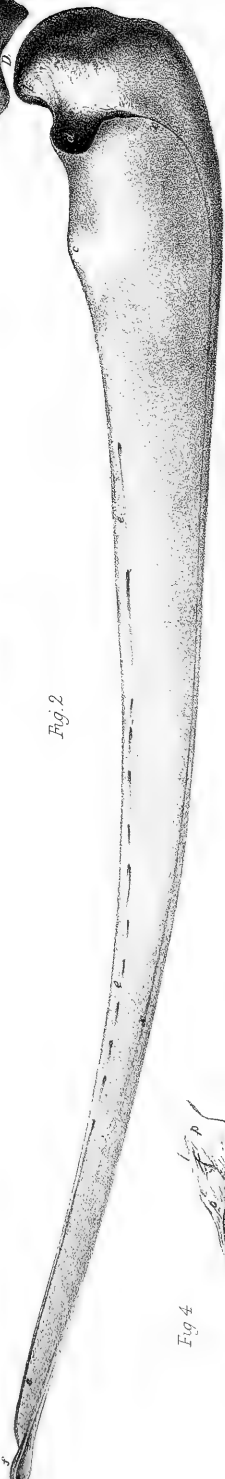


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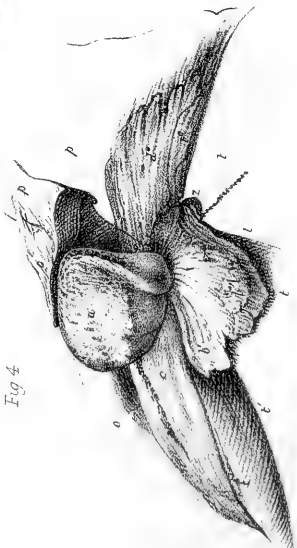
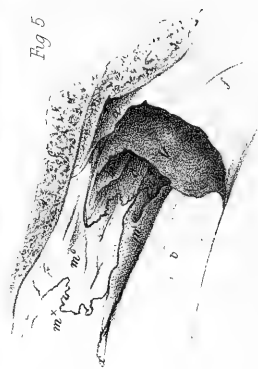


Fig. 5.



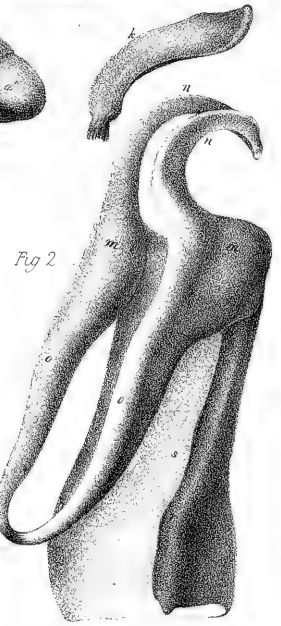
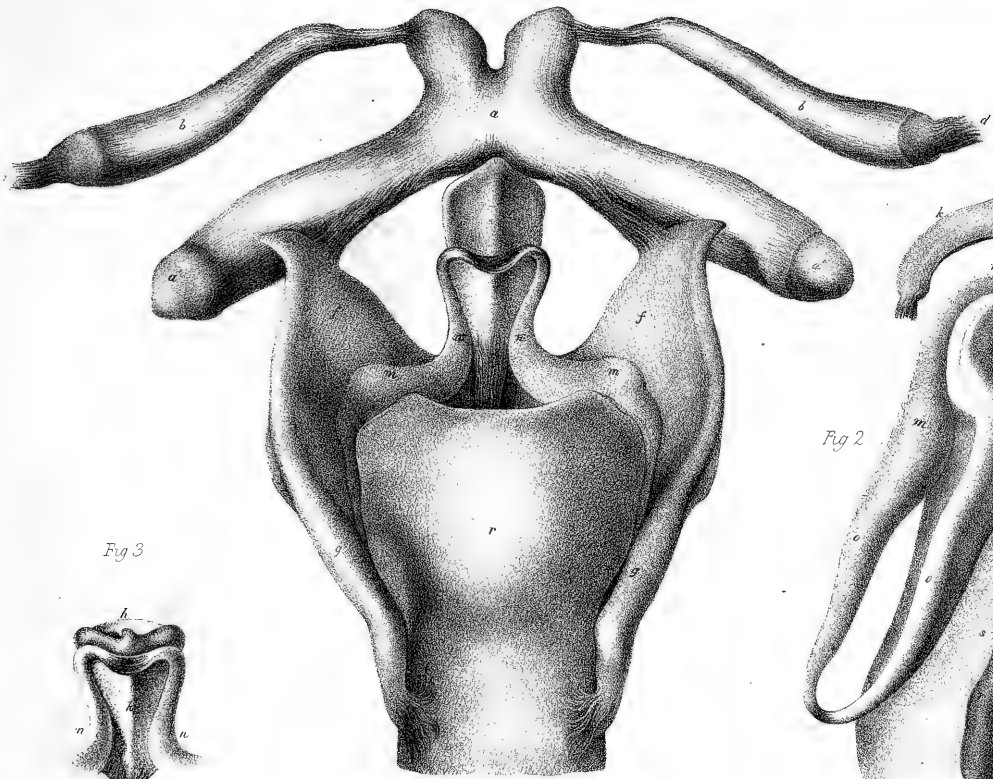


Fig 3



Fig 4

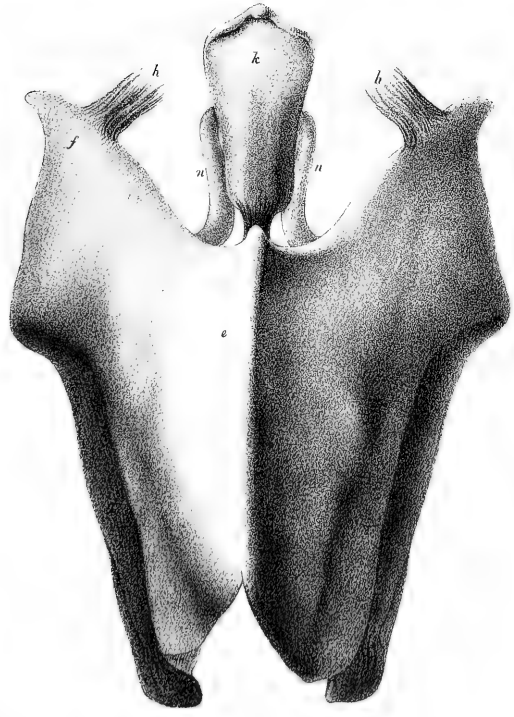
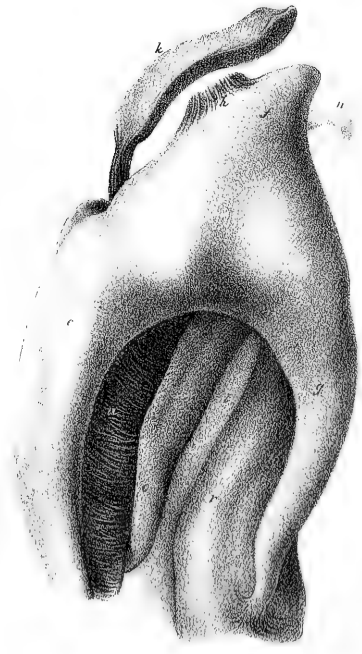
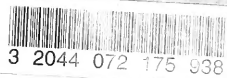


Fig 5









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