The Sei Whale (Balænoptera borealis).

By Roy Chapman Andrews.

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NEW SERIES, VOLUME I, PART VI.

MONOGRAPHS OF THE PACIFIC CETACEA.

II. — THE SEI WHALE (*BALÆNOPTERA BOREALIS* LESSON).

1. HISTORY, HABITS, EXTERNAL ANATOMY, OSTEOLOGY, AND RELATIONSHIP.

BY ROY CHAPMAN ANDREWS.

PLATE XXVIII.

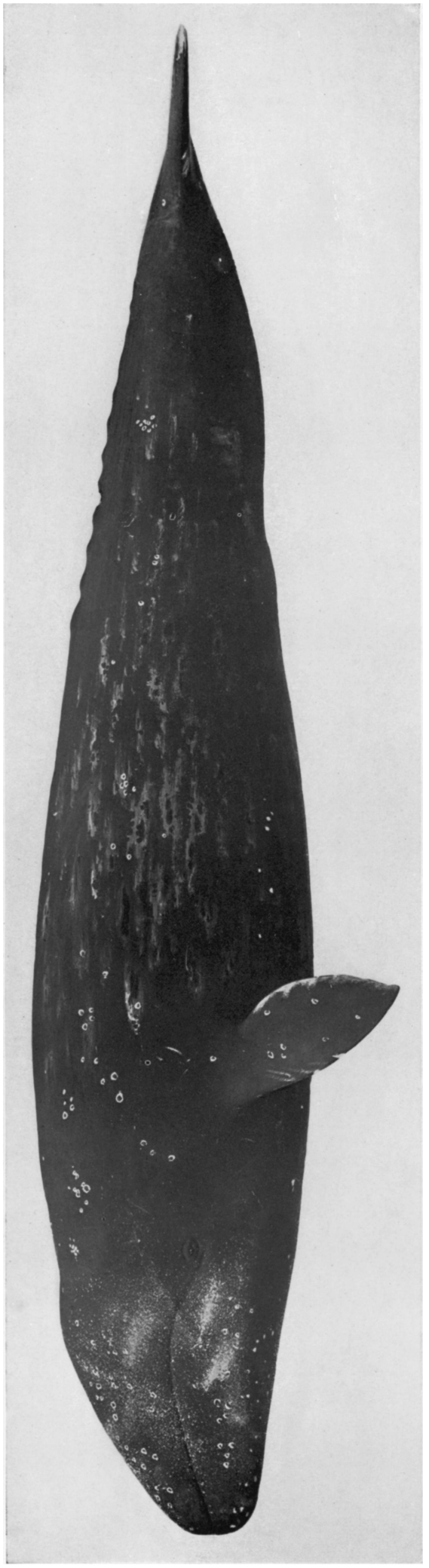
PLATE XXVIII.

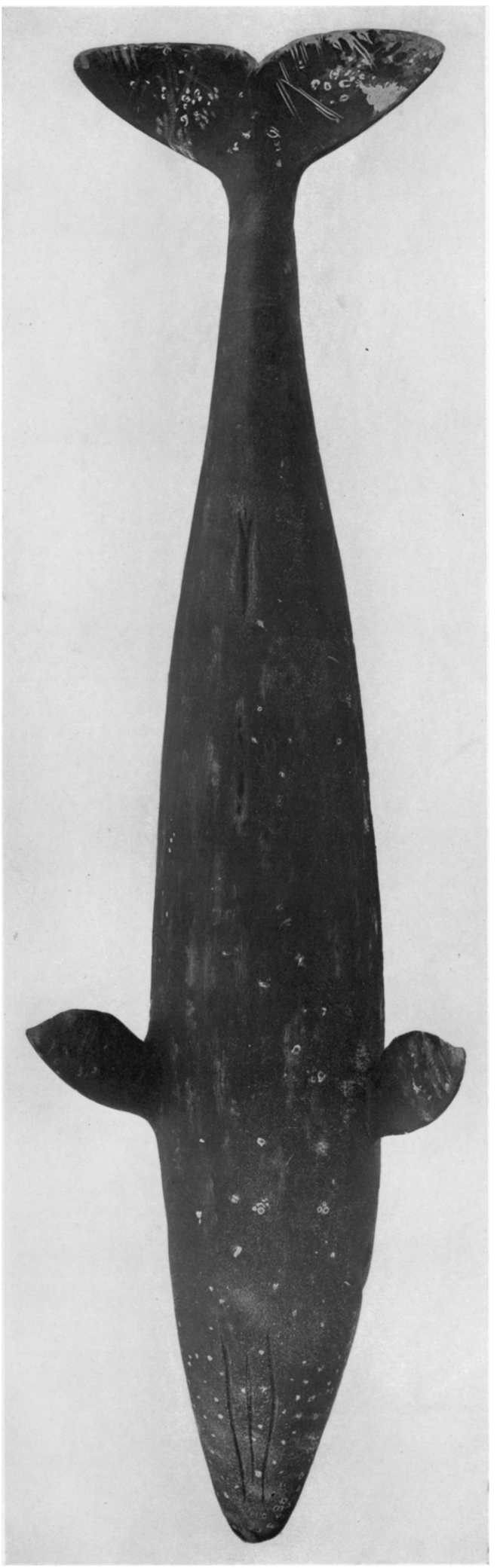
Rhachianectes glaucus.

Supplemental Plate for Part V.

Fig. 1. Lateral view.
Fig. 2. Ventral.

(From photographs of a model constructed under the direction of Roy C. Andrews.)





RHACHIANECTES GLAUCUS.

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Plates XXIX–XLII and 38 Text Figures.

CONTENTS.

Foreword.

The present paper is the second of the series of monographs now in preparation upon the Pacific Cetacea. Besides the skeleton of *Balænoptera borealis*, a well preserved fœtus was brought from Japan, and believing that valuable material of this sort should be studied by the person qualified to make the greatest use of it, the specimen was put into the hands of Dr. Herman von W. Schulte, of the Department of Anatomy, Columbia University, who is the author of the section on the soft anatomy. The advantages of such a coöperative study of any form are obvious and, so far as possible, future volumes of this series will be treated in a similar manner.

To one not familiar with the difficulties of a comparative study of large cetaceans, where for external anatomy one must depend entirely upon descriptions, measurements and photographs, the present paper may appear to contain much unnecessary, and somewhat cumbersome, detail. However, from personal experience I have learned that when the field investigator is confronted with the problem of individual variation in the Cetacea it is of surprising assistance to have before him the complete data from which earlier students drew their conclusions.

Acknowledgments.

It is always a pleasure to acknowledge the generous assistance of the President and Directors of the Toyo Hogei Kabushiki Kaisha (Oriental Whaling Co., Ltd.) of Osaka, Japan. Although personally unknown to them on my first visit to Japan, I was received with the greatest courtesy and given all possible assistance in my work. The managers of the various stations which I visited were instructed to allow me to take any specimens of interest, and skeletons of almost all the species of whales captured at the shore stations were secured. Thus the Museum has acquired what is probably the most complete collection of large cetaceans in the world.

Practically nothing was known of the whales of Japanese waters, and the specimens presented by the Toyo Hogei Kabushiki Kaisha are the only complete skeletons from this country in England, Europe or America. If all the whaling companies which are so industriously carrying on the work of commercially exterminating the large whales in other parts of the world could be induced to take the liberal attitude of the Japanese in furthering scientific study, it would in part compensate for the ruthless slaughter of the interesting and important mammals which are contributing so greatly to their financial gain.

My friends, Messrs. D. Ogiwara, T. Shibuya and M. Matsuzaki were never failing in kindly advice and assistance and to them I owe a debt of gratitude. Messrs. Uchida and Ikeda, Managers of the Aikawa and Oshima stations, furthered in every possible way the work I had undertaken and did much for my personal comfort as well.

Captain H. G. Melsom very kindly read that portion of the manuscript relating to the "Life History" and offered many valuable suggestions.

While at the various stations I was always received with hospitality on board the whaling ships and spent much time, both ashore and afloat, with Captains Y. E. Andersen, F. Olsen, Reidar Jacobsen, N. Skontorf, O. Bogen, H. Ellefsen, S. Samualsen, J. Jorgensen and M. Hansen; to these gentlemen my best thanks are due.

For the never failing kindness of Dr. J. A. Allen, who although engrossed in his own researches is never too busy to afford younger students of zoölogy the benefit of his profound knowledge, and who has supervised the printing of this monograph, I wish to express my sincere appreciation.

My mother, Mrs. C. E. Andrews, prepared the tables of ratios and assisted in other ways, and has always been ready with sound advice and encouragement in my scientific work.

Professor Charles B. Wilson, a specialist in the study of Copepods, very kindly identified the *Penella* which were taken from the Japan whales and offered helpful suggestions relative to the migration of *B. borealis*.

The photographs are the work of Mr. Julius Kirschner, the Museum photographer, and the two drawings are by Mr. J. Henry Blake, of West Somerville, Mass.

Introduction.

Upon arriving in Japan in February, 1910, for the purpose of studying cetaceans, I was surprised to learn from the Toyo Hogei Kaisha that a whale known as the *Iwashi Kujira* (Sardine Whale) formed the basis of their summer fishery. From the descriptions, the *Iwashi Kujira* could only be identified as a species identical with, or allied to, *Balænoptera borealis* of the North Atlantic, which, so far as was then known, had no representative in the Pacific Ocean. It was with the greatest interest that I examined the first specimen of this species at Oshima, Kuishui, and discovered that the *Iwashi Kujira* was none other than the Pacific counterpart of *B. borealis* Lesson. Our almost entire ignorance of the Pacific whales is well demonstrated by the fact that for 15 years or more, this species, as well as the California Gray Whale (*Rhachianectes glaucus*), has been taken by hundreds during the summer and winter along the coasts of Japan and Korea without a single mention of their occurrence finding its way into Occidental literature, either scientific or popular.

During the spring and summer of 1910, while I remained in Japan, about 75 specimens of the *Iwashi Kujira* came under my observation and it was thus possible to make a fairly extensive study of the life history, external anatomy and individual variation of the species, as well as to send to the American Museum a complete skeleton with its baleen and a well preserved fœtus. Except for a few blades of baleen from Newfoundland in the Institute of Arts and Sciences, Brooklyn, N. Y., and one mandibular ramus, two ribs, and a little baleen of a specimen which was washed ashore at Chatham Light, Mass., in 1910, there is no other material representing *B. borealis* in America. Moreover, only two photographs of Atlantic specimens of *B. borealis* have been published, although the osteology of the species is fairly well known, and consequently this was an almost untouched field.

My work in Japan furnished an excellent basis for a comparative study of the Atlantic and Pacific forms with a view to determining their relationship, as well as that of *Balænoptera schlegeli* (Flower) which had been described from Java in 1864.

The theory of the cosmopolitan distribution of the large cetaceans, especially of the genus *Balænoptera*, has been advanced by several well known cetologists during the last half century but has never, I believe, been based upon an examination and comparative study of specimens from various oceans. Such opinions are interesting as showing the increasing tendency to realize that in cetaceans geographical separation does not necessarily indicate a difference of species,

but they have no real value as proof of the facts at issue. The late Dr. F. W. True was the first cetologist to consider the relationship of the species of baleen whales of the eastern and western North Atlantic ocean, with his work based upon actual examination and comparison of specimens. He concluded, after much careful study, that the species found on both sides of the Atlantic were identical.

In the study of systematic cetology it must be remembered that geographical separation has not the importance which is justly ascribed to it by students of land mammals. Even if individuals of a species found in the Atlantic and Pacific oceans *never mingle* the conditions under which both live are usually so similar that apparently such a species can continue to reproduce its characters without material change for an indefinite period.

There is evidence, however, of a more or less continual passage of the Balænopteras from one ocean to the other by way of the waters of Cape Horn. There are practically no barriers to the wanderings of the whales of this genus, which seem to be indifferent to the temperature of the water, and the movements of which appear to be controlled mainly by the food supply. Undoubtedly herds are formed which remain for some time in certain localities, but these are probably reinforced by individuals which have wandered long distances, perhaps from the waters of the Antarctic to the North Pacific or Atlantic (see 'Migrations').

As Dr. True has justly remarked, the greatest difficulty with which systematic cetology has to deal is the problem of individual variation. At times this variation is so enormous that it seems impossible that the extremes can belong to a single species. But when specimens exhibiting such extremes of size, color or proportions are taken from the *same locality*, and in some instances from the *same herd*, it is impossible to believe that the differences are other than purely individual. Some writers, notably none who have specialized upon cetaceans, have attempted to recognize subspecies among whales, but for very obvious reasons this is impractical.

Nomenclature.

Balænoptera borealis *Lesson.*

Sei Whale.

Balæna rostrata Rudolphi, Abh. Akad. d. Wissen. zu Berlin, 1820–1821 (1822), pp. 27–40, pll. i–v.

"Rorqual du Nord" Cuvier, Recherches sur les Ossemens Fossiles, Nouvelle Edition, T. V., 1823, pp. 373 and 383–387, pl. xxvi, fig. 6.

Balænoptera borealis Lesson, Hist. Nat. des Mam. et des Oiseaux, Cétacés, 1828, pp. 342, 361, pl. xii.

Balænoptera arctica Schlegel, Fauna Japonica, 1842, Mamm. Marine, p. 26.

Balænoptera laticeps Gray, Zoology of the Erebus and Terror, I, 1844, p. 20.

Balænoptera Iwasi, Gray, Zoology of the Erebus and Terror, I, 1844, p. 20.

Physalus (?) Iwasi Gray, Cat. Mam. Brit. Mus., Part 1, Cetacea, London, 1850, p. 42.

Sibbaldus laticeps Gray, Proc. Zool. Soc. London, 1864, p. 223, figs. 16–17.

Sibbaldius schlegelii Flower, Proc. Zool. Soc. London, 1864, pp. 384–420, figs. 10–17.

Rudolphius laticeps Gray, Cat. Seals and Whales in Brit. Mus., 2nd ed., London, 1866, pp. 170–175.

Balænoptera borealis Cuvier, Actes Soc. Linn. de Bordeaux, 1881, Vol. 35, pp. 81–84.

The vernacular term Sei Whale (*Sejhval*), adopted in this memoir, is the name by which *Balænoptera borealis* is known to the Norwegians and was applied to it because this species formerly arrived upon the coast of Finmark with the "Seje," or Coal-fish (*Pollachius virens*).

The English designation for this whale is "Rudolphi's Rorqual," indicating the original describer who brought it to the attention of the scientific world in 1822.

Shore-whaling was developed by the Norwegians, and men of this nationality are scattered over the world wherever the industry is prosecuted. With them have been carried their country's vernacular names for the whales which they hunt, and it is by these names that the animals are known at the stations in almost every part of the world. But few persons would recognize the species under consideration by the name "Rudolphi's Rorqual" whereas Sei Whale identifies it at once and it appears, therefore, by far the best plan to adopt universally the term which is already current among whalemen.

The name *Balænoptera borealis* Lesson, which has for years been commonly accepted for the Sei Whale, is without doubt the earliest Latin designation which can be applied to it. Rudolphi,[1] in 1822, was the first to apply a Latin term to this species. He described it as *Balæna rostrata*, a name which is preoccupied by Müller[2] who made use of it for a *Hyperoödon*. Cuvier[3] in 1823, under the title "Rorqual du Nord," described and figured the skull of Rudolphi's specimen but did not use a Latin name. In 1828 Lesson[4] copied Cuvier's description, converting his vernacular designation "Rorqual du Nord" into Latin as *Balænoptera borealis*. Lesson's name, whether regarded as original or merely as a translation of Cuvier's application, has undoubted priority and must be retained.

In his paper on the 'Cétacés du Sud-Ouest de la France,'[5] Paul Fischer cites the name as *Balænoptera borealis* Cuvier, following the usual custom of French authors in the numerous cases in which a species was described by Cuvier under a vernacular term without bestowing upon it a formal Latin designation. Dr. J. E. Gray,[6] in 1844, applied the name *Balænoptera laticeps* to the Sei Whale, placing in his synonymy the *Balæna rostrata* of Rudolphi and the "Rorqual du Nord" of Cuvier but not mentioning Lesson's name. Some years later Dr. Gray described the genus *Sibbaldus*,[7] afterward modified to *Sibbaldius*, with *S. laticeps* Gray as the type species.

In 1866[8] he erected his genus *Rudolphius* for the reception of *laticeps* and it appears as *Rudolphius laticeps* in his 'Supplement to Catalogue of Seals and Whales' and in his 'Synopsis of the Species of Whales and Dolphins.'

In 1842 Schlegel[9] named a whale *Balænoptera arctica* from the descriptions and figure in a Japanese work upon the Cetacea, and although his species can not be absolutely determined, I have little doubt that it refers to *Balænoptera borealis*. Gray in 1844 in the 'Zoology of the Erebus and Terror,' page 20, under the title "The Japan Finner. Balænoptera Iwasi," renames Schlegel's species while quoting, almost in its entirety, the latter's description. In 1850, in the 'Catalogue of the Cetacea in the British Museum,' page 42, the name appears as "Physalus ? Iwasi. The Japan Finner."

In 1864 Prof. Flower[10] named a whale from Java *Sibbaldius schlegelii*, the skeleton of which

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[1] Abhandl. K. Akad. Wissensch. Berlin, 1820–21 (1822), pp. 27–40, pll. 1–5.
[2] Zoologiæ Danicæ Prodomus, 1776, p. 7.
[3] Recherches sur les Ossemens Fossiles, Nouvelle Edition, T. V., 1823, p. 373, pl. xxvi, fig. 6.
[4] Histoire Naturelle des Mammifères et Oiseaux. Cétacés, 1828, pl. 12.
[5] Soc. Linn. de Bordeaux, Actes, 1881, vol. 35, pp. 81–84.
[6] Zoology of the Erebus and Terror. I, 1844, p. 20.
[7] Proc. Zool. Soc. London, 1864, pp. 222, 223.
[8] Cat. Seals and Whales, 1866, p. 170 and Supplement, 1871, p. 54.
[9] Fauna Japonica, 1842, Les Mammifères Marins, p. 26.
[10] Proc. Zool. Soc. London, 1864, pp. 400–408, figs. 10–17.

was received by the Leyden Museum, although he was not able to satisfactorily decide upon any characters in which it differed from *B. borealis*.

Dr. J. E. Gray in 1865 described a whale from Formosa as *Balænoptera swinhoei*,[1] upon the basis of a few vertebræ and ribs sent him by Mr. Swinhoe. He says: "The bones are nearly the size of similar bones of the European Finner (*Physalus antiquorum*), which often reaches to the length of 60 or 70 feet, and they most probably belong to an animal nearly of that size" (*l. c.*, p. 725).

In the 'Catalogue of Seals and Whales,' pages 382–386, Gray diagnosed the subgenus *Swinhoia*, and republished the figures and description which appeared in the Proceedings of the Zoölogical Society the year before.

In 1868, in his 'Synopsis of Whales and Dolphins,' page 3, he gave *Swinhoia* generic rank, including in the synonymy of its single species, *Swinhoia chinensis* and *Balænoptera swinhoei*.

Dr. Trouessart in his 'Catalogus Mammalium' [2] has doubtfully referred to the *B. swinohoei* of Gray as a subspecies of *B. schlegeli* (Flower). He also places under *B. swinhoei* the name *sinensis* Gray, which is obviously a misspelling of *chinensis*.

Dr. Gray's statement that the bones are nearly as large as those of the European Finner (*B. physalus*), and the figures which he presents, are satisfactory evidence that this whale from Formosa is not related to *B. schlegeli* (= *B. borealis*), subspecifically or otherwise.

General History.

Because of its comparatively small size and superficial resemblance to the Blue and Finback Whales, *Balænoptera borealis* for many years was supposed to be the young of one or the other of the above species. The first individual to be critically studied by a scientist was one stranded on the coast of Holstein on Feb. 21, 1819, the skeleton of which was preserved in the Berlin Anatomical Museum. Rudolphi described and figured the skeleton in a paper entitled "Einige anatomische Bermerkungen über *Balæna rostrata*," and thus for the first time brought this cetacean before the scientific world.

A few years later Cuvier discussed this whale under the name of "Rorqual du Nord," and after comparing it with the "Rorqual de la Méditerranée" (= *B. physalus*) stated his belief that it represented a distinct species. As his name indicates, he was under the impression that this whale was confined to the northern seas.

Not long after Cuvier's work was published, Lesson copied his description in the 'Histoire Naturelle des Mammifères et Oiseaux,' converting into Latin as *Balænoptera borealis* the name "Rorqual du Nord."

The skeleton of Rudolphi's specimen was again figured by Pander and D. Alton, and in 1829 Brandt and Ratzeburg published a drawing by Mathiesen made from the stranded specimen.

In 1844, Dr. J. E. Gray applied the name *Balænoptera laticeps* to Rudolphi's whale, and in 1849 Eschricht noted a skeleton in the Leyden Museum which had been taken in the Zuider Zee, near Monnikendam, Holland, on August 29, 1811. This skeleton and a second in the Brussels Museum, obtained in 1861 by Eschricht from the North Cape, was discussed by Prof. Flower

[1] Ann. and Mag. Nat. Hist., 3d Ser., Vol. XVI, Sept. 1865, p. 148; Proc. Zool. Soc. London, 1865, pp. 725–728, figs. 1–6.
[2] Page 1080; Quinquennale Supplementum, 1904, p. 783.

in 1864 and some years later was described and figured by Van Beneden and Gervais in their 'Ostéographie des Cétacés.'

In 1866, Lilljeborg described a skeleton of this species in the Bergen, Norway, Museum, and in 1876 Paul Fischer reported upon a specimen cast up on the coast of France, giving a valuable series of external measurements. A brief description of the exterior of *B. borealis* was given, at second hand, by Prof. Turner in 1882 from a specimen captured in the Firth of Forth and the skeleton of which was preserved in the Edinburgh Anatomical Museum.

The following year Prof. Flower described the skeleton from a specimen taken in the River Crouch, England, which he examined at the Zoological Gardens, and in 1884 G. A. Guldberg published his observations on this species made at the Finmark station. Previous to Guldberg's paper it had not been definitely determined what species was represented by the animal known to the Norwegian whalemen of Finmark as the "Sejhval," or Sei Whale. His researches proved beyond a doubt that this animal was none other than *Balænoptera borealis* Lesson.

The history of this whale on the Finmark coast is interesting. According to Collett it was first seen there in 1860, and in 1861 the Brussels and Bergen Museums received the skeletons mentioned above. It was not until August of 1881 that Svend Foyn, who had hitherto not attempted to capture this species because of its small size, took the first Sei Whale off Varangerfjord. A year later a regular fishery began and eight examples were caught off Sørvær, west Finmark. Up to 1885 *B. borealis* was considered to be a rather rare cetacean, but in the spring of that year these whales appeared by thousands along the entire Finmark coast and remained until September; again in 1898 there was a great invasion of Sei Whales at Finmark, and this species is now known to be among the most abundant of the large cetaceans.

Previous to 1884, when Guldberg's paper appeared, the color and external characters of this whale were almost unknown, for, although its osteology had been frequently described, only meagre details, which came nearly always at second hand, as to its external appearance had been published during the sixty-five years that the species had been before the scientific world.

Guldberg's paper was followed two years later by an excellent discussion by Prof. Robert Collett of the external characters of six fresh specimens examined by him at the Vardö, Norway, whaling station. Prof. Collett's contribution was the first satisfactory account of the exterior of this whale which had up to that time been published.

In 1888, Prof. Van Beneden summarized the existing knowledge relating to *Balænoptera borealis* but added little new material, and Dr. F. W. True in 1903, gave the first authentic record of the occurrence of the Sei Whale in the western North Atlantic, four specimens having been captured at the whaling stations in Placentia Bay, Newfoundland.

In 1906, J. G. Millais, Esq., presented a popular account of *Balænoptera borealis* in which new information relative to its distribution and habits is given, and in 1907 Mr. R. C. Haldane reproduced two photographs of the Sei Whale which, so far as I am aware, are the only ones which have yet been published.

The latest paper of importance relating to this whale is in a volume devoted to the cetaceans of the Antarctic by Dr. J. Liouville, in which is given the most extensive and valuable account of *B. borealis* from southern waters which has yet been published. The paper is a valuable contribution to the history of the species and furnishes much new information regarding the life history of the Sei Whale and its distribution.

Synonyms of Balænoptera borealis.— In the 'Fauna Japonica,' 1842, Schlegel named a

whale *Balænoptera arctica*, from the drawings and descriptions contained in a Japanese work upon the Cetacea. While this whale is not positively identifiable, the Japanese name "*Iwasi Kujira*," as well as certain references in the description, indicate *Balænoptera borealis* and I have little hesitation in referring it to this species. *B. arctica* was renamed *Balænoptera Iwasi* by Dr. Gray in 1844 and later changed to *Physalus ? Iwasi*.

Prof. Flower, in 1864, described a skeleton which had been received from Java by the Leyden Museum as *Sibbaldius schlegeli*, although he stated that he could not fix upon any characters in which it decidedly differed from *Balænoptera borealis* of the North Atlantic. He was, however, not able to convince himself that two whales, inhabiting oceans on opposite sides of the world, could belong to one and the same species.

In 1891, Paul Gervais published a memoir on the skeletons of two Balænopteras secured on an expedition to Cape Horn, referring one of them to *Balænoptera schlegeli* (Flower), which he says is synonymous with *B. borealis* Lesson.

When the author arrived at the whaling stations in Japan during the early part of 1910, it was soon evident that the whale called by the Japanese "Iwashi Kujira" was identical with *B. arctica* Schlegel or *B. schlegeli* (Flower), and it will be seen from the present memoir that both these names are synonyms of *B. borealis* Lesson, and that the cosmopolitan distribution of this species is fairly well established.

Synopsis of the Literature.

When beginning the study of *Balænoptera borealis* my first step was to familiarize myself with the literature of the species and to this end a brief synopsis of each paper was prepared. As work progressed these synopses were so continually referred to, and proved of such great assistance, that I determined to publish them as aids to future students of the species. I have not attempted to make the bibliography complete, only such papers being listed as proved of value in the present work.

1818.— Lacépède [1] described from drawings four Japanese baleen whales none of which are positively identifiable. His *Balænoptera punctulata* and *Balænoptera nigra* probably indicate Humpbacks, and his *Balænoptera cærulescens* is presumably either a Blue Whale or a Finback. In his description of *Balænoptera maculata* he says: "la dorsale á une distance presque égale des pectorales, et de la nageoire de la queue; la couleur générale noirâtre; quelques taches, très-blanches, presque rondes, inégales, et placées irrégulièrement sur les côtés de l'animal" (*l. c.*, p. 474).

His remarks as to the position of the dorsal fin and the white patches upon the sides suggest *Balænoptera borealis* but too indefinitely to cause this name to be seriously considered.

1822.— Professor D. K. A. Rudolphi [2] described for the first time a skeleton of *Balænoptera borealis* from an individual cast up on the Holstein coast Feb. 21, 1819, the bones of which were preserved in the Berlin Anatomical Museum. He erroneously identified this specimen with *B. rostrata* of Fabricius and Hunter, a species well known at that time, and gave a series of external measurements and a description of the osteology of the animal. In five large plates he

[1] Mém. du Mus. d'Histoire Naturelle, 1818, T. IV, pp. 467–474.
[2] Abh. K. Akad. d. Wissen. zu Berlin, 1820–1821 (1822), pp. 27–40, pll. i–v.

figured the entire skeleton, dorsal, ventral and lateral views of the skull, the hyoid bone, third caudal vertebra, pelvic rudiment, first rib, and three views of the larynx.

1823.— Cuvier [1] in his great work on the 'Ossemens Fossiles' discussed the Sei Whale under the title "Rorqual de la Mer du Nord," giving a description of the skull and skeleton and comparing it with his "Rorqual de la Méditerranée" (= *B. physalus*). He also gave a figure of the skull of Rudolphi's specimen in the Berlin Museum.

1827.— In an extensive work entitled 'Vergleichende Osteologie' Dr. Chr. Pander and Dr. Ed. D'Alton [2] published some beautiful drawings of Rudolphi's Holstein specimen under the name *Balæna rostrata*. The figures comprise the entire skeleton, superior, inferior, anterior, posterior and lateral views of the skull, the cervical vertebræ and first rib, scapula and pectoral limb, pelvic and hyoid bones. The text is a comparative discussion of the skeletons of various cetaceans.

1828.— Lesson [3] discussed the Sei Whale under the title "Le Rorqual du Nord, *Balænoptera borealis* Lesson," thus translating into Latin Cuvier's vernacular name. He quotes Cuvier's description of the type but includes with it an account by M. Souty, Surgeon of the Marines, of a whale cast up on the island of Aleron, March 10, 1827. Lesson erroneously identifies this specimen as *Balænoptera borealis* and gives a detail description of it.

1829.— Brandt and Ratzeburg [4] published in the 'Medizinische Zoologie' a drawing from the flesh made by Von Mathiesen in 1819 from the animal which was captured on the coast of Holstein. The skeleton of this specimen was preserved in the Berlin Anatomical Museum and is the one described by Rudolphi under the name *Balæna rostrata;* it is the type of *Balænoptera borealis* Lesson. (I have not been able to examine a copy of the 'Medicinische Zoologie' containing the figure of this whale.)

1842.— Under the name *Balænoptera arctica*, Schlegel [5] gives an account of a whale known to the Japanese as the "Iwasi-Kuzira." He says that there is in a Japanese work upon the Cetacea the figure and description of a young individual stranded in 1760 on the coast of the Province of Kii. This whale was 25 feet long, black, with belly whitish and the sides white. It is distinguished from the other Balænopteras by the pectoral fins being shorter as well as having a smaller, narrower and more pointed head. His plate (pl. xxx) does not refer to this species but to his *Balænoptera antarctica*, which is probably a Humpback.

While it cannot be absolutely proved just what whale was meant by Schlegel's *B. arctica*, his description as well as the Japanese name strongly indicate *B. borealis*, and I have little hesitation in referring it to this species.

1844.— Dr. J. E. Gray [6] attempted a synoptic revision of the Cetacea and in this work applies the name *Balænoptera laticeps* to the Sei Whale, giving a brief diagnosis of it. He places in its synonymy the *Balæna rostrata* of Rudolphi and "Rorqual du Nord" of Cuvier, but does not mention Lesson's name.

Under the title "The Japan Finner. Balænoptera Iwasi," he quotes Schlegel's name *B. arctica* and almost in its entirety the latter's description published in the "Fauna Japonica."

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[1] Recherches sur les Ossemens Fossiles, Nouvelle Édition, T. V., 1823, pp. 373 and 383–387, pl. xxvi, fig. 6.
[2] X. Lieferung. Die Skelete der Cetacean, Bonn, 1827, pll. ii and iii.
[3] Histoire Naturelle des Mammifères et des Oiseaux, Cétacés, 1828, p. 342–361, pl. 12.
[4] Med. Zool. Berlin, 1829, p. 119, pl. xv, fig. 3 and pl. xvi, figs. 1 and 2.
[5] Fauna Japonica, 1842, Les Mammifères Marins, p. 26.
[6] Zoology of the Erebus and Terror, I, 1844, p. 20.

1849.— D. F. Eschricht [1] in a paper entitled 'Undersögelsen over Hvaldyrene' presents in tabular form data in regard to whales which had been stranded on the European coast since 1669. His list includes the date, locality, collector, place of publication, figures, sex, length, length of pectoral fin, color of body, pectoral fin and baleen, number of vertebræ and ribs, form of the sternum, where the specimen is preserved, and the species. In this paper Eschricht erects his genus *Pterobalæna* for the "short handed" Fin Whales.

1850.— In his 'Catalogue of Cetacea,' Dr. Gray [2] republishes the account of *Balænoptera iwasi* given in the 'Zoology of the Erebus and Terror' under the following title: "Physalus? Iwasi. The Japan Finner."

1864.— Dr. J. E. Gray [3] described the genus *Sibbaldus*, which was later modified to *Sibbaldius*, with *Balænoptera laticeps* as the type species. Dr. Gray says of this genus: "the great character is that the front rib is split into two separate parts near the condyle, or double-headed, as Dubar calls it." Under *Sibbaldus laticeps* he gives the following: "*Hab.* North Sea; Holstein, 1819 (*Rudolphi*); skeleton in Mus. Berlin, 31 feet long. Zuyderzee, 1816, skeleton in Mus. Leyden."

1864.— In his paper upon the whalebone whales, J. E. Gray [4] notices *Sibbaldus laticeps* and *S. schlegeli* as follows:

> "1. *Sibbaldus laticeps*, Gray, Proc. Zool. Soc., 1864.
>
> *Balænoptera laticeps*, Gray; Lilljeborg, *l. c.*, p. 63. Ribs 13.13. Dorsal fin compressed.
>
> *Hab.* Northern Seas. Skeleton, Mus. Berlin.
>
> 2. *Sibbaldus schlegelii.*
>
> *Balænoptera* from Java, Schlegel, Mus. Leyden.
>
> *B. Schlegelii*, Flower, MS.
>
> '*Megaptera* from Java,' Van Beneden, Gray, Proc. Zool. Soc. 1864, p. 208.
>
> *Hab.* Java. Skeleton, Mus. Leyden (young); skull, Mus. Leyden."

1864.— In November, 1864, Prof. W. H. Flower [5] published a paper entitled 'Notes on the Skeletons of Whales in the Principal Museums of Holland and Belgium, with Descriptions of Two Species apparently new to Science.' In this communication he discussed the skeleton of a whale which the Leyden Museum had received during 1864 from the northwest coast of the island of Java and named it *Sibbaldius schlegeli*. Except for the absence of a few bones of minor importance, Prof. Flower stated that the skeleton was complete and that of an "adolescent" individual. After comparing this specimen with that of *Balænoptera borealis* Lesson from the Zuider Zee, in the Leyden Museum, and the figures and descriptions of the type in the Berlin Museum, he was not able to fix upon any characters in which they decidedly differed except that the orbital plate of the frontal of the Java cranium was somewhat narrower at the outer end than in the skulls from Europe. Nevertheless he could not bring himself to believe that the specimens were specifically identical because of their wide geographical separation. In regard to this he says: "We have, however, here an important alternative: either a species of Whale found in the North Sea, between the North Cape and the south coast of England, is

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[1] K. Dan. Vid. Sel. Skr., Femte Række, Nat. og Mat., 1849, pp. 85–138. Also Untersuchungen über die Nordischen Wallthiere, Leipsig, 1849.

[2] Catalogue of the specimens of Mammalia in the collection of the British Museum. Part 1, Cetacea, London, 1850, p. 42.

[3] Proc. Zool. Soc. London, 1864, p. 222, figs. 16–17.

[4] Notes on the Whalebone-Whales; with a Synopsis of the Species. Ann. and Mag. Nat. Hist., 1864, Vol. XIV, pp. 345–353.

[5] Proc. Zool. Soc. London, 1864, pp. 384–420, figs. 10–17.

found also on the coast of Java, without being known (at present at least) in any intermediate locality, or, on the other hand, in the specimen which I now bring before the notice of this Society we have a species new to science. As I know that the latter opinion will be adopted by many cetologists, I propose to call this specimen provisionally by the name of *schlegelii*, in honour of my distinguished friend, by whose influence the specimen had been made accessible to European naturalists, and who has himself made valuable contributions to this department of zoology" (*l. c.*, p. 408).

1864.— In the same paper on the 'Whales in the Principal Museums of Holland and Belgium' Prof. Flower discussed a skeleton in the Leyden Museum marked "*Balænoptera physalus.*" This specimen was taken in the Zuider Zee, near Monnikendam, Aug. 29, 1811, its length being 32′ Rheinland, and is No. 17 of Eschricht's list.[1] Prof. Flower discusses the skeleton quite fully, giving measurements of many of the principal bones, and after comparing it with Rudolphi's description and figure of the specimen in the Berlin Museum (the type of *B. borealis* Lesson) states that there can be little doubt of their specific identity.

In the same paper he describes a second young specimen of *B. borealis*, in the Royal Museum of Natural History at Brussels, which was obtained by Eschricht from the North Cape and is "almost the exact counterpart in size to that in the Leyden Museum." Prof. Flower gives a brief description of the skeleton as well as measurements of the skull and a very interesting discussion of the ribs. He says: "The first pair of ribs have double heads; but the anterior head on both sides is very incompletely developed, and on the right side completely detached from the remainder of the bone; it has a pointed end below, merely applied to the main part of the rib; so that if it had been lost in maceration, this rib might have been supposed to be simple. On the left side it is ankylosed, but very slender. It would be interesting to ascertain, by the examination of younger specimens, whether this anterior head has always a separate centre of ossification, as it is not improbable that this singular double-headed bone is in reality formed by the coalescence of two originally distinct ribs" (*l. c.*, p. 417).

1866.— Dr. J. E. Gray,[2] under *Sibbaldius laticeps*, gives a brief description of the external characters as well as a review of the synonymy of the species, and quotes at length from Flower's discussion of the Leyden and Brussels Museum skeletons in the P. Z. S., 1864.

Under *Sibbaldius schlegeli* (pages 178–186) he figures a double-headed rib with the caption: "First rib of *Sibbaldius Schlegelii ?*, in Mus. Roy. Coll. Surgeons," and remarks: "There is the first rib of a whale of this genus in the Museum of the Royal College of Surgeons, which, if it is not this, would seem to indicate a fourth species. The origin of the specimen is unknown." He then quotes in full Flower's original description and figures from P. Z. S., 1864.

In this 'Catalogue' the genus *Rudolphius* is first characterized, as follows:

"*Dorsal fin compressed, falcate, two-thirds of the entire length from the nose. Ribs 13.13. First rib short, dilated at the sternal end. Sternum with an elongate, narrow posterior lobe. Rudolphius*" (*l. c.*, p. 170).

Gray again lists (p. 163) "*Physalus ? Iwasi*" quoting as before Schlegel's original description and adding a note from Mr. Swinhoe about Finbacks in the Strait of Formosa.

1866.— In his 'Scandinavian Cetacea,' Lilljeborg[3] gives a description and measurements

[1] Untersuchungen über die Nordischen Wallthiere, Leipzig, 1849; and Undersögelser over Hvaldyrene, K. Dan. Vid. Sels. Skrift, Fremte Række, Nat. and Mat., 1849.

[2] Catalogue of Seals and Whales in the British Museum. Second Edition, London, 1866, pp. 170–175.

[3] Synopsis of the Cetaceous Mammalia of Scandinavia. W. Lilljeborg. Ray Society, 1866, pp. 219–309.

of the skeleton of *Balænoptera borealis* in the Bergen Museum, under the name of "Herring Whale" or "Sillhval" (Swedish), *Balænoptera laticeps* Gray. He also presents Rudolphi's external measurements of the type specimen, a young female. According to Dr. D. C. Danielsen, who secured the Bergen Museum specimen from Norwegian West Finmark, the species is not scarce in that locality, neither is it an infrequent visitor to the coasts of Norway.

1866.— Prof. E. D. Cope [1] published a brief description of a whale captured by Dr. P. A. Taliaferro at Mobjack Bay, Virginia, referring it to his *Megaptera osphyia* and later in the same year (p. 297) concluded that it represented the *Sibbaldius laticeps* of Gray. In 1869 [2] he decided that it was a new species, which he named *Sibbaldius tuberosus*. Dr. F. W. True [3] when considering this specimen was not able to locate the skeleton, which was destined for the Philadelphia Academy of Sciences but seems never to have reached there, and he had only the published descriptions for the identification of the species. He concluded "that the question of the identity of *S. tuberosus* cannot be positively decided until some of the more important bones of the Mobjack Bay specimen are found and examined," but refers it to the Finback, *Balænoptera physalus*, an opinion in which I concur.

1868.— During a controversy with Dr. J. E. Gray on the distribution of whales, Professor Van Beneden [4] discusses the significance of the bifid first rib of the Cetacea. Among the examples cited is the skeleton of *Balænoptera borealis* received by the Brussels Museum from the North Cape. Professor Van Beneden concludes that double ribs are merely individual variations and should not be made the basis of either generic or specific distinctions. In the case of the Brussels skeleton of *B. borealis* he demonstrates that on the right side a cervical rib is applied to the first dorsal rib and that, although it is now free, it would undoubtedly become ankylosed with advancing age. Both first ribs are figured in plate 1.

1868–1880.— Profs. P. J. Van Beneden and Paul Gervais [5] presented a historical review of *B. borealis* with its synonymy and literature and a list of the skeletons in the museums of Great Britain and Europe. A skeleton in the Brussels Museum from an individual taken at the North Cape, which had previously been commented upon by Flower (P. Z. S., 1864), is described and compared with *B. physalus* and *B. acuto-rostrata*. In plates x and xi, twenty-five figures of the skeleton of *B. borealis* are presented and for the first time satisfactorily illustrate the osteology of the species.

On pages 220–225, *Balænoptera schlegeli* (Flower) is considered in detail and the principal bones of the skeleton are figured in two magnificent plates (xiv and xv). The authors believe that the species is separable from *B. borealis* and summarize their conclusions as follows:

"M. Flower a soigneusement comparé ce squelette de Java avec ceux d'Europe, et il reconnaît qu'il est difficile de déterminer les caractères par lesquels il diffère de la *Balænoptera borealis*. Ce que M. Flower trouve de plus caractéristique, c'est que la portion sus-orbitaire du frontal est plus étroite dans le crâne de Java que dans la *borealis* d'Europe.— Nous croyons pouvoir ajouter que les os propres du nez sont plus longs et plus étroits à la base dans la *Balænoptera Schlegelii*, et que l'occipital est notablement plus large à la base, moins étendu en avant et ne présente pas cette forme lobée dans la partie qui recouvre les os frontaux.— Nous trouvons des différences

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[1] Proc. Acad. Nat. Sci. Philadelphia, 1866, p. 8.
[2] Proc. Acad. Nat. Sci. Philadelphia, 1869, p. 17.
[3] Whalebone Whales of the Western North Atlantic, 1904, pp. 81–85.
[4] Bull. Acad. Roy. de Belgique, 1868, 2 ser., T. XXVI, pp. 7–16, pll. i–ii.
[5] Ostéographie des Cétacés. Paris, 1880 (1868–1879), pp. 198–209, pll. x and xi, figs. 11–35.

également dans le maxillaire inférieur, dans les vertèbres cervicales et le sternum. Enfin les apophyses épineuses des dorsales et des lombaires nous paraissent plus longues et plus fortes.

Il est inutile de faire remarquer, que le squellette de Java, qui indique une longueur au moins de 45 pieds, dépasse notablement la taille de la *Balœnoptera borealis* ou *laticeps*, qui n'atteint pas au delà de 35 pieds, et qu'au lieu de 13 côtes comme la *Balœnoptera borealis*, cette espèces en a 14" (l. c., pp. 224–225).

1876.— Paul Gervais[1] published a paper entitled 'Remarques sur les Balénides des Mers du Japon,' in which he figures the skull and tympanic bones of a whale from Japan designated as the "Nagazu-Kuzira (*Sibbaldius ? Schlegelii*, Flower)." He speaks of the Japanese skull and its relation to Flower's specimen from Java as follows:

"Le crâne prouvenant des côtes de Java et celui qui a été envoyé du Japon appartiennent à une seule et même espèce ou à deux espèces voisines, trop peu différentes l'une de l'autre pour qu'on les sépare dans la classification; ils sont tous deux remarquables par l'allongement de leur partie faciale, ce qui leur donne une resemblance curieuse avec le grand Cétacé, fossile en Criméé, qui a été décrit sous le nom de *Cetotherium Ratkei*, et cette ressemblance mérite d'autant plus d'être signalée que les dépôts faluniens de la Crimée ont été considérés comme laissés par un bras de mer qui aurait autrefois communiqué avec l'océan Indien" (*l. c.*, p. 7).

Gervais also discusses the whales of Temminck and Schlegel's 'Fauna Japonica' and tries to identify them. Among the rest he considers the "Iwasi Kuzira" (*Balœnoptera arctica*), but, since nothing except the external characters of this whale are known, he does not suspect its identity with the skull which he has referred to *Balœnoptera schlegeli*.

It may be remarked that the "Nagasu Kujira" is the name applied by the Japanese to the Finback Whale and not to *B. borealis*.

1876.— On July 29, 1874, a young male *Balœnoptera* was thrown up on the coast of France, near Biarritz, and reported upon by P. Fischer[2] under the title: 'Sur une Baleinoptère boréale, échouée à Biarritz en 1874.'

A valuable series of external measurements are given as well as a brief discussion of the principal osteological characters. He remarks upon the bifurcated first rib of *Balœnoptera borealis* which, he says, seems to be a constant character of the species. Gray attributes a generic value to this character, which exists equally among the *B. schlegeli* of Java and among other large Balænopteras of the European seas.

1881.— Paul Fischer[3] substantially republishes his account of the Biarritz whale given in the 'Compte Rendus' of 1876, with the addition of a crude, full-length drawing of the specimen and a figure of the first rib, as well as a plate showing two views of the tympanic bone.

1882.— Prof. Wm. Turner[4] published an interesting paper entitled 'A Specimen of Rudolphi's Whale (*Balœnoptera borealis* or *laticeps*) Captured in the Firth of Forth.' He gives a description and measurements of both the external anatomy and skeleton and discusses the bifurcated first rib which is supposed to be a character of the species and which Gray considered to be of generic importance.

He also compares his specimen with *Balœnoptera schlegeli* which Flower regarded as closely

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[1] Journal de Zoologie, T. V, 1876, pp. 1–10, pll. i–ii.
[2] Comp. Rend. de l'Académie des Sciences, 2 semestre, 1876, pp. 1298–1301.
[3] Actes Soc. Linn. de Bordeaux, 1881, Vol. 35, pp. 81–84, figs. 3–4, pl. i, figs., 4–4*a*.
[4] Journ. Anat. and Phys., Vol. XVI, 1882, pp. 471–484.

allied to, if not specifically identical with, *B. borealis* and says that without doubt the resemblance in many particulars is very striking. In commenting upon the fact that Flower could not bring himself to believe in the specific identity of the Java specimen with those from Europe because of their wide geographical separation, Turner says: "At the time when Prof. Flower wrote his description, there was a greater tendency, on the part of cetologists, to limit the area of distribution of the individual species of cetacea, than now exists, and to confer specific value upon specimens which, though in many respects similar in characters, yet came from distant seas. The wider range of distribution of some of the species of the marine mammals is now more generally recognized, and the remoteness of the *habitat* of Schlegel's *Balænoptera* ought not, if the anatomical arrangements correspond, to bar its association with *B. borealis*" (*l. c.*, p. 484).

1884.— G.-A. Guldberg[1] published an important paper entitled 'Sur l'existence d'une quarteième espèce du genre Balænoptera dans les mers septentrionales de l'Europe.' He speaks of *B. rostrata* (= *B. acuto-rostrata*), *B. musculus* (= *B. physalus*) and *B. sibbaldii* (= *B. musculus*) as being well known in the northern seas of Europe and says that a fourth species, *B. borealis* Less., is admitted by some authors. Certain naturalists regard this as problematical since few individuals have been captured up to the present time.

The exterior form and color are those of *B. musculus* (= *B. physalus*); the skeleton a mixture of the characters of *B. rostrata* (= *B. acuto-rostrata*) and *B. musculus* (= *B. physalus*); the number of the vertebræ is 55 or 56 (*B. acuto-rostrata* 48, *B. physalus* 62). The size and the shape of the skull is also intermediate between the two. Therefore, many naturalists doubt the existence of the species. Some authors believe that the species is a large *B. acuto-rostrata* or that it is a hybrid between it and *B. physalus*.

After expressing his doubt as to hybridism in the Cetacea, Guldberg goes on to say that certain whaling captains believe in the existence of a hybrid between *B. musculus* (= *B. physalus*) and *B. sibbaldii* (= *B. musculus*), and cites the characters by which it is supposed to be distinguished.

He continues that during a voyage to Finmark he has gathered some information on the external form of the "Sejhval" of that coast, which is undoubtedly *Balænoptera borealis* Lesson, as well as on the baleen and skeleton of an adult individual belonging to that species. These observations definitely dispose of all doubt as to the existence of a fourth species of *Balænoptera*.

His observations made at the Finmark stations, where many whales of this species are taken, for the first time established the identity of the Norwegian "Sejhval," and include a description of the external characters, with measurements of a fœtus 1.355 meters in length. He also describes and presents measurements of the skull and other bones of the skeleton which had been received by the Christiania Museum. A few notes upon the habits of the "Sejhval" are appended.

1884–1890.— During the years 1884–1890 inclusive, A. H. Cocks, published annually in the 'Zoologist' accounts of 'The Finwhale Fishery on the North European Coast.' *Balænoptera borealis* is among the other species considered and much information as to its appearance upon the shores of Finmark is given as well as lists furnished by the Norwegian whalers showing the numbers taken each year, with the total lengths of the animals.

1886.— Prof. Robert Collett's[2] contribution entitled 'On the External Characters of Rudolphi's Rorqual (*Balænoptera borealis*),' is the first and only paper which has given anything

[1] Bull. de l'Académie Royale de Belgique, 3me Série, T. 7, 1884, pp. 360–374.
[2] Proc. Zool. Soc. London, 1886, pp. 243–265, pll. xxv–xxvi.

approaching a satisfactory description from fresh individuals of the external characters of *Balænoptera borealis*. As Professor Collett remarks, even up to the year 1882 the species was only known from a small number of stranded specimens, the skeletons of which had found their way into different museums; of the external characters of these examples either no particulars were obtained, or they were confined to a few scanty remarks by casual observers.

In 1882 a whaling-factory was established at Sörvær, near Hammerfest, West Finmark, where the greater number of whales caught were the so-called 'Sejhval.' Professors Collett and Sars became convinced that the Norwegian 'Sejhval' was none other than *Balænoptera borealis* Lesson, and in 1884 Dr. Guldberg finally proved this to be true by his researches upon some parts of a skeleton from Sörvær. During a stay of two days at Vardö, Prof. Collett had an opportunity to examine and measure six specimens which were brought to the whaling stations.

In his paper he gives the general characters of the species, accurate descriptions of the color of the body and baleen, and of the form of the flippers, mandible, blowholes, and furrows. He also discusses the hairy covering, parasites, time of capture, fœtus, food, habits, value, and monstrosities. He presents two excellent plates giving a lateral and two ventral views of specimens showing different types of coloration and one of the whitish spots on the skin. These figures can not be commended too highly for they are the first good published drawings of this whale and are accurate both as to form and coloration. Prof. Collett's paper is a splendid contribution to the history of the species.

1888.— Prof. P. J. Van Beneden [1] published a paper under the title of 'Histoire Naturelle des Balénoptères' in which the Sei Whale is discussed at length with the other species of the genus. In the first portion of his paper he summarizes the distinctive characters of the Balænopteras, both external and internal, giving, as well, the food of the different species and a short account of the status of the Greenland Right whale fishery and that of the Norwegians on the coast of Finmark.

He then gives a valuable discussion of the distribution of the Balænopteras and compares the species described from the different seas of the world with those of the North Atlantic. He believes the members of this genus to be cosmopolitan and expresses his conviction as follows:

"Contrairement aux Baleines véritables, les Balénoptères sont probablement toutes cosmoploites, et on trouve les quatre formes de nos régions septentrionales, aussi bien dans l'Atlantique méridonale, que dans l'océan Pacifique, la mer des Indes et l'océan Austral" (*l. c.*, pp. 11–12).

Under *Balænoptera borealis* a review of the literature of the species is presented, as well as its history, synonymy, external and osteological characters, and habits. He also gives an account of its geographical distribution, a list of all the individuals which have been cast up on the shores of Europe and of the skeletons preserved in European Museums, as well as the published figures of the species and the parasites which infest it.

Although the paper is almost entirely a compilation, and but little new information is added, it is, nevertheless, a valuable contribution because of its summary of all the published material relative to the species.

1891.— Dr. H. Paul Gervais published his 'Mémoire sur deux Squelettes de Baleinoptéres,' [2] describing a fragmentary skeleton of *Balænoptera schlegeli* from Staten Island, and stating his belief that the Balænopteras of the Northern and Southern Hemispheres are specifically identical.

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[1] Mém. Cour. Ac. Roy. de Belg., 1888, T. XLI, pp. 1–145.

[2] Mission scientifique du Cap Horn, 1891, T. VI, Zoologie. Anatomie Comparée, pp. 1–58, pll. i–iv.

Although he describes the skeleton under the name *B. schlegeli* he repeatedly states that he does not consider that this species can be distinguished from *B. borealis*, and concludes his discussion as follows:

"La découverte de ce squelette, appartenant à une espèce qui n'avait pas encore été signalée dans les mers du Sud, présents donc un grand intérêt scientifique. Elle permet en effet de compléter la liste des Mysticètes qui vivent dans ces parages et d'établir d'une façon certaine que tous les Baleinoptéres qui fréquentent les mers de l'hémisphère nord sont représentés dans l'hémisphère sud avec des caractères identiques. Ce fait avait déjà été constaté pour les *Balænoptera musculus* et *B. rostrata;* il nous a été permis de le mettre en lumière pour la *Balænoptera Sibbaldii* ainsi que pour la *B. Schlegelii*, espèce qui n'est autre chose que la *B. borealis*, nom auquel on devrait substituer désormais celui de *B. laticeps*, proposé autrefois par le Dr. J. Gray, et qui rappelle un des caractères saillants de ce Cétacé, celui d'avoir un crâne proportionnellement plus large que celui de tous les autres Baleinoptères" (*l. c.*, p. 55).

1891.— Flower and Lydekker's [1] account of *Balænoptera borealis* is so brief that it may be quoted in full: "*Balænoptera borealis*, often called Rudolphi's Whale from its first describer, is a smaller species, scarcely attaining a length of 50 feet. It is bluish-black above, with oblong light-colored spots, whilst the under parts are more or less white; the whole of the tail and both sides of the flippers are black; the baleen is black, and the bristly ends fine, curling, and white; the flippers are very small, measuring one-eleventh of the total length of the body. There are 56 vertebræ, with 14 pairs of ribs. This species, according to Collett, feeds chiefly on minute crustaceans, mainly *Calanus finmarchicus* and *Euphausia inermis*, and not on fish. Until lately it was considered the rarest of the Whales of European seas, and was only known to science from a few individuals stranded on the coasts of northern Europe at long intervals, the skeletons of which have been preserved in museums. The most southern point at which it has been met with hitherto is Biarritz in France. Since the establishment of the whaling station near the North Cape it has been shown to be a regular summer visitor, and in 1885, 771 individuals were captured on the coast of Finmark."

1893.— Dr. John Struthers [2] published an important paper entitled 'On the Rudimentary Hind-Limb of a Great Fin-Whale (*Balænoptera musculus*) in Comparison with those of the Humpback Whale and the Greenland Right-Whale,' in which he describes and figures the pelvic rudiments of *B. borealis* taken from a specimen 36 feet long, which was beached alive at St. Margaret's Hope, Orkney, in the end of November, 1884. In a note on page 324, Dr. Struthers says: "The dissection of the pelvic region was made in 1885, under pressure for time, only to the depth necessary to enable me to ascertain that a femur was not present. The parts were preserved for subsequent dissection of the muscles, etc., but, under the misapprehension that I was done with them, have been mascerated since I left Aberdeen. In their natural position the pelvic bones were 12 inches apart, the hinder end 9 inches in front of the anus."

1900.— F. E. Beddard [3] in his popular book on whales has given a brief compiled account of *Balænoptera borealis* based almost entirely upon Collett's work, and has added no new information. His figure of the whale is that published by Collett in 1886.

1903.— Émil G. Racovitza [4] described the cetaceans observed during the cruise of the

[1] An Introduction to the Study of Mammals Living and Extinct, 1891, p. 244.
[2] Jour. Anat. and Phys., Vol. XXVII, 1893, pp. 291–335, pll. xvii–xx.
[3] A Book of Whales, 1900, pp. 154–156, pl. ix.
[4] Résultats du Voyage du S. Y. Belgica, Zoologie, Cétacés, 1903, pp. 38–40, and p. 56.

'Belgica,' and identified a small whale which was quite frequently seen as *Balænoptera borealis;* he did not, however, have an opportunity to examine any specimens of this cetacean. He gives a few general notes upon the exterior of the whale, as well as observations on its respiratory and diving movements. On page 56, he says:

"On a vu dans la première partie de ce mémoire qu'il existe de bonnes raisons pour croire à la présence de cette espèces, ou d'une forme très voisine, dans les glaces qui se trouvent à l'Ouest de la Terre de Graham. Les voyageurs antarctiques signalent également la présence de Balénopterès de petite taille, aussi bien dans les parages antarctiques sud-américains que sud-australiens. 4 fois (en comptant les 'Finnfische' de Dallmann) dans la premlère région entre 47° et 59° O, et 59° et 66° S, et 11 fois dans la région des Terres Victoria entre 165° et 175° E et 65° et 76° S. Mais toutes ces 15 apparations ne se rapportent certainement pas à ce type; dans la majorité des cas il s'agit d'un Balénoptère plus petit, 10 mètres environ, qui sera étudié plus bas. Il reste donc quelques citations de petits Belénoptères qui, n'étant accompagnées d'aucun détail descriptif, ne peuvent servir pour determiner si ces Cétacés visitent aussi d'autres régions que celles où nous avons constaté leur présence."

1903.— Dr. F. W. True [1] noted in 'Science' the first authentic record of the occurrence of the 'Sejhval,' *Balænoptera borealis* Lesson, in the western North Atlantic, four specimens having been captured at the whaling station in Placentia Bay, Newfoundland.

1904.— At the time Dr. F. W. True [2] wrote his great work on 'The Whalebone Whales of the Western North Atlantic,' only two or three examples of *Balænoptera borealis* had been taken on the American coasts and he did not have an opportunity to examine any individuals of this species. He has, however, published a diagnosis of the species based on Collett's account (pp. 300–301, pl. 49, fig. 2), and alluded to it in two significant sentences which are quoted below. In stating his conclusions that the whalebone whales occurring in the western North Atlantic Ocean are identical with those occurring in the eastern North Atlantic, he says:

"As no specimens of the Pollack whale, *Balænoptera borealis*, from American waters have been examined, it is not certain that the species is really the same on both sides of the Atlantic. As the other species are the same, the presumption is, of course, that the Pollack whale also undergoes no modification. This, however, requires to be demonstrated" (*l. c.*, p. 297).

In speaking of the relationship between the baleen whales of the Pacific and Atlantic Oceans, Dr. True remarks: "*Balænoptera borealis* of the eastern North Atlantic has no representative, so far as known at present, in the North Pacific,— an interesting circumstance" (*l. c.*, p. 270).

1904.— In his paper 'On the Whale Fishery from Scotland, with Some Account of the Changes in that Industry and of the Species Hunted,' Mr. Thos. Southwell [3] gives a general account of the whaling industry and, with other species, a synopsis of the characters of *Balænoptera borealis*. Plate iv shows an excellent photograph of the baleen of this species.

1905.— Mr. Thomas Southwell [4] published an interesting paper entitled 'Some Results of the North-Atlantic Fin-Whale Fishery,' in which he considers "the results of the [Norwegian whaling] operations in the three great centres of the industry, with a view to ascertaining if possible whether any racial variation is to be observed in the members of the same species

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[1] Science, N. S., Vol. XVII, No. 421, 1903, p. 150.
[2] Smith. Cont. Knowl., Vol. XXXIII, 1904.
[3] Ann. of Scottish Nat. Hist., 1904, pp. 77–90, pl. iv.
[4] Ann. and Mag. Nat. Hist., ser. 7, Vol. XVI, 1905, pp. 403–421.

frequenting the several localities, as indicated by appreciable differences in their habits, frequency or external characters" (*l. c.*, p. 405).

He discusses four species, *Balænoptera musculus* (= *B. physalus*), *Balænoptera sibbaldii* (= *B. musculus*), *Megaptera longimana* (= *M. nodosa*), and *Balænoptera borealis* Lesson. Under the last named species he gives an account of its abundance, numbers killed, time of appearance, etc., upon the coasts of Norway, Shetland, and Newfoundland. A valuable table of the length of fœtal specimens with the dates of capture is also presented.

1905–1910.— During the years 1905–10, inclusive, Mr. R. C. Haldane [1] annually published accounts of the whaling in Shetland and Scotland, giving notes and statistics of the species taken at the stations there. *Balænoptera borealis* is among the whales discussed, and the volume for 1907, pages 12–13, plate i, contains an interesting account of the animal as well as two photographs. These show the dorsal and ventral views of a specimen which had been drawn out upon the slip, and to the best of my knowledge they are the only published photographs of this species.

1906.— J. G. Millais [2] gave a popular account of the Sei Whale in which some new information relating to its distribution and habits is furnished. He presents a drawing of the skull and a shaded figure of the whale and discusses it under the headings, characters, distribution and habits. While the account of the species is excellent, his figure is unfortunately not an accurate representation of *B. borealis*.

1908.— 'Die Morphologie der Hüftbeinrudimente der Cetaceen' [3] is the title of an elaborate monograph of the pelvic rudiments of the Cetacea by Prof. O. Abel of the University of Wien. He considers this portion of the anatomy of several cetaceans and sirenians, among them *B. borealis*. He adds, however, no information to Struthers's account, merely identifying the pelvic elements and republishing his description and figures.

1910.— D. G. Lillie [4] published a paper entitled 'Observations on the Anatomy and General Biology of some Members of the Large Cetacea,' in which observations made at South Innishkea Island, west Ireland, are recorded. Although Mr. Lillie did not have an opportunity to see specimens of *Balænoptera borealis*, a reference to that species in his paper is interesting and is here quoted:

"*Balænoptera sibbaldii* Gray was taken from the end of June till September. The captures of *Balænoptera borealis* Lesson, were restricted to the last half of May and the first half of June, the last specimen being caught ten days before the first *B. sibbaldii* Gray was taken. This whale is said to leave our shores upon the arrival of *B. sibbaldii*" (*l. c.*, p. 773).

1911.— J. A. Mörch,[5] of Christiania, contributed an interesting paper upon whaling in the Southern Hemisphere entitled 'On the Natural History of Whalebone Whales.' He gives a brief review of the history of whaling in the Antarctic but says little about *Balænoptera borealis*. His references to this species are contained in the following quotations: "The species which are principally hunted are the Humpback Whale (*Megaptera boops*), the Blue Whale (*Balænoptera sibbaldii*), and the Finback Whale (*B. musculus*); and, in one locality (the Falkland Islands), the "Seihval" or Rudolphi's Whale (*B. borealis*), which also occurs on the coast of Chili and the west coast of South Africa without having been actually hunted there yet"(*l. c.*, p. 662).

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[1] Annals Scottish Nat. Hist., 1905–1910.
[2] The Mammals of Great Britain and Ireland, 1906, Vol. III, pp. 275–278, plates facing pp. 243, fig. 2, and 278, fig. 2.
[3] Denkschriften der K. Akad. der Wiss. Wien, LXXXI Band, 1908, pp. 139–195.
[4] Proc. Zool. Soc. London, 1910, April–June, pp. 769–792, pl. lxxiv, text figs. 69–78.
[5] Proc. Zool. Soc. London, 1911, pp. 661–670, text figs. 160–163.

Later in commenting upon the whales off the coast of Portuguese West Africa, he remarks: "Large schools of Rudolphi's Whales and Blue Whales have also been observed along these coasts, feeding upon plankton, but the few Blue Whales caught were all very lean. The coast of Chili, from which whaling is at present being prosecuted, also offers opportunities for interesting observations upon the periods of gestation of various species of whales, especially those of the Blue Whales and Rudolphi's Whales, which are very little known" (*l. c.*, pp. 664–665).

Again he says: "Rudolphi's Whales (*B. borealis*) are very erratic in their appearances. In 1884, for instance, only six were killed on the Finmark coast; in 1885, 659. This is a typical plankton Whale, and it appears on that coast only during the summer, feeding on *Calanus* etc. The fœtuses have a length of from 3 to 4 feet in June, from which it may be inferred that the cows give birth to their young during the latter months of the year in localities at present unknown. In Shetland in 1906 I observed on a Rudolphi's Whale, which had the front end of its lower jaw deformed, a colony of *Conchoderma auritum* fastened thereto. This is the only instance of parasites on this species that I know of" (*l. c.*, p. 668).

1911–1912.— Prof. Robert Collett [1] gave an account in Norwegian of *Balænoptera borealis*, which is substantially a republication of his paper in the Proceedings of the Zoological Society of London, 1866. After a short résumé he discusses the whale under the following heads: Distribution, External Characters, Abnormal Individuals, Hunting, Habits, Parasites, Food and Fœtus.

Under "Distribution" he gives information additional to and later than that contained in his 1886 paper, and as it is written in Norwegian, I have presented below a free translation of this section.

"Distribution. Sei Whale, called the Summer Whale, in smaller or larger herds, comes under the land of our north coast in June and disappears in August; in September it is very seldom seen.

"This species was first seen on the Finmarken coast in 1860. In 1861 the Brussels Museum received a skeleton from East Finmarken (through Eschricht), and the same year the Bergen Museum secured the skeleton of a younger individual (L. 9, 4 meters) which was stranded in June in Altenfjord.

"In August 1881, Svend Foyn, who hitherto had not bothered with this species, took the first Sei Whale outside Varangerfjord; in 1882 a regular fishery began, 8 examples being caught by M. Bull outside Sørvær and in West Finmarken. But already before that time there were more or less regular appearances; thus in 1878 five specimens stranded in the middle of July at Sørvær, in West Finmarken (where later on a whaling station was built) and the 20th of July a herd of 13 ran ashore in Billefjord, in Porsangerfjord, probably hunted by Killer Whales (*Orcinus*). As well in 1879, as in 1880 it appeared in Varangerfjord in great numbers.

"But still in the beginning of 1880, *B. borealis* was only known by a few whalers in Finmarken and through some skeletons of stranded specimens which were preserved in European museums. The external characters were as yet almost unknown.

"In 1884, Prof. Guldberg, after having visited the station at Sørvær (at Hammerfest), was able to show that the whalemen's Sei Whale belonged to this species. In 1885 great numbers of Sei Whales appeared, and in 1886 the author gave drawings of the exterior and the first accounts

[1] Norges Pattedyr, af R. Collett. Kristiania, 1911–12, pp. 596–605, two figures.

of its biology, likewise at the same time Mr. Cocks gave several enlightening observations on its coming to Finmarken during the above-named year.

"Like the Blue Whale (*B. musculus*), it is dependent on the tides that bring its food, which consists entirely of pelagic crustaceans. It follows on the whole the Gulf Stream and is more confined to the temperate waters than are the northern baleen whales. Their visits to our waters are therefore irregular; in some years they do not appear at all while in others they are seen in great numbers.

"As above mentioned, this species in 1885 appeared in great numbers on the Finmarken coast. In this year they stood under the land by the thousands right from the Tromsø coast to Varangerfjord and further on along the Murman coast. They first appeared in the middle of May but the main mass came in the beginning of July; altogether 720 were killed and brought to the factories in Finmarken this year.

"During three weeks of June great numbers remained almost at the same place outside of Sørvær, in West Finmarken, and at the same time appeared in countless numbers from the North Cape to Vardø in East Finmarken. Somewhat later they were found on the Murman coast, where the first Sei Whales were caught on the 10th of July.

"The numbers decreased quickly during the month of August; the last examples were caught outside of Varangerfjord the 28th of August, at which place a few more were seen up to the 8th of September.

"The year of 1898 was almost as good, but on the whole the catch in later years has been poor. Most of the Sei Whales have been caught off West Finmarken for they were not as common in the colder waters to the east of the North Cape.

"At the most southerly of the whaling stations, Skaarø opposite Tromsø, Sei Whales were yet caught regularly every summer; but off the coast south of Tromsø there are before us no complete records of this species. Now and again individuals are found which are stranded outside of Lofoten; among a herd of about 700 specimens of Grundhval (*Globicephalus melas*) that were caught the 4th of September 1890 in Vaterfjord, Lofoten, a small whale was found about $12\frac{1}{2}$ meters (40 feet) in length, 'with irregular white markings,' which probably was a *B. borealis*" (*l. c.*, pp. 597–599).

1912.— Mr. S. T. Burfield,[1] in his report on the 'Belmullet Whaling Station,' considers in detail both Finback and Blue Whales, but has little to say of *B. borealis*. He remarks: "There seems to be a more or less definite periodicity in the appearance of certain species of whales. Thus the whalers say that the Right whales (*Balæna biscayensis*, Gray) follow the Sejhvals (*Balænoptera borealis*, Lesson), and both disappear by the end of June. The last Sejhval caught from the Belmullet station in 1911 was brought in on May 18, but most of the first half of June was too stormy for 'fishing'" (*l. c.*, p. 154). Again he says: "The Right whales and Sejhvals are said to appear only during the earlier part of the season — in May and perhaps the early part of June" (*l. c.*, p. 158).

1913.— During his description of *Balænoptera brydei* Mr. Ørjan Olsen [2] has instituted comparisons between his new species and *B. borealis*. While his remarks concerning the latter species are chiefly confined to its external anatomy as distinguishing it from *B. brydei*, he never-

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[1] Report of the British Association for the Advancement of Science, Dundee, 1912, Sept. 4–11. London, John Murray, 1913.

[2] On the External Characters and Biology of Bryde's Whale (*Balænoptera brydei*), a new Rorqual from the coast of South Africa. Proc. Zool. Soc. London, 1913, pp. 1073–1090, pll. cix–cxiii.

theless throws some light upon the abundance of the Sei Whale in South African waters, a subject of which practically nothing was known. The most interesting section of Mr. Olsen's paper relating to *B. borealis* follows: "It is not impossible that some of the 'Sei'-Whales from Portuguese W. Africa may have been Rudolphi's whale (*B. borealis*), a typical specimen of which was captured outside Saldanha Bay in November 1912. This is the first South African specimen of *B. borealis* which has been reported further south than off Cape Blanco (20° 45′ n. l.). It was easily recognized as the proper 'seihval' by the Norwegian whalers; and Capt. P. J. Larsen kindly presented me with a quantity of the baleen, which was quite distinctive of *B. borealis*" (*l. c.*, p. 1083).

1913.— William Taylor [1] reported the find of a water-worn first cervical vertebra of *Balænoptera borealis* from the post-glacial sand of Elgin. He says: "As Elgin is about 5 miles from the sea, and the river Lossie at this point is 50 feet above sea-level, the bone must be very old. Probably it was washed out of the post-glacial sand which covers the valley at Old Mills. The only species of Rorqual common on our Moray Firth shores at present are the Common Rorqual and the Lesser Rorqual, and, as far as I know, this is the only record connecting Rudolphi's Rorqual with the Moray Firth area."

1913.— In a volume devoted to the cetaceans of the Antarctic, Dr. J. Liouville [2] gives the most extensive and valuable account of *Balænoptera borealis* from southern waters which has yet been published. He considers the dimensions, coloration, baleen, form of the body, and other details of the external anatomy, as well as the respiration, diving, food, parasites, distribution and commercial importance. His paper is a valuable contribution to the history of the species and furnishes much new information regarding the life history of the Sei Whale and its distribution. Unfortunately the drawings accompanying this publication are so crude and inaccurate that they detract from the work. The figure of *B. borealis* is especially bad, the dorsal fin being placed considerably *posterior* to the anus, and the coloration is quite unlike that of a Sei Whale.

Dr. Liouville is the first author to formally include *B. schlegeli* (Flower) in the synonymy of *B. borealis*.

Life History.

Plates XXIX–XXXII.

DISTRIBUTION AND TIME OF CAPTURE.

Finmark and Russian Lapland.— Collett [3] has given the most reliable account of the appearance of this whale on the Finmark coast. He says:

"Thus, whilst *B. borealis*, as has been stated, is a constant summer visitor on the coasts of West Finmark, where it has annually, although in varying numbers, occurred off Söröen, near Hammerfest, probably to gorge upon the 'Aate,' or the shoals of Crustacea which constitute its food, it has, as mentioned above, only exceptionally visited East Finmark, and on the coast east of the North Cape only a few specimens had been caught, and not every year.

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[1] The Scottish Naturalist, 1913, No. 21, Sept., p. 211.
[2] Dieuxième Expédition Antarctique Français. Cétacés de l'Antarctique, 1913, pp. 100–110, pl. ii, fig. 3.
[3] Proc. Zool. Soc. London, 1886, pp. 245–246 and 259–260.

"It does not, however, appear to have been altogether unknown even on this part of the coast. During a stay in Finmark in 1878, I received information that a school of 13 whales, of about 40 feet in length, had stranded in a bay of the Porsangerfjord to the east of the North Cape. I did not have an opportunity of visiting the place; but as the baleen-plates of these Whales were described as being black, it seems very probable that they belonged to this species.

"In the same month 5 similar small whales were stranded at Sörvær, near Hammerfest (where the above-mentioned factory had not then been established). Moreover, several whalers have informed me that this species visited the Varangerfjord in 1879 and 1880, but was not caught; they also noticed that whenever this species came in, *B. sibbaldi* left the coast and went out to sea.

"During the past summer, 1855, the Sejhval (*B. borealis*) came quite unexpectedly under land along the whole coast of Finmark, not singly or solitarily, but in such large numbers that, during the whole summer, most of the whales caught both in West and East Finmark consisted of this species. Of the other species, *B. sibbaldi*, *B. musculus*, and *Megaptera boops*, which in former years had formed the majority, only a comparatively small number were caught.

"Of *B. borealis* 724 specimens were caught by 18 companies stationed in Finmark, and 47 specimens by 3 companies, on the Murman coast, making together a total of 771 specimens.

"In fact they were caught by all the companies along the whole coast from Söröen, near Hammerfest, to Jarfjord in Syd Varanger, and on the Murman coast at least to Kildin. . . . .

"It has been previously stated, that in 1882 *B. borealis* first became the object of general capture, especially at the newly founded establishment at Söröen, near Hammerfest, and it appears to 'close the land' about there every year, although in varying numbers. In previous years the first specimen, according to Capt. Bull, was captured in the beginning of June. The 24th of June was about the best period for catching them, while after the 8th July they gradually disappeared, when other species generally appeared (*B. musculus* and *B. sibbaldi*).

"This year (1885) *B. borealis* coasted the land along the whole of Finmark, and formed such a considerable portion of the 'Fishery,' that it surpassed the number of all other species combined.

"The first specimens observed in shore in 1885 were captured near the establishments on Söröen, near Hammerfest, on the west coast of Finmark, the first on the 14th May, by one of the steamers belonging to Böle (Capt. Foyn); the second on the 18th by one of the Sörvær steamers (Capt. Bull). These two factories together obtained during May five specimens. Whales were under the land the whole time, but the fishery was hindered by bad weather. In the previous year this whale had never approached land so early.

"The first one captured by the whalers in East Finmark was killed on the 18th June off Nordkyn.

"Many were seen the same day, and they proceeded in an E. S. E. direction, keeping at about 4 Norwegian (over 28 English) miles from land. It was, however, some time before they appeared in any considerable numbers. First, towards the end of June, they began to be captured by several of the whalers, and even then only in small numbers. In the beginning of July, however, the numbers were greater; and during an entire month some were caught daily along the whole coast of Finmark by all the companies; and occasionally several individuals were captured in a day by the same company. The best period was the latter half of July. In the course of August their numbers diminished, but even towards the end of the month several were

caught, but the 'schools' appeared then to be more under the Murman coast or further out at sea. The last one obtained was by Captain Sörensen on the 28th August, but others were seen during the first week in September (the last time being the 8th September)."

A. H. Cocks, Esq.,[1] in his account of 'The Finwhale Fishery of 1885 on the North European Coast,' says of *Balænoptera borealis:* "The season of 1885 was a very remarkable one. On the one hand, Rudolphi's Rorqual, which was previously only known to the Eastward of the North Cape as an accidental straggler, appeared last year in thousands along the whole coast shore whose waters are hunted by the Norwegian and Russian Finwhalers, over 700 of this species having been captured; on the other hand, Sibbald's Rorqual, or the Blue whale, hitherto the principal object of pursuit, was extremely scarce, several of the Norwegian companies not having taken a single example, the average being less than one per boat; while the Russian boats averaged exactly half a dozen each, the number of this species killed by the three Russian companies actually exceeding that taken by the nineteen Norwegian establishments."

The following year, Mr. Cocks says of the appearance of *Balænoptera borealis* on the Finmark coast: "Rudolphi's Rorqual, which in 1885, for the first time on record, appeared in such large numbers to the eastwards of the North Cape, last year confined itself again to its usual habitat, only eight individuals being taken by ships of the companies having their stations to the east of that headland, and it is quite likely that some, and possibly all, even of this small number were actually killed to the *westward* of it. None were even *seen* by the Russian boats" (*l. c.*, 1887, p. 207).

Writing of the 1887 fishery, Mr. Cocks remarks that the number of Sei Whales killed was nearly six times the total of 1886, and says: "Capt. Bull reports that from the latter half of June, through July, a number of Rudolphi's Rorquals were seen round Loppen Island, and in Sörö Sound, also by Skjærvö in Kvenangen Fjord, right up to Reisen. A reference to the list at the end of this paper will show that he captured the astonishing number of 110 of this species! Capt. Berg says that in July they were sometimes seen in small numbers to the eastward of the North Cape; the average take of this species for the companies of which I have returns — omitting Capt. Bull's — being about $4\frac{2}{3}$ per vessel. Of course the fact must not be lost sight of, that these smaller whales are not hunted when bigger game is to be found.

"Capt. Bull captured his last Rudolphi, and his last whale for the season, on August 12th; his first Rudolphi was obtained on May 21st. Of the two remaining species, his first Common Rorqual was killed on April 16th, and his last on August 6th; his first Humpback — his first whale for the season — on March 28th, and his last on August 7th.

"Captain Bull sends me an interesting note, in addition to the above, of which the following is a translation:— 'In West Finmarken common Rorquals generally come under the coast in the month of July, at the same time that Rudolphi's Rorquals usually leave the coast. This year, on the contrary, the Rudolphi's were under the land right up to the middle of August, and in July the Blue whales came under the land, while, meantime, the Common Finners only presented themselves to the extent of a couple of individuals.' In former seasons Capt. Bull, in his West Finmarken cruising-grounds, only obtained two or three examples of the Blue Whale each year, but between the 8th and 29th July last he captured no less than seventeen of these leviathans. The above he considers as a (further) proof that Blue Whales and Rudolphi's live on the same kind of 'kril' (= *Thysanopoda inermis*)" (*l. c.*, 1888, p. 204).

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[1] The Zoologist, series 3, vol. X, 1886, pp. 121.

Mr. Cocks says little about *Balænoptera borealis* in his report of the 1888 Finwhale fishery. He remarks: "Common Rorquals *increased* by nearly five times; the unprecedented catch of 110 Rudolphi's Rorquals in 1887, was last season reduced to the yet extraordinary number of 60; and Humpbacks 11, against 4 in 1887." Again in a letter from Captain M. C. Bull of Söröen, West Finmark, which Mr. Cocks publishes is the following: "'Rudolphi's Rorqual: were under the coast in July, but not in such large numbers as in 1887'" (*l. c.*, 1889, pp. 282 and 286).

In speaking of whaling in Norway, Mr. Southwell[1] says: "Of 2266 fin whales killed in Norway in the years 1886, 1887, and 1889 (omitting the abnormal kill of 771 in 1885), 420, or 18.5 per cent., were Rudolphi's rorquals."

Scotland, Ireland, and Shetland.— Mr. R. C. Haldane, who published annually for several years in the 'Annals of Scottish Natural History' accounts of the whaling industry in Scotland, says of *Balænoptera borealis:* "In Scotland and Shetland during the season of 1905, 34 Rudolphi's Rorqual were killed. The largest bull was 47 feet long, the longest cow 46 feet. The average size works out — 18 bulls, average 39.9 feet; 16 cows, average 40 feet"(*l. c.*, 1906, pp. 135–136).

In his account the following year, he says that the season of 1906 was a very productive one, the large numbers of *B. borealis* killed being very remarkable. His remarks on this species are as follows:

"I have just stated that these whales came in vast numbers this year. In 1904 the four Shetland stations had only five of these whales. In 1905 the number went up to thirty-two, of which the Olna station had twenty-seven and the Alexandra none. 1906 showed the extraordinary number of 262. It was not only off the Shetland coast where they were, but off Harris they seemed just as plentiful. Once off the coast of Finmark there was a similar invasion, when Finner whales kept away; the following year they were gone. To those who are interested in the migration of fish and other denizens of the sea this will be noteworthy. These whales feed on much the same food as *B. sibbaldii* and do not eat fish. Hjort gives the length as from 40 to 50 feet... A note from the manager (of the Buneveneader station) says: 'From 13th June to 6th of July 62 Seihval were killed near St. Kilda; 22 of these were female, but no fœtus; dimensions, 36 to 48 feet and from 14–20 (girth). A storm came and brought them away (6th July), so none were to be seen on the fishing grounds after that.'

"The last paragraph is very interesting; the whales, curious, changeful creatures, went off on account of a storm. In Shetland we had fine weather at the time and they stayed on for another twelve days and left us on the 18th July. We had a storm on the 19th, few were seen after that. I particularly wanted a small fœtus of *B. borealis* for the University Museum of Zoölogy, Cambridge, but during the month they were near us the fœtuses were all too large. In this they seem different from *B. musculus*, the fœtuses of which vary greatly in size" (*l. c.*, 1907, pp. 12–13).

In his report of the whaling in Scotland for 1907 Mr. Haldane says that the season was a very productive one, the whales appearing in large numbers and showing no signs of diminution, and that 151 examples of *B. borealis* were killed. He also gives the number of whales taken at the Thorsvig station at Faroe Islands where 18 of this species were captured.

In regard to the whaling in Scotland for 1908, he says: "*B. borealis* were more abundant, *B. musculus* scarcer than last year; the reason given for this is that during the time of the 40-mile limit there were plenty of *B. musculus* within the limit, doubtless feeding on the herring

[1] Ann. and Mag. Nat. Hist., Ser. VII, Vol. XVI, 1905, p. 421.

which were abundant on the west coast of Shetland, while beyond the 40 miles *B. borealis* were plentiful and *B. musculus* not so numerous."

Again he remarks of this species:

"These whales were plentiful this last season; to my mind the most graceful of all whales, as its proportions are so perfect and wanting the clumsy strength of the two larger Balænoptera, Sperms, and Megaptera. It is also far the best whale to eat, the flesh tasting of something between pork and veal, and quite tender. . . .

"The Seihval are certainly the second most common whales in Shetland waters, always excepting *B. rostrata* and the smaller whales, of which I know nothing. But I have noticed that they are restless — one week there will be plenty, the next week none. I have before pointed out how a storm took them away both from Buneveneader and Shetland; they certainly seem to be of a shy nature" (*l. c.*, 1909, pp. 63, 67).

He also states that at the Dansk Hvalfangst and Fiskin Co. fifty-one of this species were taken.

Mr. Haldane's report on whaling in Scotland for 1909 is very brief. He states that forty-four Sei Whales were taken at the Buneveneader station and that in Shetland except for three *Megaptera* at the Olna station only *B. musculus* (= *B. physalus*) and *B. borealis* were killed.

J. G. Millais, Esq., says: "Both in the deep seas and the narrow voes and tide-races of Shetland and the Hebrides this species is common in summer, and within a mile of the northern coasts one is almost certain to see one or more of these Whales in a day's cruise. I counted seventeen in one day when seal-hunting between Whalsey and the Muckle Skerries. The high and hooked back fin renders them easy to distinguish. To Shetland they come in varying numbers. In 1904 only nine were killed; in 1905 thirty-four were taken in Shetland and the Hebrides. In 1906, however, they came in great numbers to the north of Shetland, and Mr. Haldane informs me that up to July 1 out of fifty Whales killed at the Alexandra station nearly half were of this species.

"The records of specimens stranded on the coasts of England, Scotland, and Ireland are so numerous that we need not refer to them, as they do not give any information not already well known, although pointing to the fact that they are often trapped in shallows on their southern migration. My Lydekker points out that Biarritz is the most southerly point at which this Whale has been obtained" (*l. c.*, p. 277).

Mr. D. J. Lillie states that during the season of 1908 the catch of whales at the Innishkea, west Ireland, station was as follows:

"5 *Balæna biscayensis* Gray [= *B. glacialis*].

21 *Balænoptera musculus* Linnæus [= *B. physalus*].

19 *Balænoptera sibbaldii* Gray [= *B. musculus*].

31 *Balænoptera borealis* Lesson.

1 *Megaptera longimana* Rudolphi [= *M. nodosa*]."

During 1909, out of 102 whales, 9 *B. borealis* were taken.

Iceland.— When in 1903, the Norwegian Storthing prohibited whaling in Norway several stations were erected on the coasts of Iceland and many *Balænoptera borealis* taken there. Mr. Haldane states that at Captain Bull's station at Nordfjord, East Iceland, during 1906, one Sei Whale was killed and two during 1908.

Newfoundland.— In 1903, Dr. F. W. True published a note in 'Science' which is so interesting that it is here quoted almost in its entirety:

"I am in receipt of reliable information that during the season of 1902 four finback whales of a species corresponding to, or identical with, *Balænoptera borealis* Lesson were taken at the whaling station at Rose-au-Rue, Placentia Bay, Newfoundland. This is the first authentic record of this form of finback in the western North Atlantic. The species is called 'Sejhval' (pollack whale) by the Norwegian whalers. Whether the species taken at Newfoundland is really identical with the European species can of course only be determined by examination of specimens.

"The species named *B. tuberosa* by Cope, on the basis of a specimen killed in Mobjack Bay, Virginia, may be the same as the Newfoundland pollack whale, but the description of that species is inadequate for a positive determination, and the whereabouts of the type is at present uncertain. It is quite as probable that the Mobjack Bay whale represented *B. physalus* L." (*l. c.*, p. 150).

J. G. Millais, Esq., who has spent much time in Newfoundland, writing in 1906 in his 'Mammals of Great Britain and Ireland,' says: "Rudolphi's Rorqual also visits the coast of Newfoundland in large numbers in certain seasons, but is seldom killed owing to its small value.[1] About thirty to forty are usually captured and are taken near the south coast station. Captain Nilsen tells me that they first put in an appearance in August and September on the south coast of Newfoundland, their favorite resorts being Hermitage, Fortune, and Placentia Bays. In August 1903 Placentia Bay was swarming with these Whales, but the whalers did not kill one.

"Of their distribution on the western side of the Atlantic we know little. Captains Nilsen and Larsen inform me that *Seihvalen* are most numerous in summer on the Labrador coast north of Battle Harbour, where they have seen large numbers of this species and the Lesser Rorqual. Near Iceland it is well known, but it is not killed by the whalers" (*l. c.*, pp. 276–277).

An examination of the reports of the "Department of Marine and Fisheries" of Newfoundland shows that in 1904, 39 Sei Whales were killed, and in 1905, 1906, and 1909, 2 were taken in each year. None were captured in either 1908 or 1911, but I have not the reports for 1910, 1912 or 1913.

Two letters from Mr. John Harvey, of Harvey & Co., a firm which has conducted whaling operations in Newfoundland since the beginning of the shore-industry there, gives some interesting information regarding Sei Whales. Extracts from these letters under dates of May 26, and June 12, 1914, are as follows:

"Replying to your esteemed inquiry of the 18th just to hand. We have to advise that no Sei Whales, practically speaking, are now taken in these waters, nor have there been any Sei Whales taken, so far as the writer's information goes, for several years.

"Some time ago a very few of these whales were brought in, but so far as the operations of the *Cabot*, our own whaling steamer, goes, we do not think she ever brought in over two or three in any season and we think the same experience covers that of the other whaling company's steamers."

Mr. Harvey further writes (June 12):

"As far as I can find out, no Sei Whales have been caught here for over two years, and the last year, 1912 early, only two Sei Whales were got.

"The reason Sei Whales are not killed in Newfoundland at present is, that they are not here. The whalers will take Sei Whales or anything else they can get. . . . . I think there have never been

[1] Only two were shot in 1905.

very many Sei Whales in these waters. As a matter of opinion purely, I should doubt whether in any year more than a dozen or fifteen Sei Whales have been caught by the entire fleet, carrying on whaling operations about Newfoundland and Labrador.

"Since I last wrote you (May 26) nothing at all has been done with whales, practically speaking. There are three and possibly four steamers now operating along the South coast of Newfoundland and as far as I can learn the catch to date is 2 Sulphurbottoms [*Balænoptera musculus*] and 1 Finback or Humpback. Of course the weather has been bad and our reports are that the prospects are somewhat improving as the caplin are beginning to come into shore."

These letters from Mr. Harvey and the Fishery reports seem to demonstrate that Sei Whales are stragglers on the Atlantic coast of North America and that in recent years, at least, they have not been there in any numbers. Their sudden appearance at Newfoundland in 1902 is interesting when compared with their invasion of the waters east of the North Cape, Finmark, in 1885.

Massachusetts.— Dr. Glover M. Allen, of the Museum of Comparative Zoölogy, Cambridge, has very kindly allowed me to publish here the record of a specimen of *B. borealis* stranded at Chatham, in August, 1910. The lighthouse keepers preserved some of the baleen and two ribs with one ramus of the jaw which Dr. Allen secured and placed in the Museum. This is the first record of *B. borealis* on the western Atlantic coast, south of Newfoundland.

Japan.— The occurrence of this species in the North Pacific was unknown to the scientific world until my work in Japan during 1912. The Sei Whale, called by the natives *Iwashi Kujira* (Sardine Whale) is probably the most abundant of the large Cetacea in Japanese waters, and during June, July, and August constitutes the greater part of the summer fishery.

That it has been known to the natives for some time is attested by the fact that in 1830 Schlegel named this species *Balænoptera arctica* and says that in a Japanese work upon the Cetacea there is the figure and description of a young individual which on March 6, 1760, was cast up on the coast of Kii province.

Vancouver Island.— There is every reason to believe that *B. borealis* should occur with the other Balænopteras upon the west coast of North America, but up to the present time I have no entirely trustworthy records of their appearance there. Since 1908 I have personally talked with many whalemen who have hunted on the west coast from Washington to the Aleutian Islands, but all have assured me that they have never seen a Sei Whale.

My friend, Mr. Sydney C. Ruck of Victoria, B. C., Superintendent of the Canadian North Pacific Fisheries, Ltd., writes me on May 7, 1914, as follows: "As regards Sei Whales. At Sechart (Vancouver Is.) last year we captured two. These were secured by one of our boats manned entirely by Norwegians, and although I did not see the whales myself I think there can be no doubt about them being Sei Whales as the Norwegians have seen these whales in the Atlantic and also our Manager at Sechart (Mr. Gosney) was formerly at a station in Newfoundland where many of this species were handled. If it had been one of our local gunners who pronounced them to be Sei Whales, I should have been somewhat doubtful. These whales were included in our records as Finbacks but we have details of length, etc., which are as follows:

"Sei Whales captured May 21st, 1913, at Sechart station:

No. 1 Female — 60 ft. long, fœtus 42 inches.

" 2 Male — 50 " "

"Although I have never had the opportunity of seeing any Sei Whales on this coast, on

several occasions our stations have reported whales about which they were doubtful as regards species, the doubt being whether they were Sei Whales or Finbacks cross-breed."

Inasmuch as the maximum length for the Pacific Sei Whales is 53 feet it appears to me that there is strong reason to believe that at least one of the specimens mentioned by Mr. Ruck was not *B. borealis*. On the other hand it seems improbable that men who had once killed or 'cut in' Sei Whales would not recognize the species. However, further proof must be forthcoming before the appearance of *B. borealis* along the west coast of America can be considered as established.

Falkland, South Shetland, and South Georgia Islands, Chile, and South Africa.— Mr. J. A. Mörch says in regard to the whaling operations in the Southern Hemisphere:

"The species which are principally hunted are the Humpback whale (*Megaptera boops*), the Blue whale (*Balænoptera sibbaldii*), and the Finback whale (*B. musculus*); and, in one locality (the Falkland Islands), the 'Seihval' or Rudolphi's Whale (*B. borealis*), which also occurs on the coast of Chili and the west coast of South Africa without having been actually hunted there yet," (*l. c.*, p. 662).

In his description of *Balænoptera brydei*, from the coast of South Africa, Mr. Ørjan Olsen speaks of *B. borealis* as follows: "It is not impossible that some of the 'Sei'-whales from Portuguese W. Africa may have been Rudolphi's whale (*B. borealis*) a typical specimen of which was captured outside Saldanha Bay in November, 1912. This is the first S. African specimen of *B. borealis* which has been reported further south than off Cape Blanco (20° 45′ N. l.). It was easily recognized as the proper 'seihval' by the Norwegian whalers; and Capt. P. J. Larsen kindly presented me with a quantity of baleen, which was quite distinctive of *B. borealis*" (*l. c.*, 1083).

My friend, Captain H. G. Melsom, with whom I spent many pleasant days in Korea while studying the California Gray Whale, since the winter of 1912, has been hunting whales at the South Orkney Islands. He writes me on June 5, 1914, from Tønsberg, Norway, where he has just returned, as follows:

"We have had a bad season at the Orkneys; a strange thing because last year it was literally thick with whales, and this year there were but few. That they got killed or driven off is impossible for the hunting was only going on for 2½ months and only in a very limited area. You ask about Sei Whales. They do not appear in the South seas near Orkneys or Shetland, but there are plenty of them around the Falklands and I have passed thousands of Sei Whales between the Falklands and 20° S. L. off Cape Frio, Brazil. Also they have appeared round South Georgia this year for the first time.

"But everything was changed this year. At the Orkneys very few whales, and at Georgia also few, with some Sei, but around the Falklands plenty all the time."

In a letter from Mr. W. P. Pycraft, who has been engaged in editing the notes secured on cetaceans of the South Atlantic by the late Major Barrett-Hamilton, there is the following under date of June 18, 1914: "*Balænoptera borealis* was, I believe, met with in large numbers at the Falklands; it was, indeed, the dominant species there, but it has been so ruthlessly slaughtered as to have become no longer worth fishing for. It seems never to occur at South Georgia."

We also have as a record from the vicinity of Cape Horn (Staten Island) the skeleton described in 1891 by Paul Gervais under the name *Balænoptera schlegeli* (Flower), and the

observations of Dr. Liouville in the vicinity of the Shetland Islands. His remarks as to the "Aire de dispersion" are:

"Il ne semble pas que *B. borealis* soit un Mystacocète côtier. Nous l'avons vu au large de la Baie Matha, dans le Détroit de Bransfield et par travers des Shetlands Australes. Racovizta ne l'a aperçu que dans la banquise flottante qui dérive à l'Ouest de la Terre de Graham. Les autres *Minkehvlen* signalés par les auteurs antarctiques avaient toujours été observés au large. Depuis notre retour, Amundsen, à bord du 'Fram,' en a vu un très grand nombre dans la Baie des Baleines, tout côntre la Grande Barrière de glace de Ross. Ses films cinématographiques, pris à cet endroit, en révélaient des quantitiés, nettement distinctes par leurs taches, au millieu des autres Baleinoptères à peau plus foncée. C'est donc un des Mystacocètes qui s'avancent le plus vers le Pôle Sud. Ses mœurs d'habitant de la banquise lui permettent meme, en cheminant au voisinage des canaux qui se forment sans cesse à sa surface, de se rapprocher plus qu'aucun autre de ce point" (*l. c.*, p. 110).

I can not feel as certain as does Dr. Liouville that many of the whales identified by Racovitza and others were *B. borealis* and not *B. acuto-rostrata*, which could easily be mistaken for it because of its small size and falcate dorsal fin.

Java.— The skeleton in the Leyden Museum which was taken on the northwest coast of Java, and is the type of *Balænoptera schlegeli* (Flower), is the only record of this species from those waters. Flower says regarding this skeleton: "According to the statement received with the specimen, whales are of rare occurrence upon that coast, the present one having been an object of great curiosity to the natives" (*l. c.*, p. 400).

During a cruise of several months among the Dutch East India Islands in 1909, I saw no whales whatever although constantly watching for them.

Summary.— According to the observations presented above, *Balænoptera borealis* is known in the North Atlantic from the coasts of Europe, Newfoundland, Massachusetts and Labrador; in the South Atlantic along the coasts of South Africa and of South America from latitude 20° S. to the Shetland Islands. In the North Pacific from Japan and possibly from Vancouver Is.; in the South Pacific from Java and Chile.

Migration.— In the western North Pacific the Sei Whales seem to have more or less regular migrations. The records furnished by the whaling company show that during 1909, 1910, 1912, 1913 and 1914 the total number of Sei Whales taken each month in the winter were as follows: 8 during November, 2 in December, 8 during January, 11 during February, and 6 in March. These were all captured at the following stations in the southern part of the main islands: November, Oshima and Nikishima; December, Nikishima; January, Nikishima, Hososhima and Oshima; February, Shimizu; March, Oshima and Shimizu.

When I arrived in Oshima, Kuishiu, on April 6, the Sei Whales were just beginning to come, and I was told that a little later in the spring they were almost the only species taken there. After leaving Oshima I went in the middle of May to Aikawa, a small village in Rikuzen province, about 300 miles north of Tokyo on the Pacific side, where the Toyo Hogei Kaisha had a large and important station. At the time I arrived only Finbacks were being taken, but it was said that the Sei Whales would appear later in the summer.

The first Sei Whale to be killed at this station, from which eight ships were hunting, was on June 8, and it may be safely affirmed that this animal was one of the first arrivals in the north, for all the whalers were on the watch for them. From June 8 until September 1, when the

station closed, Sei Whales were killed almost every day. During June, July, and August they were far more abundant than any other species and in the last two months, with the exception of an occasional herd of Sperm Whales, were almost the only large cetaceans to be found. Toward the end of August their numbers had so much diminished that it was no longer profitable to operate the station and it was closed until the following spring. By consulting the tables it will be seen that June was the month in which the greatest number were taken, July was a close second, and that by August the numbers had greatly decreased, except in the year 1914. These figures give a very fair idea of the relative abundance of Sei Whales during the different months, although in some cases (*i. e.*, 1914) they were undoubtedly affected by the opening or closing of certain stations or the abundance of other whales, for *B. borealis* is not killed when larger species are to be had. There is little doubt, however, that June and July are the months of greatest abundance on the Japanese coast. The statistics of the whaling company show that from 1910 to 1914 only four Sei Whales were taken in the Japan sea; one was killed at Shimpo, Korea, and three at Hidakatsu, on the island of Tsushima, and Capt. H. G. Melsom says that during 14 years of hunting on the Siberia and Korea coasts he never saw Sei Whales.

In the North Atlantic, on the Norwegian coast, according to Collett, the Sei Whales come "under the land" in June and disappear in August, very few remaining as late as September. They are regular visitors to West Finmark but are not as common east of the North Cape.

Their visits are very irregular, in some years the animals do not appear at all while in others they are seen in great numbers. Collett, Cocks, and other authors have chronicled the great invasion of these whales along the whole coast of Finmark and Russian Lapland in 1885, when they came in thousands and far outnumbered all other species. A similar invasion occurred in 1898, according to Collett, but he says that in later years the catch has been much less. During 1885, the first Sei Whales appeared in the middle of May, but the main body did not arrive until the beginning of July; in August the numbers decreased rapidly and by the 8th of September all were gone. In the following year (1886) the Sei Whales appeared in their usual numbers and confined themselves to their accustomed habitat along the shores of west Finmark, only five being killed east of the North Cape.

Mr. R. C. Haldane reports that in 1906, on the coasts of Scotland and Shetland, enormous numbers of Sei Whales appeared, as they had done in Finmark during 1885; the time of their arrival was between the middle of June and the middle of July.

These observations show that in the eastern North Atlantic the Sei Whales have more or less regular migration periods, and that from June until September they may be found along the north European coast in varying numbers.

It is interesting to compare the movements of the Sei Whales in the Atlantic and Pacific oceans. In the Atlantic these animals reach the North Cape, approximately in latitude 70° N., during early June and leave in late August. In the Pacific at Aikawa, Japan, approximately in latitude 40° N., the Sei Whales also come in early June and begin to leave in August.

The fact that this species arrives at Aikawa and the North Cape at the same time, although the former point is nearly 2000 miles south of the latter, may possibly be connected with the action of the ocean currents. An Arctic current extends southward past Kamshatka, the Kurile Islands and Hondo to some distance south of Aikawa, while along the main islands of Japan south of Tokyo runs the warm "Kuro Shiro," or Black Current. The Sei Whales which spend the winter near Oshima and Nikishima are in comparatively warm waters, and in the spring

the main mass reaches there early in April. They work slowly northward until the Arctic current is met a little south of Aikawa and arrive at that place about the middle of June; how much further north they go is problematical but numbers have been taken at the recently erected station of Same on the northern end of Hondo.

On the European coast as the whales travel northward past Scotland and Shetland they are in the warm Gulf Stream, which finally sweeps in toward the North Cape. They do not meet the Arctic current until latitude 70° N. is reached, while in the Pacific the cold water is encountered a little south of 40° N.

Collett and others have remarked that *B. borealis* is a temperate water whale and does not often go to the eastward of the North Cape because of the icy water there. This hypothesis might explain conditions in the North Atlantic and North Pacific if Dr. Liouville's observations on the Sei Whales of the South Atlantic were left out of consideration. In that region, the animals about the Falkland and Shetland Islands are continually in frigid currents and Dr. Liouville believes this species goes further toward the South Pole than any other Fin Whale.

My own study of the genus *Balænoptera* has led me to conclude that *the temperature of the water is of comparatively little importance in determining their movements.*

The extent of the migrations of the Sei Whales in the widely different localities where they have been observed is largely a matter of conjecture. That this species can, and does, go around Cape Horn from the South Atlantic into the South Pacific Ocean I think no one will dispute, and I believe that the evidence points strongly to the conclusion that from time to time individuals actually travel from the North to the South Atlantic and into the Pacific, or *vice versa*. There appears to be no barriers in either temperature or food supply to prevent such extended travels because *B. borealis* is apparently indifferent alike to tropic or arctic water, and the crustaceans which form the greater part of its food are present in almost every ocean of the world.

The parasites, of which *B. borealis* is the host, appear to give a clue to the movements of these whales. All the specimens brought to the stations in Japan were thickly covered with scars due to the action of parasitic cirripeds, probably *Coronula*, and the Copepod *Penella antarctica* Quidor, *but very few of the parasites remained attached to their hosts.* Collett discusses at length the peculiar scars left by the *Penella*, but did not suspect they were due to parasites, since none were found upon the whales which he observed.

Dr. Liouville states (see 'Parasites') that parasites of the genera *Coronula, Tubicinella, Penella,* and *Cyamus* were present in great numbers upon *B. borealis* in the South Atlantic but, except *Penella*, these have not been recorded upon Sei Whales from other localities.

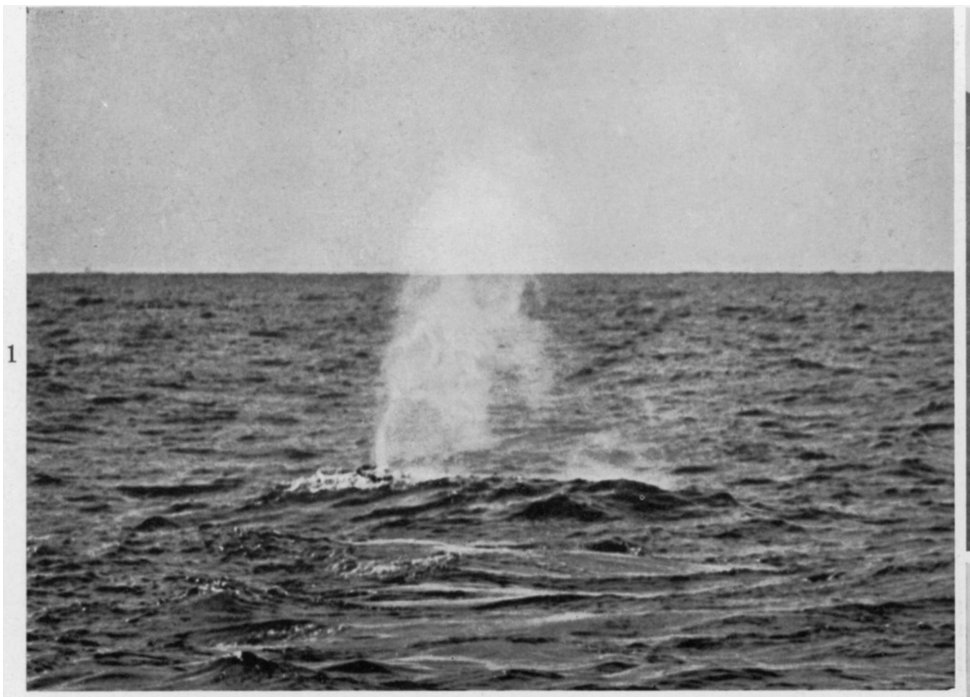
The *Penella* which Dr. Liouville removed from the Sei Whales of the South Atlantic were *P. antarctica* Quidor, and I was surprised to find that those which I collected from *B. borealis* of the Japanese coast belong to the same species. Prof. Chas. B. Wilson, to whom my specimens were sent for identification, writes in regard to them: "*Penella* is a cold water genus — almost exclusively so — and the waters of the South Atlantic and Antarctic are especially productive of them. I know that these parasites are comparatively short lived, and I believe that they would be killed or die a natural death during such migrations of their hosts as you suggest. At all events the particular species which you obtained is undoubtedly an Antarctic species, since it was found there in large numbers but has never before been found in northern waters. Would it not be possible that infection with these troublesome parasites might constitute a strong incentive to such migrations, especially since the whales apparently get rid of them *en route* and are not infested again while they remain in northern waters?"

PLATE XXIX.

PLATE XXIX.

Balænoptera borealis.

Fig. 1. Side view of a spout; full height.
Fig. 2. Posterior view of a spout; full height.
Fig. 3. Low spout.
Fig. 4. Spout of a Sei Whale fast to a ship.
Fig. 5. " " " Finback Whale.
Fig. 6. " " " Sei Whale fast to a ship.
Fig. 7. " " " " " " " " "
Fig. 8. " " " " " " " " "



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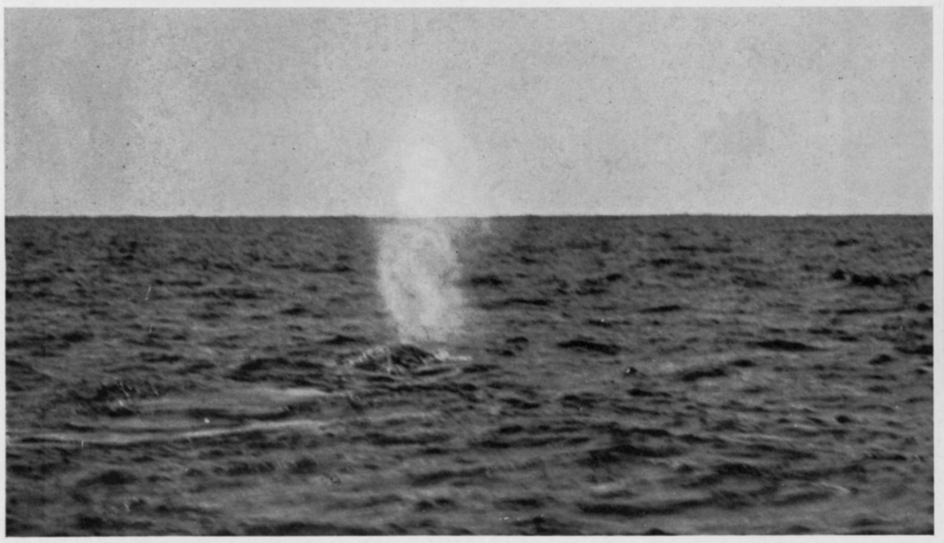

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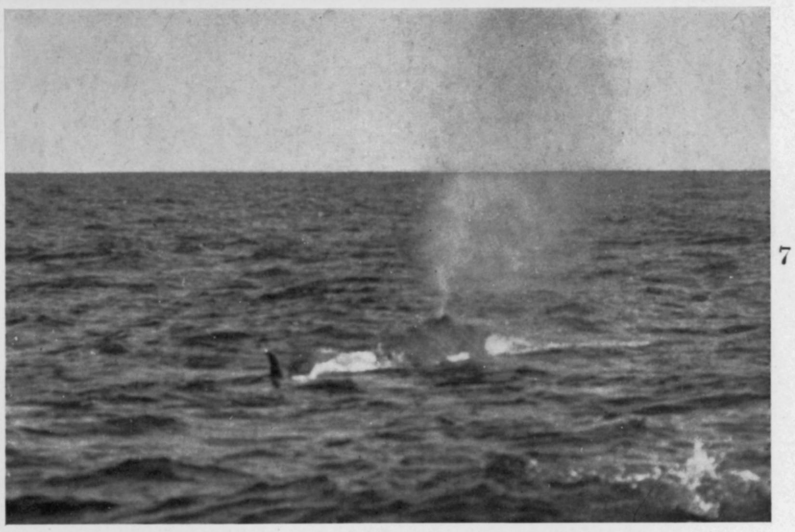

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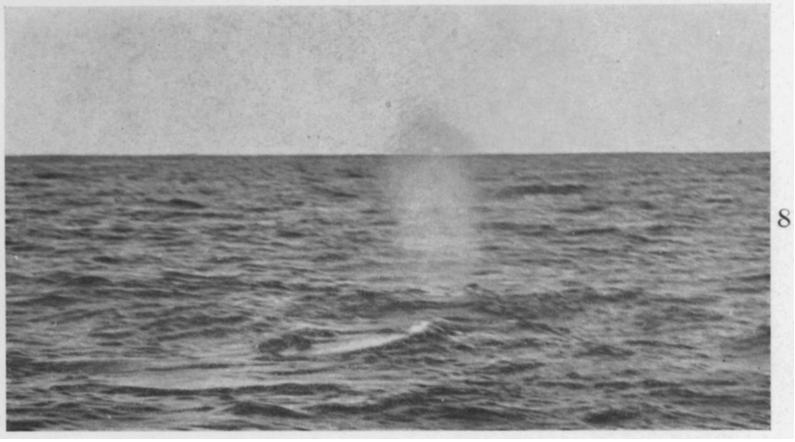

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Balænoptera borealis.

The facts that hundreds of scars left by *Penella* and *Coronula* are found on the body of *B. borealis* and practically none of the parasites themselves: that the *Penella* is identical with the species present in great numbers upon the Sei Whales in the Antarctic, and that this form has never been recorded from northern waters, together with the wandering disposition of *B. borealis*, appear to indicate that this species may actually migrate from the South Atlantic and Pacific northward to the coasts of Norway and Japan; that while in the south the parasites are contracted and that before the whales reach the northern latitudes most of the *Penella* and *Coronula* either die or break off and the wounds heal.

It should not be inferred that I believe *all* Sei Whales make annual migrations from the North to the South Atlantic and Pacific; in fact it is highly improbable that such is the case. Indications point strongly to the fact that *some* individuals do travel from the North to the South Atlantic and Pacific, and probably in all oceans certain herds are formed which visit the same localities every season for several years, migrating annually for comparatively short distances as the food moves, and reinforced by stragglers which have arrived from either the north or south. Probably it is on such recent arrivals that the *Penella* are found *in situ* while on those individuals which have remained in the northern waters for one or more seasons the parasites have all died or dropped off and the scars healed.

The sudden appearance in 1885 of great numbers of Sei Whales east of the North Cape, Norway, where previously they had only been seen as stragglers, and of similar invasions of the waters about Scotland; also their arrival at Newfoundland in 1902 and at the South Georgia Islands in 1913–1914 where before they were quite unknown, indicate that *B. borealis* has a roving disposition and sometimes travels great distances in its wanderings.

Spouting.— The spout of *Balænoptera borealis* is neither as dense nor as high as that of the Finback Whale which it most resembles. Under normal conditions it ascends vertically about ten to fourteen feet in a roughly cone-shaped column of vapor which quickly dissolves or drifts away on the wind. Plate XXIX, Fig. 1, shows a side view of the spout of a Sei Whale and near it (Plate XXIX, Fig. 5), for comparison, that of a Finback. When both photographs were taken a light wind was blowing, but because of its greater density this had little effect upon the Finback's spout, while in the case of the Sei Whale the vapor was beginning to drift away almost before it had reached its full height.

Because of its lightness, the Sei Whale's spout is easily influenced by weather conditions and is consequently more variable in form than is usual with other whales. It may be a wide, bushy spray as shown in Plate XXIX, Figs. 1, 2, 6, or a low, fountain-like jet, as in Plate XXIX, Fig. 3.

In Plate XXX, Fig. 1, the spout of a whale which is fast to the ship has only risen a few feet above the surface, and in Plate XXX, Fig. 2, the spout is dissolving.

As in all whales, the height and density of the vapor column is dependent upon the length of time the air has been retained in the lungs; if the period of submergence has been considerable the spout will be much higher and denser than if the whale had been below only a few minutes. It is generally possible to distinguish the spout of *B. borealis* from that of other species but by no means invariably so, and frequently one can not be certain that one is observing a Sei Whale until the high dorsal fin appears; this can be seen at a considerable distance and is an unfailing identification mark.

The delivery of the spout is invariably accompanied by a metallic whistling sound, as is usual with all other large cetaceans, caused by the rush of air through the pipe-like nostrils.

This is by no means as loud as in the Finback or Blue Whales, but on a still day it can be heard for more than a mile.

As soon as the spout has been delivered the refilling of the lungs begins and continues for several seconds. During inspiration the nostrils are opened to their fullest extent, taking the form of a wide ellipse, and are protruded in a remarkable manner; the protrusion is probably to prevent water from entering the lungs. Plate XXX, Fig. 4, shows the wide open nostrils in an excellent manner. The photograph was taken from above and directly behind the animal, the spout having just dissolved. Plate XXX, Figs. 2 and 3, and Plate XXXI, Figs. 1 and 5, also show the same condition from a three-quarter posterior view.

I had an opportunity to examine carefully the blowholes of a Sei Whale fœtus, 259 cm. (8′ 6″) long, with a view of determining how they are protruded. The nostrils are situated between two prominences which meet anteriorly. By inserting my fingers in the blow-holes and pressing downward and forward enough to open the nasal passages the prominences at the sides and in front of the nostrils were thereby considerably raised, which must be the position they assume during the act of spouting. By spreading the blowholes until they took the form of a wide ellipse, which, as shown by the photographs, is their condition during inspiration, both edges of the nostrils were still more raised, the inner slightly and the outer greatly. Thus the act of opening the nasal passages either for the exhalation or inhalation of air itself raises the surrounding parts.

Of the Sei Whale's spout, J. G. Millais[1] says: "The spout is not high, about eight to twelve feet, and exactly like that emitted by the Finback, but on a smaller scale. In the sea this species can be recognized at once by its relatively large and deeply hooked dorsal fin, which is always a conspicuous object as it rolls over. The whalers think that this species does not swim deeply when in pursuit of its food, as its course on a still day can be marked by the line of bubbles which come to the surface."

Collett says of *B. borealis:*[2] "As a rule they blow only once or twice, whilst the other kinds blow as often as five or six times during each visit to the surface, and they swim for a considerable distance before they again appear. Their course under the water can be traced by the bubbles of air which appear on the surface. When in amongst a shoal of *Calanus finmarchicus*, and on the feed, they swim quite slowly, with their snout and half of their back above water. The *B. musculus* [= *B. physalus*] and the *B. sibbaldi* [= *B. musculus*] under such circumstances often turn on their side whilst swimming, with their mouths open to take the crustaceans. . . . All the whalers are unanimous in opinion that *B. borealis* (as well as *B. musculus* and *B. sibbaldi*) can remain under water for a far greater time than is generally supposed. The duration of this time is estimated to be from 8 to 12 hours. Such periods of rest often occur at particular hours of the day. These animals are never heard to make any sound."

My observations on the Japanese whales bear out Collett's statement that *B. borealis* blows less frequently than do Blue or Finback Whales. The number of spouts depends, however, largely upon the length of time which the whale has been below the surface. If the period of submergence has been long, the animal will blow two or three times to thoroughly reoxygenate its blood before again going down; if, on the contrary it is feeding near the surface, it will perhaps

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[1] The Mammals of Great Britain and Ireland, 1906, p. 278.
[2] Proc. Zool. Soc. London, 1886, p. 263.

PLATE XXX.

PLATE XXX.

Balænoptera borealis.

Fig. 1. Spout of a Sei Whale fast to the ship.

Fig. 2. Sei Whale fast to ship; spout dissolving.

Fig. 3. Sei Whale which has just spouted.

Fig. 4. Sei Whale's nostrils dilated during inspiration.

Fig. 5. A Sei Whale pursuing a school of sardines.

Fig. 6. A Sei Whale which had charged the ship; the blubber of the snout and right lip, which was torn by the propeller, is shown.

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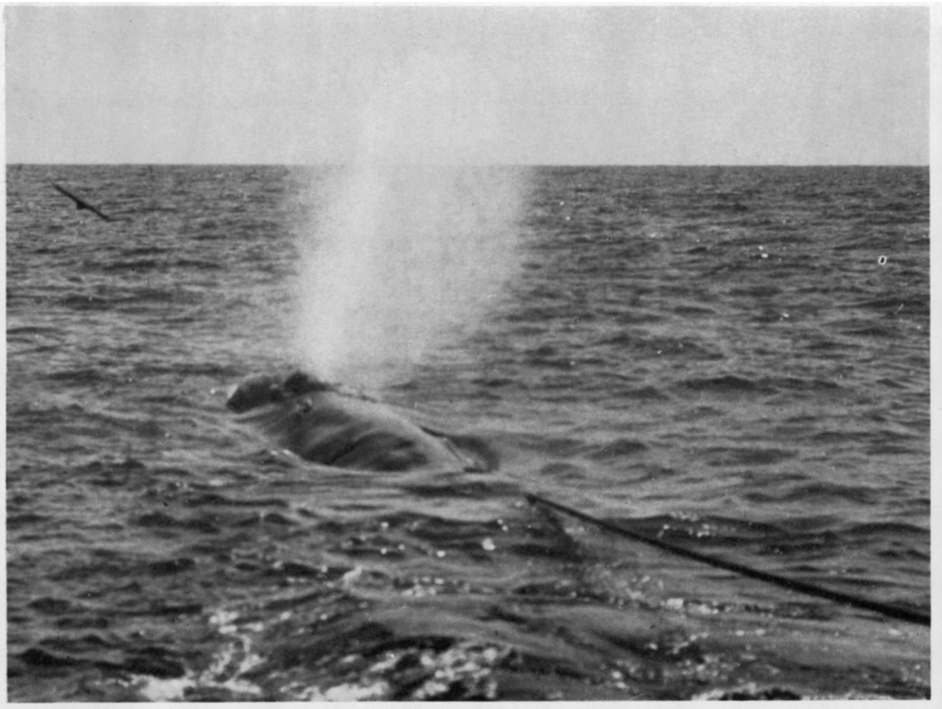

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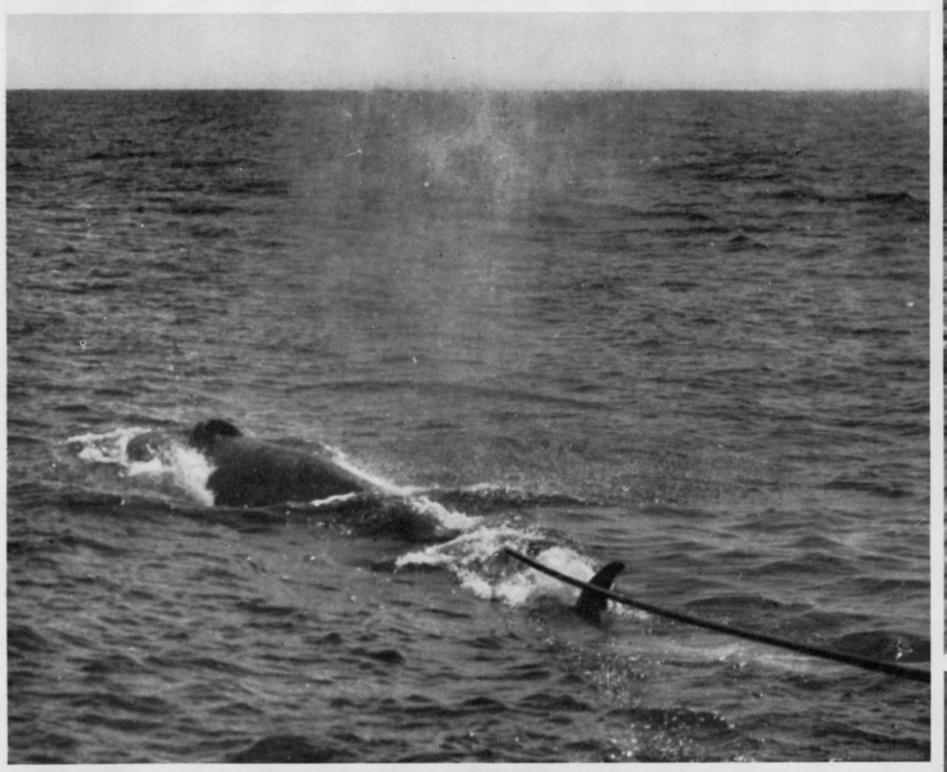

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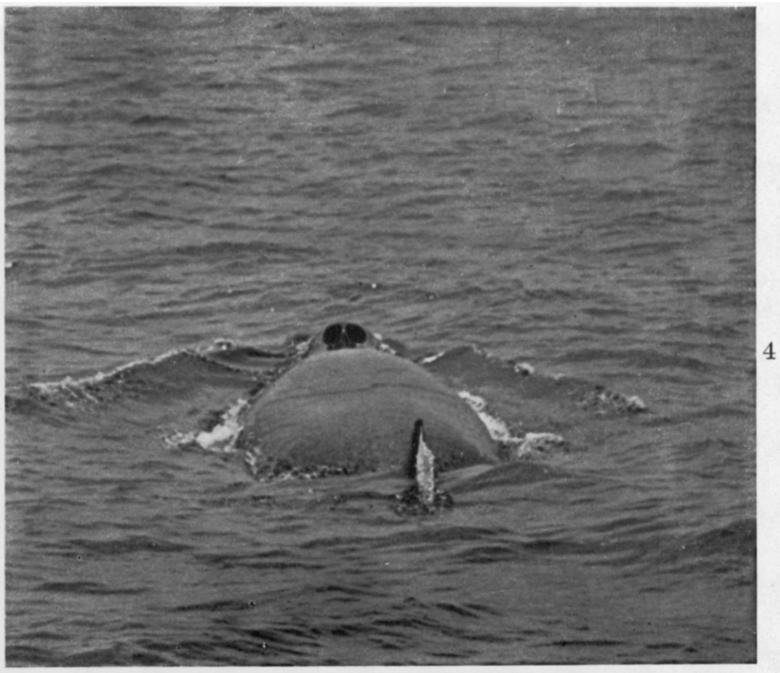

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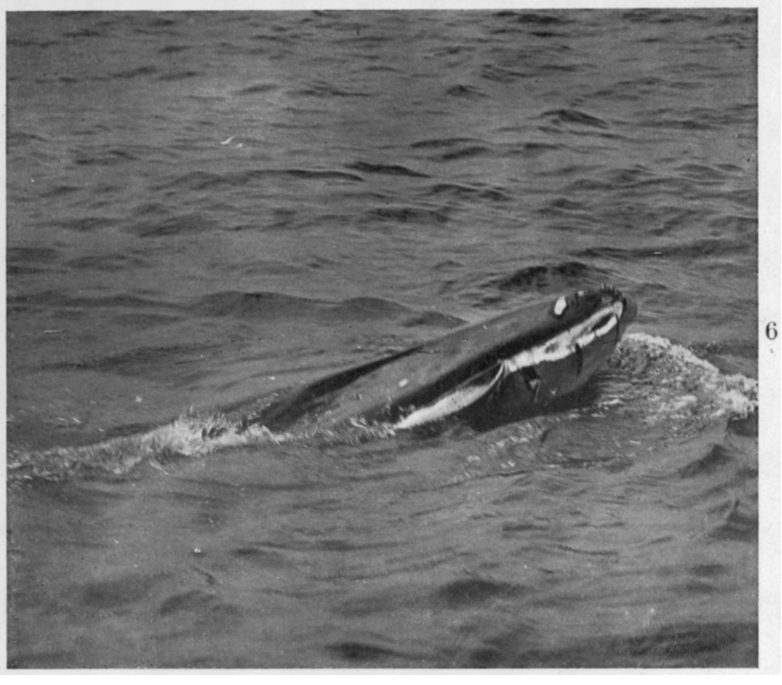

BALÆNOPTERA BOREALIS.

blow only once at each appearance. I have watched Sei Whales which were spouting every minute or so and again have seen them blow very infrequently. When 'travelling' or frightened they often swim for a considerable distance without rising to spout.

On August 2, 1910, we hunted a Sei Whale which remained below the surface 40, 25, and 125 seconds. A second individual remained submerged 22 seconds, spouted and sounded for 4 minutes, came up and after two quick spouts went down again for 2½ minutes; it then spouted twice at 4 second intervals and a third time after 14 seconds; again in 18, 20, and 20 seconds. It blew 3 times at 10 second periods and sounded for 2 minutes.

Collett's statement that the whalers believe that the Sei, Blue, and Finback Whales can remain under water for eight to twelve hours without coming up to breathe is one which I have frequently heard in various parts of the world. This seems to be based upon the fact that whales will suddenly appear where for hours before no spout has been seen. On two occasions I have personally witnessed this but believe it can be explained in a very simple way. It is well known that whales, when changing their feeding grounds or moving about from place to place, swim steadily at considerable speed and do not come to the surface to breathe as frequently as when feeding or remaining in one locality. The Balænopteras can all swim twelve or fourteen miles per hour without exertion and when they suddenly appear where none have been seen for some time, they probably last spouted beyond the range of human eye sight.

Diving.— The appearance of the Sei Whale when diving is very characteristic and differs considerably from that of either the Finback, Blue or Humpback Whales. The animal comes to the surface very obliquely, the snout first appearing, then the top of the head and the anterior portion of the back. Instantly the spout is delivered, the motion is continued forward and downward, the body gradually sinking lower and lower until the dorsal fin is submerged and the animal finally disappears, the flukes not being withdrawn.

When a Finback or Blue Whale 'sounds' the body is arched in the form of a half circle and slowly revolves (see Plate XXXI, Fig. 4), but this is strikingly different in the case of the Sei Whale, which never arches the back and shows but comparatively little of itself above the water. Because of this when hunting a Sei Whale the gunners shoot as soon as the spout is delivered, while with either of the other species they wait until the back is well arched and the maximum amount of the body is displayed above the water.

There is very little difference in the positions assumed during the 'sounding' and 'surface' dives of *Balænoptera borealis;* in the former the animal simply lifts itself a little higher than in the latter but the position of the body is very similar in both, and at no time are the flukes shown. On the contrary, there is a great difference between the sounding and surface dives of the Blue and Finback Whales.

The photographs illustrate the appearance of *Balænoptera borealis* in the water. In Plate XXX, Fig. 3, and Plate XXXI, Fig. 5, whales are shown which have just spouted and are refilling their lungs; almost as much of the back as appears in these photographs is displayed when the animal first comes to the surface. Plate XXXI, Fig. 3, shows the dive slightly further advanced, and in Plate XXXI, Fig. 2, a direct lateral view, the head is again below the surface and the dorsal fin is appearing. Plate XXXI, Fig. 1, taken at the instant the harpoon-gun was fired, gives an excellent view of the animal's entire back. Plate XXX, Fig. 5, shows a Sei Whale pursuing a school of sardines and swimming with only the dorsal fin exposed.

The gunners all tell me that the Sei Whales very rarely 'breach,' or throw themselves out of the water, and I have never seen a performance of this kind.

B. borealis has a habit of swimming for considerable distances just under the surface. I saw three individuals which swam for five minutes just below the surface while the ship was running beside them awaiting a shot. One whale I could easily trace by a white harpoon mark on its back as it swam along beside us. At times the animal was deep enough below to be out of sight but that it was not far down was indicated by the trail of smooth green water which was invariably present just above it.

Speed.— There is little doubt that for short bursts of speed no other large whale can approach *Balænoptera borealis*. This fact is attested by all the whalemen who have hunted this species and on many occasions I have personally witnessed instances of it. As soon as the harpoon strikes its body, if the iron does not penetrate a vital place, the animal dashes off at a tremendous pace for perhaps a third of a mile or less but soon tires and swims slowly thereafter. During the initial rush, I believe the Sei Whale can attain a speed of thirty miles per hour.

I have never known of Finbacks or Blue Whales reaching the speed of a Sei Whale's first dash, although the two former species have great strength and can drag a ship after them for hours with seemingly little effort.

On land the Sei Whale is paralleled by the African Cheetah, or Hunting Leopard (*Acinonyx jubatus*), which in its first dash is said to be able to run down almost any other animal but can continue its great speed for only a comparatively short distance.

On August 3rd, while on board the ship 'Go Hogei Maru,' Captain Y. E. Andersen, a Sei Whale was struck about thirty miles off Aikawa, Japan. The animal lay motionless at the surface for a few moments after the shot and then slowly sank, apparently dead. The harpoon-gun was leisurely reloaded, an operation which consumed about twenty minutes, when the order was given to haul the whale to the surface. As soon as the wheels of the steam winch had begun to revolve the line became as rigid as a bar of steel and we could see that the whale was rising to the surface at a tremendous speed. A few seconds later the animal burst from the water, throwing half its length into the air, and falling back started slowly toward the ship, its speed increasing with every fathom. The vessel was 'lying to' and when the whale was about forty fathoms away on the port beam, suddenly with a tremendous smash of its flukes it turned half on its right side with its body partly out of the water and dashed straight for the ship. The man at the wheel swung the vessel's nose about just in time, so that the whale struck a glancing blow amidships, scraped along the side and ran its head squarely into the propeller. The whirling blades tore great strips of blubber from its snout and lips and the animal backed off astern. Then with its entire head projecting from the water it swam along parallel with the vessel, and a few seconds later rolled on its side and sank, dead.

I snapped a photograph (Plate XXX, Fig. 6) as the whale passed the ship just before it sank and the white strips of blubber torn off by the propeller can be plainly seen.

I do not believe that the animal deliberately charged the vessel with intent to do damage, but without doubt suddenly went into its 'death flurry' and was blindly dashing about. Very probably almost all the accidents which have occurred to steam whalers have been caused by animals which struck the ship quite by chance while in the death flurry.

Balænoptera borealis, because of its small size, does not begin to have the strength of its larger relatives the Blue and Finback Whales, and is unable to tow a steamer with the engines reversed for any distance, even if it has not been badly wounded.

PLATE XXXI.

PLATE XXXI.

Balænoptera borealis.

Fig. 1. Sei Whale struck by a harpoon.
Fig. 2. Side view of a Sei Whale diving.
Fig. 3. Oblique posterior view of a Sei Whale diving.
Fig. 4. Finback Whale sounding.
Fig. 5. Sei Whale which has just spouted.

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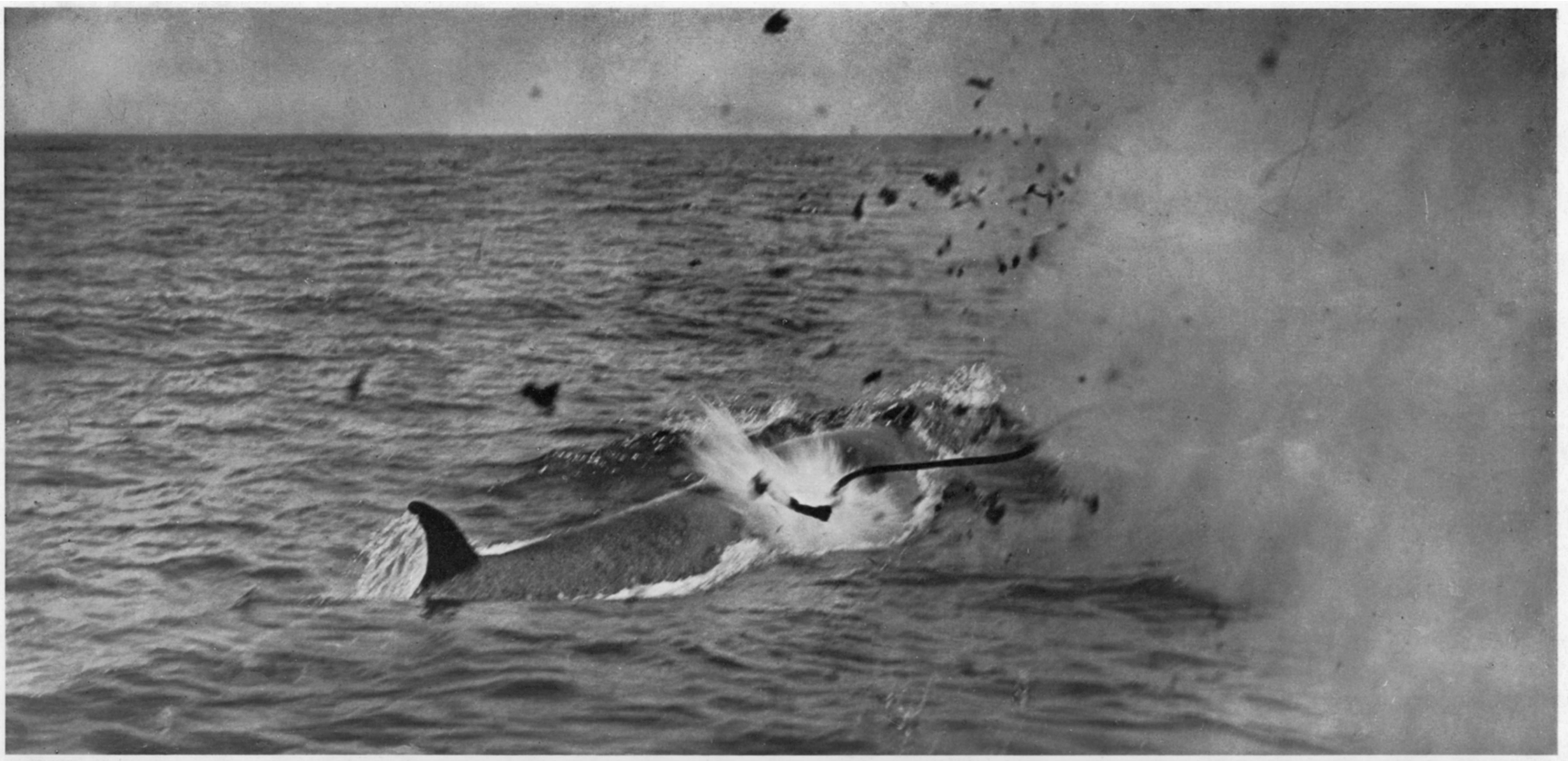

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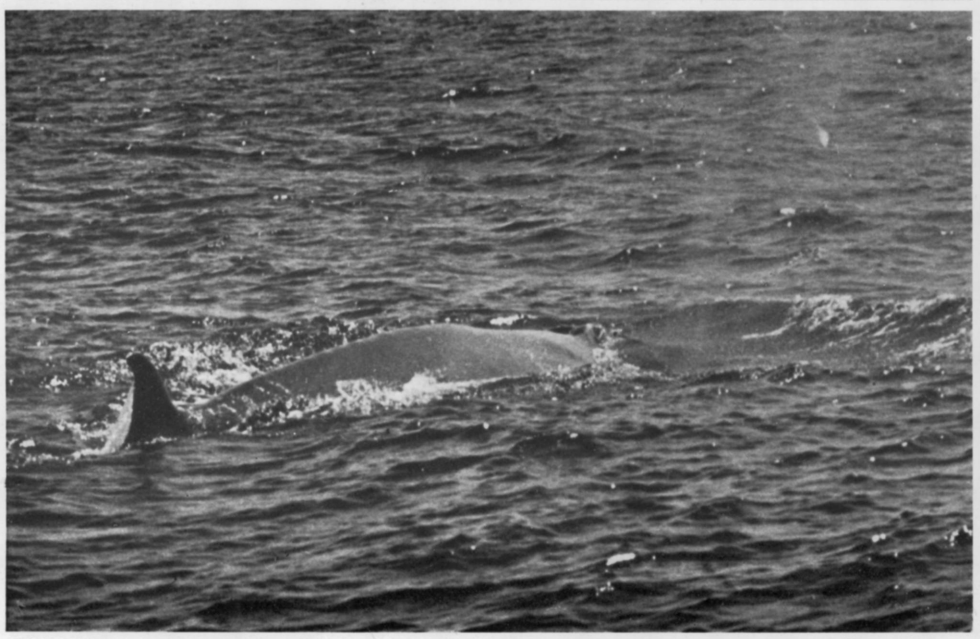

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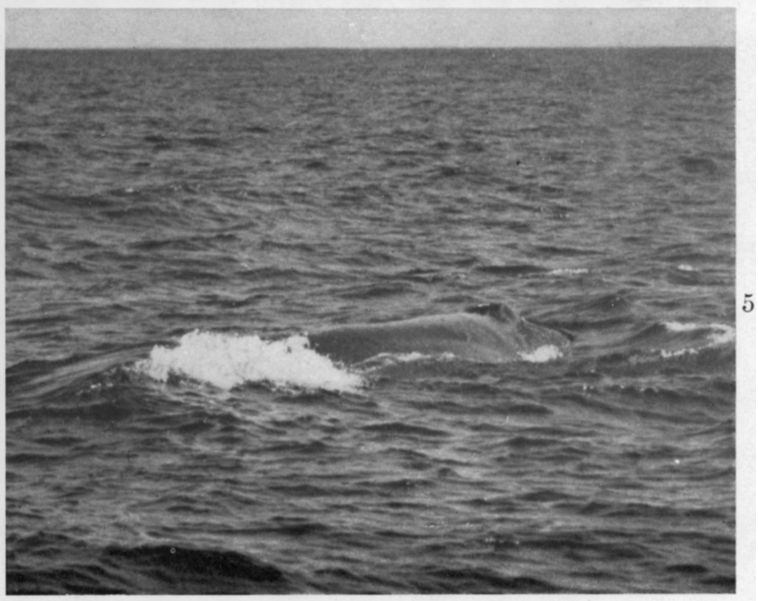

BALÆNOPTERA BOREALIS.

In regard to the speed of Sei Whales in the North Atlantic, J. G. Millais [1] says: "All the whalers are agreed that Rudolphi's Rorqual when struck by the harpoon can rush out the line at a greater speed (for a short distance) than any other Whale; captains have told me that they have estimated this pace at twenty knots. Its strength, however, bears no comparison with that of the great Whales, so that after a course of a mile it rapidly gives in when the engines of the steamer are reversed. In its dying struggles, however, it is very active and somewhat dangerous, often striking the boats and the steamer, denting the plates or breaking the propeller."

Collett [2] speaks of *B. borealis* as follows: "In its temper *B. borealis* is inoffensive and avoids the boats. But it has sometimes happened that in its death-agonies it has struck the boats, and on several occasions has injured the sides or propellers. Such conduct has, however, probably been unintentional, or committed in its agony, and cannot be considered, as it has often been called, natural ferocity."

Food.— The Japanese call the Sei Whale *Iwashi Kujira* (Sardine Whale) and maintain that it eats small fish. Out of all the whales of this species taken at Aikawa during the summer of 1910 which I examined, five had a quantity of sardines (probably *Eugraulis japonicus*) in their stomachs, while all the others had been eating only the small crustacean *Euphausia*. There seems little doubt, therefore, that in this locality when *Euphausia* is obtainable the Sei Whales prefer that food rather than fish.

Two animals which had eaten sardines ("iwashi") were taken during July and the fact was reported to me by the station master. On the 2nd of August, while aboard the whaling ship 'Go Hogei Maru,' Captain Y. E. Andersen, I saw a Sei Whale following a school of sardines. The animal was swimming near the surface with the high dorsal fin exposed, twisting and turning its lithe body as it pursued the terrified skipping fish (Plate XXX, Fig. 5). The whale was so intent upon its feeding operations that it allowed the ship to approach at once and was killed without difficulty. I did not have an opportunity to observe a Sei Whale which was eating *Euphausia* but Capt. H. G. Melsom tells me that he has never seen one turn upon its side as do the Humpbacks and Finbacks. When feeding, the Sei Whale frequently swims with the dorsal fin exposed, leaving behind it a long wake above which hundreds of sea birds often hover.

Millais says of the Atlantic Sei Whales: "When travelling they move fast, but when feeding they go through the water very slowly, rolling in the usual fashion *without turning on the side*" (*l. c.*, p. 277).

It is said that on the Finmark coast the Blue Whales (*Balænoptera musculus*) leave when the Sei Whales arrive. It is true that in Japan Blue Whales are most abundant during the winter and are infrequently killed in the summer when *B. borealis* appears upon the coast, but I do not believe that these facts have any connection. The Blue Whales feed exclusively upon *Euphausia* which, in this locality, also forms the principal food of *B. borealis*, consequently the disappearance in summer of the former species must be due to some other reason than lack of food. Finback Whales are taken during the entire summer with *B. borealis* although, like the Blue Whales, they are most abundant during the winter months.

In regard to the food of *B. borealis* on the coast of Finmark, Collett [3] says: "In all the examples I examined in the middle of July the stomach and intestines were filled with a fine

[1] The Mammals of Great Britain and Ireland, 1906, p. 278.
[2] Proc. Zool. Soc. London, 1886, p. 263.
[3] Proc. Zool. Soc. London, 1886, p. 261–263.

gritty mass, which consisted entirely of *Calanus finmarchicus*. These were half digested, but among the hairs of the baleen-plates they occurred in great numbers and in a tolerable state of preservation. The fœces had the same intensely red color as the contents of the intestines and stomach. *Calanus finmarchicus* is known to occur in two forms, one large, the other small. The form here met with was the latter. How far this Copepod formed the only nourishment of this species during the time they remained under the Finmark coast is doubtful. In East Finmark it probably formed their only food; but Captain Bull, from West Finmark, asserts that not only this summer, but in the previous ones, he found that the stomach contained the so-called 'Kril,' which forms the chief nourishment of the *B. sibbaldi*. This 'Kril' is *Euphausia inermis*, a Thysanopod Crustacean, about $1\frac{1}{2}$ inches in length and semi-transparent. It is therefore certain that the *B. borealis* is not confined to the Copepoda for its nourishment, although the unusually fine and curly, almost woolly bristles on the inner side of the baleen-plates clearly show that their food consists of minute animals, and hardly ever of fish."

J. G. Millais, says: "Rudolphi's Rorqual seems to feed exclusively on small crustaceans, such as *Euphausia inermis*, *Calanus finmarchicus*, and *Temora longicornis*. Note: These two last named Copepods are like fine sawdust. They are called by the Norwegians *Aaste*, and by the Newfoundlanders *Swamps*" (*l. c.*, p. 278).

Dr. Liouville [1] has recorded some interesting observations on the Antarctic Sei Whales, as quoted below:

"Ce Cétacé manifeste d'autres mouvements qui lui sont bein partculiers et qui ne rentrent pas dans la série des mouvements respiratoires. Je veux parler de deux mouvements en rapport avec sa vie alimentaire. Le premier est un mouvement horizontal de la tête à la surface del'eau. J'ai pu suivre ainsi, par calme plat, en janvier 1909, dans la Baie Matha, avec un de mes collègues de l'Expédition française, les évolutions de deux *B. borealis*, qui, tout en faisant une route rectiligne (à 25° environ de notre bâtiment), fauchaient littéralement la surface de l'eau avec le bord de leurs fanons, inclinant les joues tantôt à droite, tantôt à gauche, et balayant ainsi vers le fond de leur bouche grande ouverte une profondeur d'un mètre d'eau de mer environ sur une surface de 15 ou 20 mètres d'étendue. Cet exercice, qui durait au moins sept minutes, était suivi d'une courte plongée pour gagner du champ, puis recommençait plus loin. Nous l'observâmes en tout trois fois, mais avec la plus grande netteté. Au cours de ce mouvement, la tête du Cétacé, lorsqu'elle arrive à bout de course, est tout à fait couchée sur le côté, a la surface de l'eau, et la pectorale est visible. Le balai des fanons est alors entièrement émergé; il plonge au moment où le mouvement reprend en sens contraire et n'émerge plus qu'en arrivant au bout de l'autre côté. La progression en avant de l'animal durant cette opération est extrêmement lente, tandis que le balayage latéral paraît plus rapide. Au train dont marchent d'ordinaire les Sardines et les Harengs sur nos côtes, il semble difficile *a priori* que beaucoup de Poissons n'échappent pas au Cétacé; à moins que sa tactique n'ait pour objet de les détourner obliquement de leur route et, cela fait, de les reprendre obliquement en sens contraire, de façon qu'une partie du banc vienne, *sponte sua*, se précipiter vers son gosier. Je comprendrais plus facilement ce mode de pêche appliqué à la capture des Euphausidés du plancton, dont les bancs sont autrement denses et fournis par ceux des Poissons. Mais c'est un fait connu que *B. borealis* est ichtyophage et que le nom de *Herringhval*, lui a été donné par les pêcheurs scandinaves en raison

[1] Cétacés, de l'Antarctique, 1913, pp. 106–108.

de sa nourriture. Peut-être est-il susceptible de se nourrir à l'occasion de Crustacés. Nous reprendrons cette discussion au chapitre de *B. acutorostrata* Lacép.

"Le second mouvement propre à *B. borealis* a été vu par tous les cétologistes qui ont observé cette espèce. C'est un mouvement d'émersion verticale de la tête, à la faveur duquel on aperçoit nettement les deux parties de son museau: la face supérieure pointue, carénée, et la face inférieure qui la déborde en avant, par le bourrelet de la lèvre mandibulaire sous laquelle on aperçoit la naissance des premiers plis. Ce second mouvement s'effectue tantôt spontanément, sans que rien l'ait précédé; tantôt, au contraire, il a lieu après le souffle, ainsi que l'a observé Racovitza. 'Ensuite, dit-il, au lieu de faire un simple mouvement tournant, l'animal continuait le mouvement d'émersion de la région antérieure, de sorte que sa tête, jusqu'en arrière de l'œil, apparaissait hors de l'eau.'"

What Dr. Liouville first describes are undoubtedly the movements indulged in while *B. borealis* is feeding upon *Euphausia*. He says that perhaps this is the case, but assumes that *B. borealis* is largely a fish-eater and that the name "Herringhval" was given to it by the Scandinavians because of its food. Collett's researches, and those of other writers, show that on the Finmark coast, the Sei Whale's food consists chiefly of crustaceans, and this was the case with the examples from Japan which I observed.

If Dr. Liouville had had an opportunity to examine the stomachs of several specimens, I believe that in the great majority of cases he would have found their contents to be Crustacea. He discovered, however, a great difference in the taste of the flesh of *B. borealis* and *B. musculus;* the latter, he knows, feeds upon *Euphausia* and he therefore believes that *B. borealis* does not; this conclusion, it seems to me, is hardly justifiable.

Period of Gestation.— Only three or four Sei Whales taken during 1910 at Aikawa, Japan, were gravid and all but one of these specimens were brought in while I was at sea. On August 5, a fœtus 259 cm. (8′ 6″) long was taken from a female 1463 cm. (48′) in length, and in the whaling company's records for 1913 two specimens are noted as pregnant; one 1432 cm. (47′) long taken September 12 at Aikawa and one 762 cm. (25′) captured October 12 at Shimpo, Korea. I was not able to obtain any reliable data from which to draw conclusions as to the period of gestation of the Pacific Sei Whales, but of the Atlantic specimens Collett, Millais and Southwell have given some observations which are quoted below.

Collett [1] speaks as follows: "All the managers agree that about an equal number of each sex were captured. The six specimens examined by me were three males and three females. One of the whalers believes from his observations that at the beginning of the fishing-season most of those captured were females.

"Most of the females were gravid. At the commencement of the season (in the beginning of July) most of the fœtuses were 3 or 4 feet long, in the middle of the month they were often 6 or 7 feet (1.8–2.2 m.), and towards the end of the season, in August, some were seen of from 8 to 10 or 12 feet in length. Although there was thus a somewhat regular increase in the size of the fœtus as summer advanced, their growth increased apparently but slowly, and there were several instances of irregularities. Thus a fœtus taken out at one of the factories at Vardö, on the 15th of July, had a length of 8 feet (2½ m.); whilst at the same place, on the 18th of July, one was obtained which measured only 2 feet (0.6 m.). Some whalers consider it difficult to lay

[1] Proc. Zool. Soc. London, 1886, pp. 260–261.

down any fixed rule for the size, having often obtained on the same day both large and small fœtuses. So far as my knowledge goes, a fœtus has never been met with under 2 feet in length.

"The four fœtuses examined by me were taken out between the 16th and 19th July, and from 5 to 9 feet (1.5 to 2.8 m.) in length. . . . The color of these fœtuses was homogeneous, a reddish-brown on the upper and under sides, without any appearance of white on the belly. It was only in the largest ones that there was any indication of the baleen. Their covering of hair, on the contrary, as previously stated, was considerable.

"Twins.— On the 27th July, Capt. Brunn captured at the entrance to the Varangerfjord a female 43 feet long, which contained two young ones each six feet seven inches long. So far as I know, twins have never been observed by others."

Millais [1] says: "In June all the adult females are found to be gravid with fœtuses of from two to five feet in length. In August females with fœtuses of from nine to twelve feet are taken. The females probably bring forth about November after a period of gestation of ten or eleven months" (*l. c.*, p. 276).

Thomas Southwell [2] has given some valuable information as to fœtal specimens which is embodied in the following quotation: "As in the case with all the members of this family, the date of pairing, period of gestation, and season of calving are not known with certainty, but the following measurements of fœtuses, with the dates of their occurrence, afford some indication:—

"Date	Length of fœtus ft.	in.	
June 21	4	10	
July 3	2	1	
18	6	0 ♂	Two fœtuses.
	4	0 ♀	
26	8	5	
28	5	6	
Aug. 6	3	7	
10	6	0	
10	5	0	
15	9	0	

"A female, 46 ft. 10 in. long, brought into the factory at Trufjoed on the 18th July, 1885, contained twin fœtuses of opposite sexes. Prof. Collett (P. Z. S. 1886, p. 261) mentions a similar instance of twins in a whale of this species 43 ft. long captured at the entrance to the Varanger Fjord, which contained two young ones each 6 ft. 7 in. long. So far as I am aware, these are the only instances of twins in this species on record."

The above observations seem to demonstrate that in the Atlantic, *Balænoptera borealis* as a rule breeds in the early spring but that mating may take place among some individuals at any time during the year. This, I believe, will be found to be true of all the Balænopterinæ. It is also probable that the time of breeding of the Pacific Sei Whales is coincident with that of the Atlantic specimens, although at present there are no data from which to draw absolute conclusions.

Parasites.— Almost all writers who have hitherto recorded observations on the external anatomy of *Balænoptera borealis* have remarked that the body was more or less covered with

[1] The Mammals of Great Britain and Ireland, 1906, p. 276.
[2] Ann. and Mag. Nat. Hist., Ser. 7, Vol. XVI, 1905, pp. 420–421.

oval or oblong white spots. These markings have always been described as a peculiarity of the coloration of this species and no one seems to have suspected that they might be due to the action of parasites. Collett [1] discussed them as follows: "Distributed over the dark parts of all the specimens examined were a greater or less number of whitish oblong spots of peculiar form and color, their length being about 100 mm., and breadth about 30. Their outer edges are not always sharply defined; their color is in general whitish grey, occasionally almost white, and more rarely dark grey. Along the centre of the long axis there runs a dark line, from which to both sides and both ends run fine radii of similar lines.

"These patches are most frequent on the sides of the body somewhat below the middle, and occur also on the tail, but may be found, when they occur to any great extent, distributed singly right up the centre of the back, and extending as far as the end of the lower jaw. They occur on all examples, although they may not be equally apparent in all. They evidently are due to a peculiar matter in the skin, as they become more perceptible after the animal has dried for a time. Single small white spots of a normal form occur less frequently in the black portion of the sides, especially up towards the back."

When studying cetaceans at the Vancouver Island and Alaska stations in 1908, I observed spots of this description on almost all the Blue and Finback Whales, as well as on several Humpbacks, and at that time suspected that they were due to the action of some parasite. These spots were present on all the baleen whales which I examined in Japan, but more especially on *B. borealis*, and in much greater numbers than on the specimens observed on the west coast of America.

Although each whale which was brought to the station was carefully examined, it was not until June 11 that I was able to discover what parasite was responsible for the spots. On that date a young Finback was captured which had a Copepod of the genus *Penella* adhering to various parts of the body, and demonstrated beyond a doubt that the spots on the Finback, Blue and Sei Whales were caused by the action of this parasite. A few days later several specimens of *Balænoptera borealis* bearing quantities of this parasite were killed, as well as other Finback and Blue Whales. A number of the *Penella* were brought to the Museum and have been identified by Prof. Chas. B. Wilson as *P. antarctica* Quidor, an Antarctic species (see 'Migrations').

The Copepod apparently fastens to the skin and travels a short distance forward, penetrating deeper and deeper into the blubber as it proceeds. In some places the parasites were embedded to a depth of 4 cm. and in others had travelled a semicircular course, again appearing at the surface about 5 cm. from the point of entrance; at the bottom of each scar containing a *Penella* was a small sac of pus.

As many spots in various stages of development were observed, their formation was easily determined. The long axis of the scar indicates the track along which the parasite has travelled and when the wound heals this appears as a thin white mark with wavy lines radiating outward from it. The wavy lines are apparently formed during the process of healing after the parasite has left the host but the median white mark, indicating the track along which the Copepod has travelled, often appears while it is still in position; this central line is not always straight but may have several ramifications and often lacks the wavy markings radiating from it. The scars are most abundant along the sides of the peduncle but are also found on the back, lips and rostrum.

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[1] Proc. Zool. Soc. London, 1886, pp. 249–250.

Fig. 1 shows two specimens of *Penella antarctica in situ* on the peduncle of a Sei Whale; the white oval and oblong scars can be easily distinguished from the normal wavy markings on the animal's body. Fig. 2 is a photograph of a section of blubber from a Finback Whale in which a *Penella antarctica* has embedded itself.

Fig. 3 shows another piece of blubber in cross-section containing two of these Copepods;

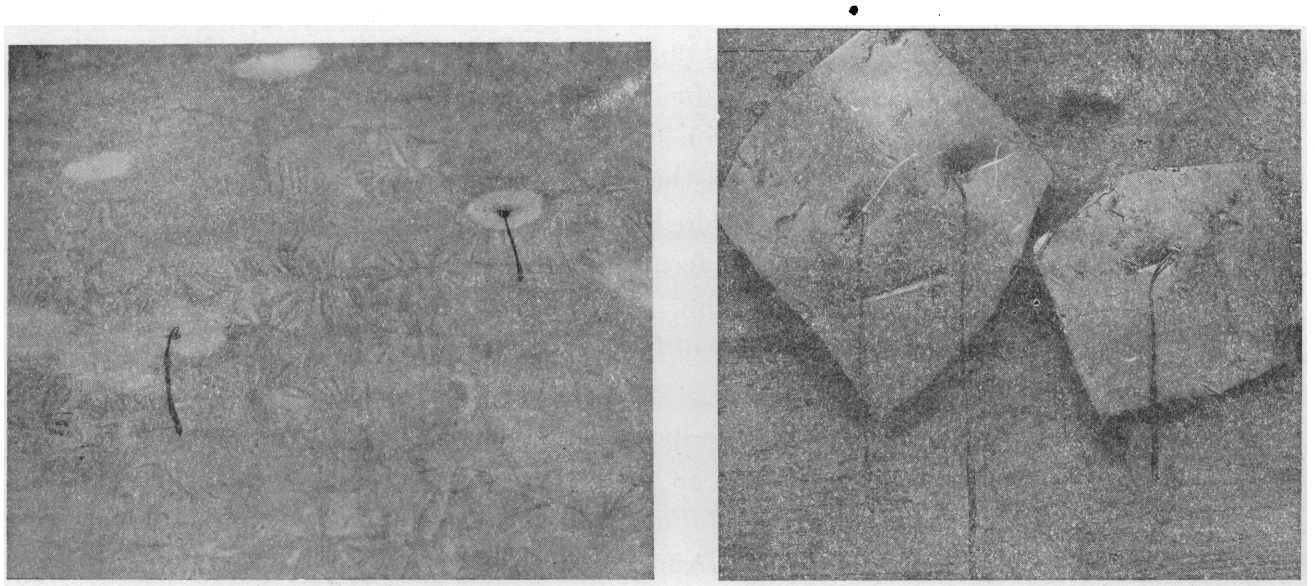

Fig. 1. Fig. 2.

Fig. 1. *Penella antarctica* Quidor *in situ* on the peduncle of Sei Whale No. 34.
Fig. 2. Section of blubber from a Finback Whale showing *P. antarctica* in situ.

the blubber, which was preserved in alcohol, has been dissected away in order to expose the positions of the parasites which are below the surface.

On several specimens of *B. borealis*, and quite often on Finback and Blue Whales, circular or oval pits were found in the blubber, each one containing a granular membrane. These I believed to have been caused by some Cirriped such as *Coronula*, but I never found one of the parasites attached to the host. Dr. Liouville's discovery of *Coronula* on the South Atlantic Sei Whales indicates that my supposition was correct.

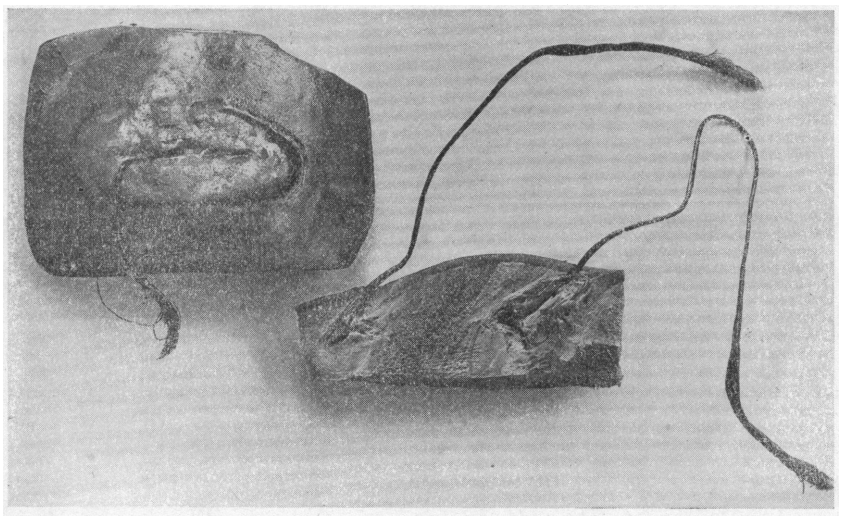

Fig. 3. Cross section of blubber from a Sei Whale showing *P. antarctica* embedded.

In his paper on *B. borealis* of the Atlantic, Collett speaks of an ecto-parasite observed by Captain Bryde which was without doubt a *Penella*, but which Collett does not suspect as being responsible for the spots on the Sei Whale's body. He records also the presence of a Copepod (*Balænophilus unisetus*) upon the baleen and two ento-parasites, *Echinorhynchus porrigens* (?) and *Echinorhynchus ruber*, from the intestines of *Balænoptera borealis*.

I am certain that no parasites were present upon the baleen of any of the Pacific Sei Whales taken while I was at Oshima or Aikawa in 1910, but can not be so positive about those of the intestines; however, as Collett says that he found them in thousands in the intestines of the Atlantic specimens, I do not believe I should have overlooked them had they been present in the Pacific whales. Collett's remarks are so interesting that certain portions are quoted:

"Parasites of three different sorts have been up to the present time found living upon or in *B. borealis;* one of these (not yet examined nor preserved) is a true ecto-parasite, one (*Balænophilus unisetus*) is an epizoon, and two *Echinorhynchi* are ento-parasites.

"I could find no trace of ecto-parasites on the specimens examined by myself; and upon inquiry amongst the whalers, I was informed that only Captain Bryde has noticed such parasites on a single individual captured off Vardö in July. As no specimen has been preserved, it cannot be stated whether they were Crustaceans (Pennellidæ ?), *Discophora* or other forms. They were worm-like animals, about 50 millim. long, and were attached to the edges of both flukes (caudal lobes), where they formed a row of free hanging threads. Some were also attached to the upper surface of the flukes.

"In a set of baleen-plates belonging to one specimen, and brought to the University Museum in Christiania from Sörvær (Hammerfest) in 1883 by Dr. Guldberg, most of the plates are infested on both sides with innumerable specimens of *Balænophilus unisetus*, a Copepodous crustacean of the subfamily Harpacticinæ, described by Aurivillius in a pamphlet published in Stockholm in 1879, and discovered by him on the baleen-plate of a specimen of *Balænoptera sibbaldi* caught at Vadsö in July, 1877. In 1884, Mr. A. Heneage Cocks found this parasite on a specimen of the same whale at Sörvær, near Hammerfest ('Zoologist,' 1885, p. 135). So far as I know, it has never been found by other observers. Its occurrence on *Balænoptera borealis* is therefore of interest. The fully developed specimens can only with difficulty be recognized in their dry state; but the larvæ in their *Nauplius*-stage, which are attached to the plates in myriads, still retain most of their original form and appearance.

"These two parasites appear, therefore, to be of very rare occurrence. However, the intestines of all the specimens that I examined, including those which I found on the beach, were, without exception, filled with thousands of *Echinorhynchi*, belonging to two different species.

"One of these, which was very much less numerous than the other, seemed to resemble very closely *E. porrigens*, Rud.... "The other species appeared in all the specimens examined, and in such vast numbers that in some places there were three or four upon each square inch, and they moreover thickly covered the inner coating of the intestines wherever an incision was made.... The species to which it approaches nearest is *E. brevicollis*, described by Malm in 1867, from *B. sibbaldi;* but as it differs in several respects.... I think that the species has not been previously described, and I propose for it the name *E. ruber*.... It cannot, of course, at present be stated whence *B. borealis* obtained the larvæ of *E. ruber*. As the species is decidedly different from *E. brevicollis*, described by Malm from *B. sibbaldi*, it is not probable that both species get their parasites from the same crustacean. We know that *Euphausia inermis* (a Thysanopod) is the species from which *B. sibbaldi* probably exclusively obtains its food in the summer months, and it is therefore not improbable that *Echinorhynchus brevicollis* passes through its first stages with this species.

"Whether *Calanus finmarchicus* is the first host of *E. ruber* can only be conjectured as a possibility. It seems, however, more probable that a somewhat larger crustacean, which perhaps

constitutes the food of this Whale at other seasons of the year, is the true transporter of this parasite" (*l. c.*, pp. 255–259).

Dr. Liouville[1] found *B. borealis* of the south Atlantic to be the host of numbers of parasites which have not been found upon Sei Whales in other waters. These observations are very surprising and of the greatest value as they will, perhaps, help to throw light on the migrations of this species.

His discussion of the parasites of *B. borealis* is as follows: "Les parasites se trouvent sur *B. borealis* en très grand nombre. Des Cirrhipidès du genre *Coronula* et *Tubicinella*, servant eux-mêmes de substratum à des *Conchoderma*, garnissent les bords de la pectorale et tout le pourtour des organes génitaux, où ils s'incrustent en bancs épais. Certains se fixent sur le bord externe des lèvres, tantôt à l' apex de la mandibule, tantôt audessous, vers la naissance des plis abdominaux. Sur les pectorales et sur les flancs, s'implantent des Copépodes volumineux du genre *Penella* (374), dont j'ai pu recueillir ainsi des espèces nouvelles (Voy. *Parasites* du chap. Balenoptéres). Dans tour les plis, de nombreux *Cyanus*."

Enemies.— Judging by the evidences of scars, etc., upon the body, the Sei Whales, at least in the North Pacific, are less often troubled by Killers (*Orca orca*) than are the Finbacks or Blue Whales. In either of the last-named species, it is exceptional to find the flukes or flippers with the tips and posterior edges in perfect condition. With *Balænoptera borealis*, however, quite the opposite is true and comparatively few specimens which I have examined showed injuries on the pectoral, caudal extremities or other parts of the body. It is probably true that in some localities *B. borealis* is more troubled by Killers than in others, yet in the seas about Japan *Orca orca* is very abundant and seems to be a menace to the Blue and Finback Whales.

Although it has sometimes been stated that sharks are responsible for the injuries to the flukes and flippers of all the *Balænoptera*, I believe this to be improbable and that Killers and man are the only enemies of the larger Cetacea. If a whale was weakened through disease or wounds sharks would probably devour it, as they frequently attack the carcass in the open sea as soon as the animal has been killed by the harpoon gun. I believe that ordinary sharks are neither powerful nor fast enough to be a menace to any of the large Cetacea.

Color.

Plates XXXII–XL.

I have at no time been more strongly impressed with the necessity for caution as to the degree of importance which should be placed upon color when dealing with large cetaceans in an attempt to accurately define species, than in the case of *Balænoptera borealis*. The range of individual color variations of this species is enormous — greater even than in the Blue or Finback Whales. The specimens which I examined in Japan seemed to fall naturally into three classes, each possessing certain features common to them all, but the extremes of which, if taken by themselves, might lead one to suspect specific differences.

These color-classes may be diagnosed as follows :

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[1] Cétacés de l'Antarctique, 1913, pp. 109–110.

PLATE XXXII.

PLATE XXXII.

Balænoptera borealis.

Fig. 1. Oblique ventral view of Sei Whale No. 41.
Fig. 2. " " " " " " " 34, showing tongue.
Fig. 3. Front view of Sei Whale No. 38.
Fig. 4. " " " " " " 35.
Fig. 5. " " " " " " 43.
Fig. 6. Oblique ventral view of Sei Whale.

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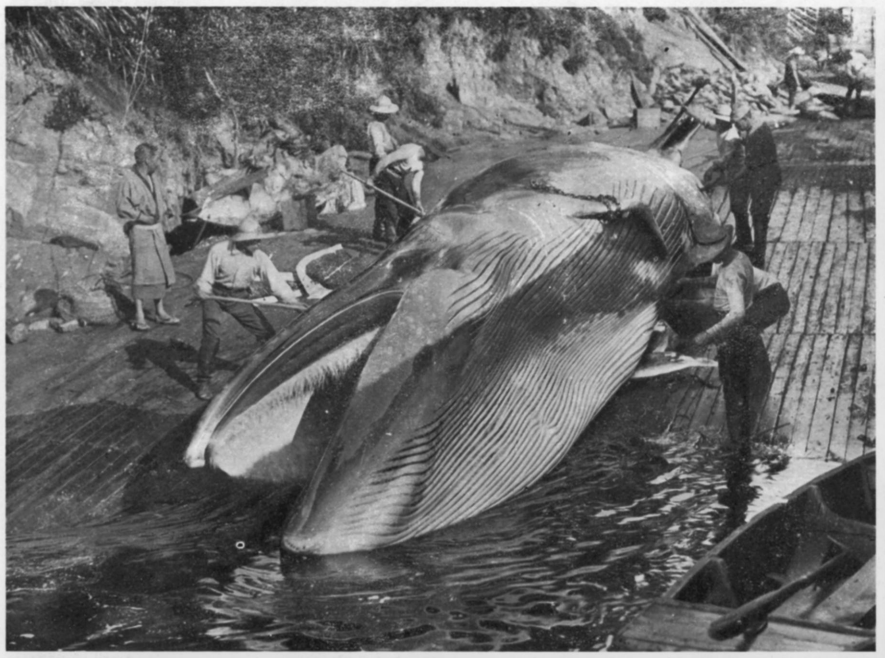

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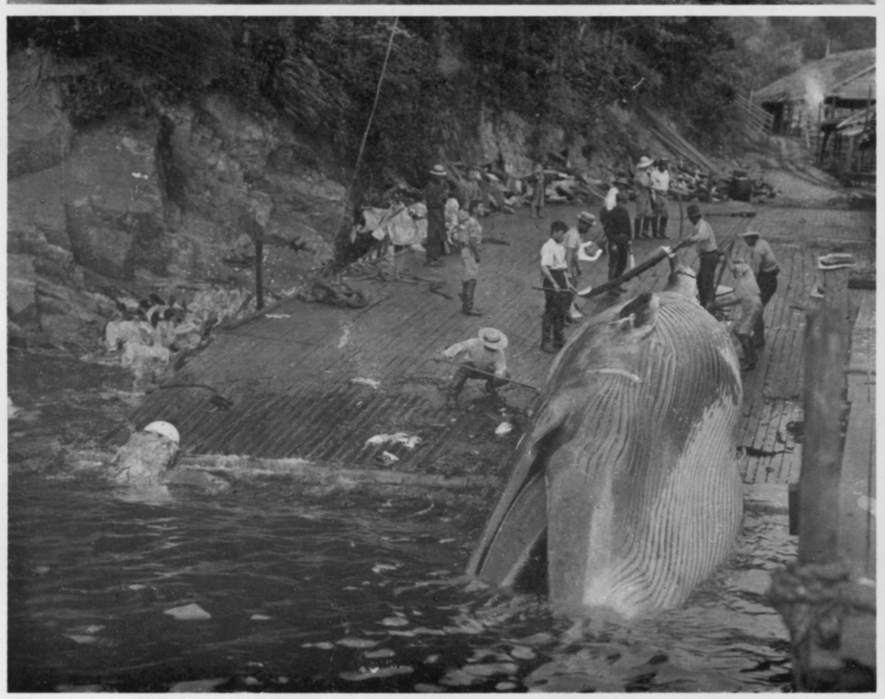

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BALÆNOPTERA BOREALIS.

I.— General color strongly bluish-gray. Throat and central breast folds white; furrows pinkish. Gray side areas joining to form a gray band across the abdomen; ventral line from the genitalia to the flukes light gray like the lower sides of the peduncle.

II.— General color gray with no bluish tinge. Folds of throat, central breast, and abdomen light pink; furrows deep pink. Gray side areas greatly reduced and very light, not meeting to form an abdominal band. Entire ventral line to flukes light pink.

III.— General color gray with a slight bluish tinge. All throat and breast folds whitish gray; furrows dark gray. An area comprising 14 or 15 folds on left side of abdomen has both folds and furrows pink. Gray side areas meeting to form a wider and lighter abdominal band than in class I.

The Sei Whales which I examined at Oshima, Kii Province, in April, were intermediate between the classes I and II. At Aikawa, Rikuzen Province, some six hundred miles north of Oshima, individuals of the first class were taken during the major part of the season. On July 31st and in early August specimens of the second and third classes, and resembling those seen at Oshima, were captured. On August 2nd, while the guest of Capt. Y. E. Andersen on the W. S. 'No. 5 Hogei Maru,' two Sei Whales, extremes of class II, were killed. These animals were not together and were taken some ten or fifteen miles apart. On August 3rd, while aboard the same ship, I witnessed the capture of two whales, both extremes of class III. These animals were killed during a cruise over the same course as that of the previous day and, like the other whales, were single individuals and taken several miles apart. Both days other ships brought in representatives of class I. As the Sei Whales which were taken during the entire season were, according to the statements of the gunners, nearly always either single or in pairs, it would seem that no distinct schools of individuals belonging to either of the three classes existed.

The following detail description was written in the field, after examining some thirty-five or forty specimens and, as it was the type of coloration possessed by the greatest number of individuals, it may be considered to be most characteristic of the Japan examples. Obviously it will apply only in part to many whales as a glance at the description of single specimens will show.

The head from the snout to the eyes is dark bluish gray. From the eyes the head-color extends in a curve upward on to the back and continues along the dorsal ridge of the peduncle to the flukes. The upper edges of the snout for 50 or 60 cm. are frequently inclined to lighter, and the under edges are pinkish for about the same distance. From the eyes backward the upper sides immediately above the pectoral fins are bluish gray, passing into beautiful light bluish gray on the sides of the peduncle, and becoming almost white as the ventral line is approached; the transition from the dark into the light color is imperceptible. The sides, from the end of the furrows to a short distance anterior to the flukes, are thickly covered with peculiar markings consisting of fine, wavy, white and gray lines radiating outward from a common center (Plate XXXVII, Figs. 3 and 6). The central axes of the markings are usually directed fore and aft, but are sometimes oblique; the tips of the wavy lines of adjacent markings meet at all angles thus producing an intricate pattern. On the upper sides these markings are scattered but they entirely cover the lower two-thirds of the peduncle, including the ventral line from the genitalia nearly to the flukes; from the umbilicus to the genitalia a narrow strip is usually white and unmarked. About the genitalia they are especially thick, and with small unmarked patches of white give a very light effect. There are a few dark markings on the dorsal ridge posterior to the fin; the back, anterior to the dorsal fin, is unmarked. Occasionally a few markings are found upon the posterior ends of the folds and scattering ones sometimes invade the breast.

Every individual which I have examined bore on the entire body, to a greater or less extent, many oblong white scars left by the parasite *Penella antarctica*. The scars were thickest along the sides of the peduncle, but the back and sometimes the head were also affected in a lesser degree.

The folds of the throat and central breast from the mandibular symphysis to a point about opposite the middle of the pectoral fins laid back, are white and the furrows deep flesh pink. The left lower lip is dark blue gray shading into lighter gray on the ramus. The right lower lip and ramus are light blue gray grading into white at the tip. (The extreme edge of the lip is usually a little darker). The inner sides of both lower lips and the upper halves of the mandibular rami are blue slate; the inner lower halves of the rami are light blue gray flecked with dark.

The gray of the mandibular rami extends backward spreading out rapidly between the corners of the mouth and fins, and continues on to the sides of the breast covering, under each fin, fourteen or fifteen folds. Opposite the middle or tips

of the fins laid back the gray side areas suddenly unite in the ventral line, thus producing a gray band across the abdomen. The lower edges of the gray lateral areas are irregular and there are usually on each side two rather prominent patch-like extensions into the white ventral region; one (which is frequently obsolete) about 100 cm. anterior to the corners of the mouth, the other and larger opposite the base of the pectoral fin. On each side a whitish, or very light gray, streak about 6 cm. wide runs from the insertion of the pectoral fin obliquely down and back almost to the ventral line, being exactly parallel with the ends of the furrows. The space between this light band and the ends of the furrows is gray —decidedly darker than the areas surrounding it.

The superior surface of each pectoral fin (Plate XXXIX, Fig. 6) is gray except the anterior edge of the distal half, which is usually light gray. The inferior surface (Plate XXXIX, Fig. 7) has the anterior half for its entire length light blue gray, which passes imperceptibly into darker gray on the posterior half. The color is produced by fine white and gray lines which, beginning at the center of the anterior edge, curve obliquely across the fin and run down the posterior edge toward the tip; proximally, the lines curve directly across antero-posteriorly. In some specimens these lines are so exceedingly fine that their presence can only be detected upon close examination; in other individuals the lines are coarser, a preponderance of the white or gray giving a correspondingly light or dark effect as the case may be. The light anterior edge of the fin is sometimes obsolete but is frequently strongly emphasised. The lower surface of the pectoral usually has a pinkish tinge in those individuals which have the lower parts of the body pinkish.

The flukes, above, are uniform dark gray like the back and unmarked. Below (Plate XXXIX, Figs. 4 and 5) they are light gray in the central portion, usually about the same shade as the sides of the peduncle. The tips are dark gray, and there is a wide posterior and narrow anterior border of the same color; frequently the dark anterior edging is absent or extends only a short distance from the tips. As in the case of the pectoral fins, the color of the under surface of the flukes is produced by fine white and gray lines which, beginning in the center of the anterior edge, run antero-posteriorly, curving inward toward the notch. On the distal portions the lines run across and then turn sharply inward down the posterior edge.

There is considerable variation in the general color of the lower surface of the flukes; in some individuals it is very light, considerably more so than the sides of the peduncle, while in others it is dark. In whales which have the lower parts light pink, the flukes, like the pectorals, usually partake of this color, being decidedly pinkish. The posterior gray border varys greatly sometimes being very wide but is often narrow.

The dorsal fin is unmarked and dark gray like the back.

Variations in Color.— In a general way the principal variations in color have been discussed above, but in the following section individual peculiarities will be considered.

1. The color of the upper parts ranges from medium to very dark gray, and may have a strongly bluish cast or none at all.
2. The area immediately surrounding the blowholes is sometimes inclined to lighter.
3. The entire ventral line from the umbilicus to the flukes, or a short distance anterior to them, may be white or pinkish or the ventral surface from the umbilicus to the genitalia may be white, pinkish or bluish white, and from the genitalia to the flukes very light gray like the sides of the peduncle.
4. The throat and central breast may be light pink and the folds deep pink; the entire throat and breast anterior to the pectoral fins may be whitish gray and the furrows dark gray.
5. The lower halves of both mandibular rami may be light gray, this color extending on to the sides of the throat, or rarely they may be entirely white like the throat.
6. The gray areas on the anterior sides may be heavy and wide, covering on each side 15 or 16 folds, or greatly reduced and very light, affecting only 7 or 8 folds. In whale No. 70 only 7 folds between the corner of the mouth and fins were light gray, all the folds between the fins being pink.
7. The narrow band running from the fin insertion downward and backward parallel with the ends of the furrows may be almost white and prominent, or gray and only suggested.
8. The two patch-like extensions of gray into the white throat and breast areas on each side may be absent, well-marked, or one present and the other absent.
9. The gray abdominal band may be heavy and wide, wide and light, totally absent, or interrupted in the center by a light area on the mid-ventral line.
10. One specimen had patches of purple in the furrows and a narrow light gray line running backward out of the ear on the right side.

Comparison of the Color of European and Japan Specimens.— The best description of the color of European specimens of *Balænoptera borealis* is that contained in Collett's account of the species, and is as follows:

"The color of the back is bluish black or occasionally somewhat brown, much resembling

PLATE XXXIII.

PLATE XXXIII.

Balænoptera borealis.

Fig. 1. Sei Whale No. 34, partly in the water.
Fig. 2. Sei Whale No. 38, partly in the water.
Fig. 3. Ventral view of Sei Whale No. 26.
Fig. 4. Sei Whale No. 43, partly in the water.
Fig. 5. Oblique posterior view of Sei Whale No. 26.
Fig. 6. Young Sei Whale being flensed.

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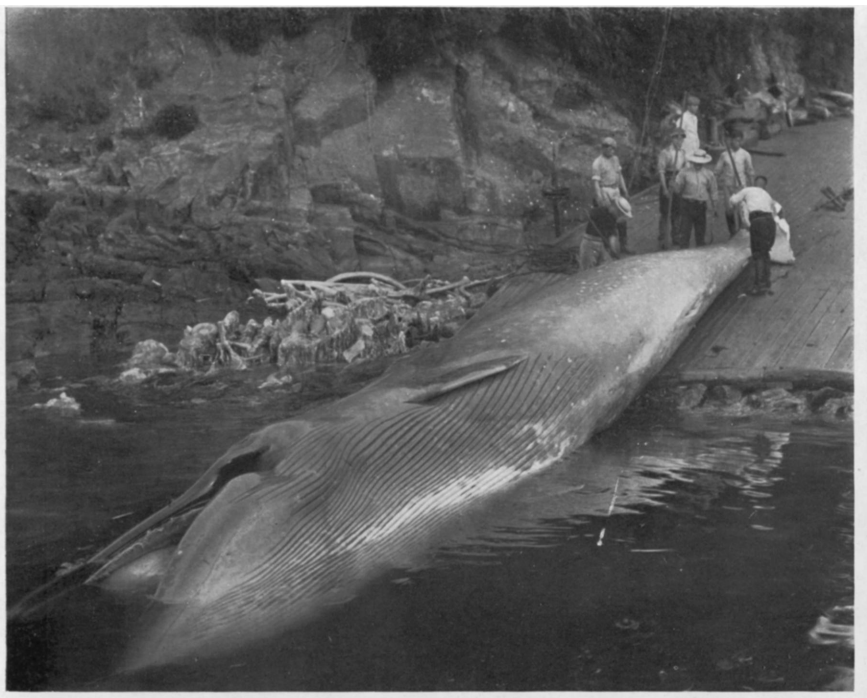

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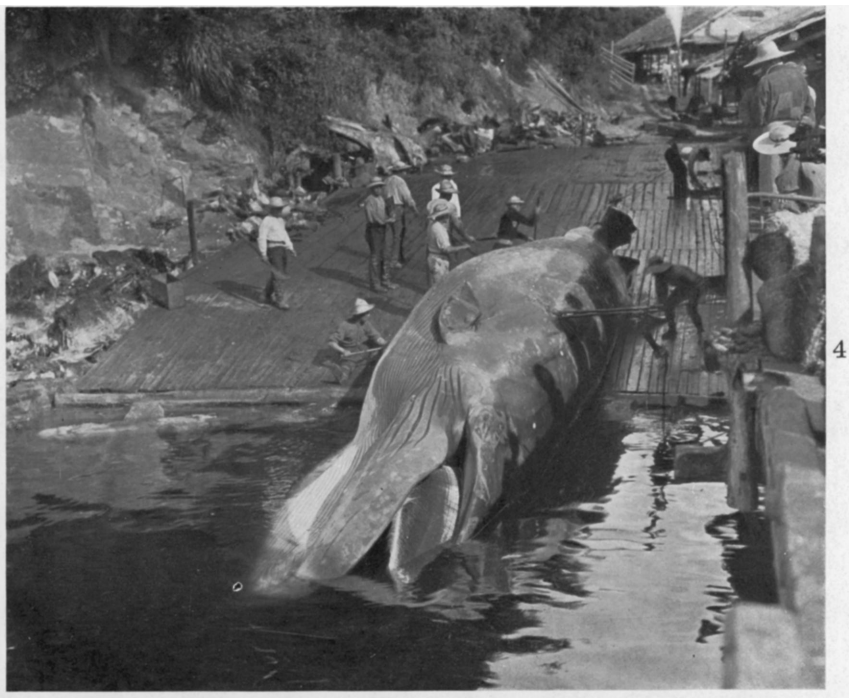

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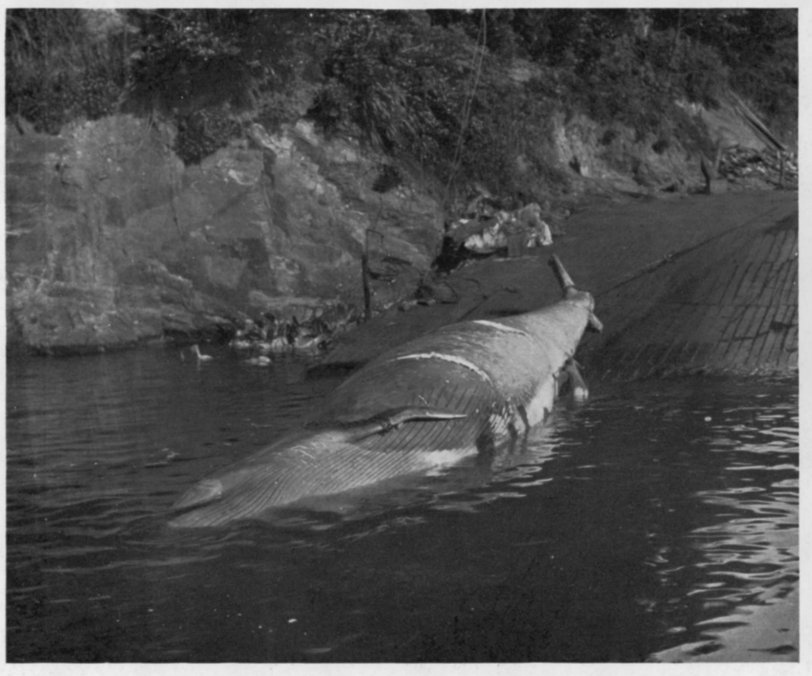

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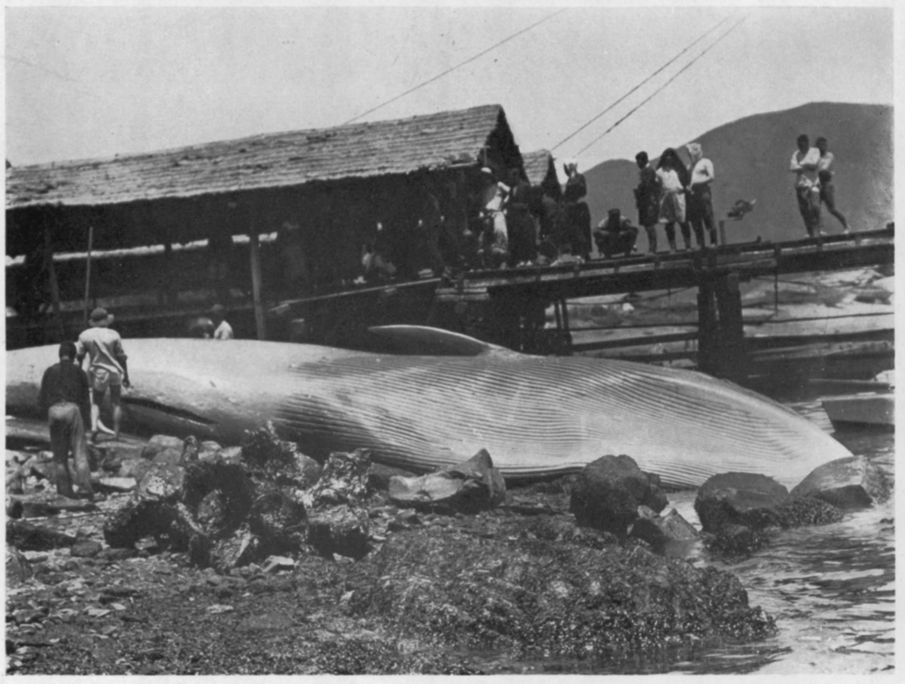

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BALÆNOPTERA BOREALIS.

the color in *B. sibbaldi*, although the blue color as a rule is less pronounced than in that species. The color after death is darker than in the living animal. On the side of the body the color becomes somewhat lighter; the belly is dark steel-gray with a white area running along the centre; the white color begins at the symphysis of the lower jaw, and terminates at the genitalia, but occasionally it is interrupted or imperceptible on the middle portion of the belly.

"Considerable variations occur in the breadth, size, and form of this white part of the belly. The throat is always white, occasionally throughout its entire breadth, sometimes only for a couple of feet. On the breast the white becomes narrower, and in many individuals is completely cut off by the bluish grey color of the sides, but it then reappears on the belly, and continues in a somewhat irregular width to the genitalia. Behind the vent the whole under-side of the tail is light bluish grey, about the same as the back.

"The white color is not always symmetrical, but is occasionally broader on one side of the middle line than on the other; also the extent of it on the belly may be rather irregular. On the throat similarly the white color is sometimes broader on one side than on the other.

"The white patch on the belly was never absent in any of the specimens examined; and this observation is confirmed by all the managers of the whaling companies, who state that it is always to be found, though it is sometimes only slightly developed.

"The white color, especially on the throat, is pure and sharply defined. On the belly and in front of the genitalia there are, on the contrary, a large number of very fine bluish-grey lines, which are quite short and run parallel to each other; these lines, which can only be distinguished when you are near to the animal, sometimes, when they are very numerous and closely set, detract from the whiteness of these portions.

"The flippers are coloured on the outer side like the back; on the inner side they are a trifle lighter, especially along the lower edge: a few individuals (such as No. 2 of the specimens examined) have large whitish spots on the inner side; these are never, however, absolutely white. The flukes of the tail are also bluish grey underneath; the dorsal fin is exactly the color of the back"(*l. c.*, p. 249).

By comparing these descriptions of the European and Japan specimens it will be seen that they agree in all essential particulars and, in fact, Collett's notes on individual variations in every case can be matched among my own. He speaks of variations in the amount of white and gray upon the throat and breast, of the patch-like extensions of gray on the lower sides which frequently unite in a band across the abdomen, of the 'anchor-like' markings of white in the gray (Plate XXXIII, Figs. 3 and 5, Plate XXXIV, Fig. 2, Plate XXXV, Figs. 1 and 3) and of the fine bluish gray lines upon the lower half of the peduncle and about the genitalia — all peculiarities of coloration equally pronounced in the Japan specimens. The dorsal fin, flukes, and flippers are alike in color, and Collett's excellent figures of the lateral and ventral surfaces of the body can be duplicated among my own photographs and descriptions.

The two photographs of *B. borealis* from Scotland published by R. C. Haldane, Esq., furnish valuable material for color comparisons. The similarity between the figure showing the ventral surface of a Scotland whale (1907, plate 1, fig. 2) and of a specimen from Japan (Plate XXXII, Fig. 6) is remarkable, the disposition of the color on both individuals being practically the same.

Collett's drawings and Haldane's photographs are the only illustrations hitherto published which are of real value in showing the coloration of *B. borealis*.

Field Color Descriptions of 25 Japan Specimens. — With some hesitation I have included

my field color notes. Since they serve as explanations of the photographs, and throw additional light upon individual variation, which cannot be overemphasized, it appeared to be worth while to publish them here.

No. 2. Male. Length 1007 cm. Oshima (Plate XXXVIII, Fig. 6). The head and back are dark slate and the edges of the snout on either side for about 30 cm. are light gray. The left ramus of the mandible is gray and a slightly darker shade continues along the side of the throat and breast. Twelve of the folds below the left fin are bluish slate, but the folds of the central throat and breast are white with pinkish furrows.

On the sides the dark slate of the back shades off rather abruptly into light gray which, on the peduncle, comes further and further down until 100 cm. behind the anus it covers all but a narrow ventral line; this narrow strip and the belly are pinkish.

The flukes are dark above and grayish white below. The pectoral fins are dark above and the dorsal fin dark slate like the back.

The greater portion of each baleen plate is dark, but a narrow band along the inner edge is white. The bristles of the baleen are all white except in the posterior half of the row where the tips become grayish. When I first examined the baleen, it seemed that the bristles of the plates were pure white for about 25 cm. up from the base and then became tinged with grayish. On closer inspection it was seen that this grayish tinge was due to the dark color of the plates showing through the fringe of bristles, and that the bristles themselves were *not* grayish except on the tips of the posterior half. The pure white strip along the inner base of the baleen plates gives the appearance of a white band about 25 cm. wide.

No. 4. Female. Length 1350 cm. Oshima. Top of head, back, and the upper one-third of the sides are dark slate. The left ramus of the mandible has the lower half light gray and the upper half slate or dark gray. The edges of the snout for 30 cm. on either side are light gray. From the tip of the under jaw the throat and breast are white; eleven folds under the right pectoral, and about the same number under the left, are dark gray. The furrows are pinkish, but this color does not extend to the folds. Directly under the corner of the mouth on the left side 20 folds are gray. The lower two-thirds of the sides are light gray, and at the umbilicus this color extends across the abdomen in a band about 100 cm. wide. From the ends of the furrows to the flukes the light gray of the sides comes down nearly to the ventral line, which is pinkish; this pink ventral area reduces gradually from the genitalia backward until it becomes a very narrow strip.

The flukes are slate above but light gray below, about the same shade as the sides of the peduncle; the posterior edges, the tips, and the anterior edges for a few cm. from the tips, are slate.

The anterior edge of the fin is light gray, caused by the light color of the under side running over the edge on to the superior surface, thus forming a band about 5 cm. wide the entire length of the fin. The remainder of the dorsal surface of the pectoral is blue slate becoming dark slate near the posterior edge. Below, the anterior half of the fin for its entire extent is light gray; the posterior half is slate, except near the proximal end where it changes to dark gray.

No. 5. Female. Length 1460 cm. Oshima. Head, back and upper sides dark gray. The upper edges of the snout for a short distance from the end on either side are grayish, this color changing to light pink underneath and extending backward for 135 cm. from the tip of the snout. The left ramus of the mandible has the upper two-thirds gray and the lower third light gray; the right ramus is light gray for its entire extent. On the breast, between the fins, are 22 white folds, and 9 dark folds under the right pectoral; the furrows are pinkish. The white area becomes narrower as it runs backward and is only a few inches wide on the ventral edge of the peduncle. The sides of the body and peduncle are very light gray.

No. 19. Male. Length 1350 cm. Aikawa (Plate XXXIX, Figs. 6 and 7). Top of head and back dark gray. The left lower lip and ramus of the mandible has the upper portion dark gray and the lower half very light gray becoming almost white at the tip; the inside of the right ramus and lip are slate color. The under edges of the snout on either side for about 30 cm. are pink, this light area corresponding in extent with the white anterior portions of the baleen rows.

The central portion of the throat and breast are white to a point about opposite the middle of the pectoral fin laid back; there, a band about 125 cm. wide with irregular margins, which extends back to a point a little behind the umbilicus, runs across the belly; this band is gray and considerably darker than the sides of the peduncle. The folds just anterior to the abdominal band are light pink. On the left side of the whale the dark gray from the upper half of the lower lip extends backward becoming wider and wider until between the corner of the mouth and the fin it spreads downward into a large blotch with irregular margins; directly under the left pectoral this dark area covers 14 folds. From a point opposite the umbilicus the dark gray of the back shades off gradually into gray on the lower sides, which covers the entire ventral line from the anus to the flukes; there is a narrow area of light pink from the umbilicus to the anus.

Below, the central portion of both lobes of the flukes is light gray, about like the lower sides of the peduncle. The distal half of each lobe, as well as a wide band along the posterior and anterior edges, is dark gray. Above, the flukes are dark gray like the back.

The pectoral fins, above, are bluish gray, which lightens somewhat along the anterior edge of the distal half of each fin. Below, the anterior half of each flipper is light gray shading off very gradually into the darker gray of the posterior half.

No. 24. Male. Length, 1455 cm. Aikawa. A light individual, the general color effect being much like that of a

PLATE XXXIV.

PLATE XXXIV.

Balænoptera borealis.

Fig. 1. Throat and breast of Sei Whale No. 36.
Fig. 2. " " " " " " " 26.
Fig. 3. " " " " " " " 43.
Fig. 4. Breast of Sei Whale No. 34.
Fig. 5. " " " " " 35.
Fig. 6. Side view of throat of Sei Whale No. 63.

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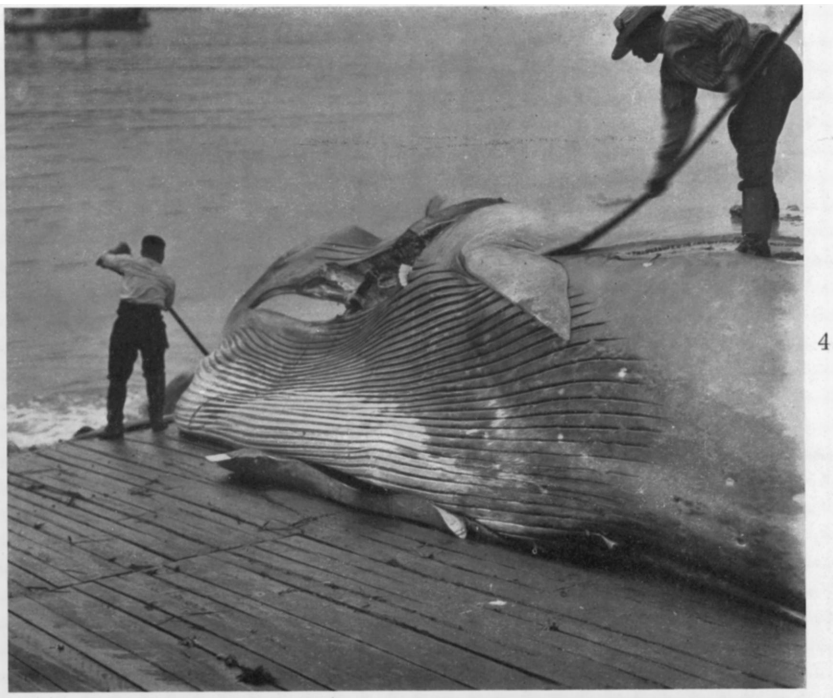

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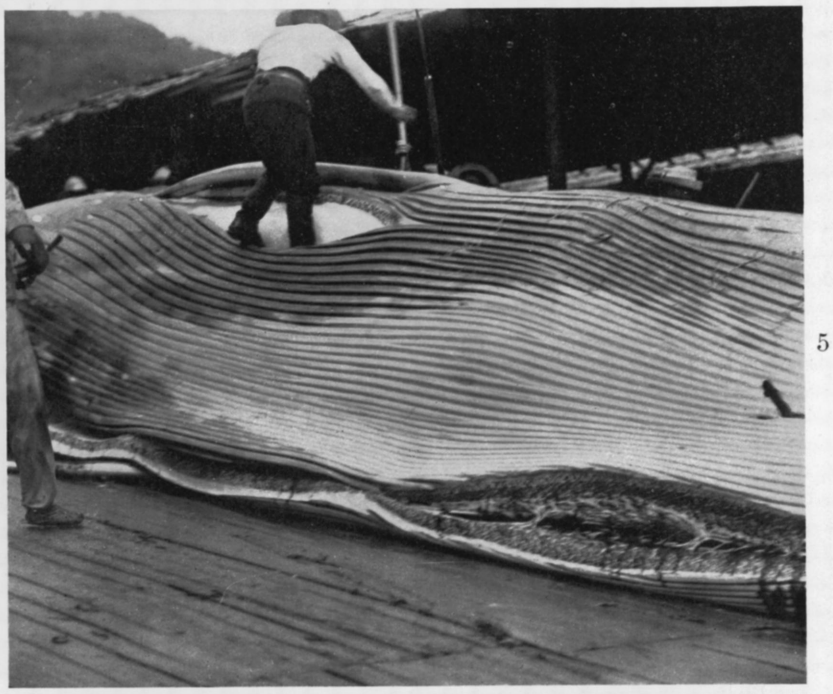

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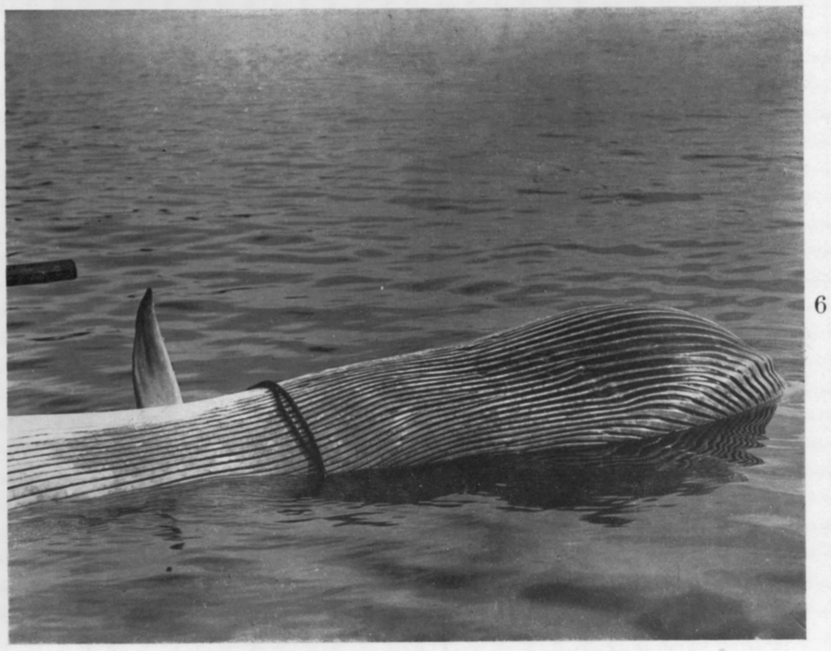

BALÆNOPTERA BOREALIS.

Blue Whale. The top of the head, back and upper sides are dark bluish gray. The side of the right lower lip and jaw is light blue gray, the edge of the lip being a little darker. The central portions of the throat and breast are white, and the furrows pinkish. Under the corner of the mouth on the right side there are 14 dark gray furrows. There is a blotch of gray with irregular margins on the folds extending from the corner of the mouth under the fin to a point nearly opposite the tip of the fin laid back; there it broadens out abruptly into a wide band, which extends across the abdomen joining the gray of the folds on the other side. The sides of the peduncle are beautiful light blue gray, becoming lighter towards the ventral line. The area between the umbilicus and the anus is almost white, but from the anus to the flukes the ventral region is light blue gray.

The flukes above are dark gray like the back; below they are blue gray like the sides of the peduncle, except for the gray tips and anterior and posterior margins.

The pectoral fins are gray above; below the anterior half is light blue gray and the posterior half gray.

No. 26. Male. Length 1380 cm. Aikawa (Plates XXXIII, XXXIV, XXXVII and XXXIX). A light whale. The inside of the upper half of each lip is blue gray and the lower half is light gray flecked with darker. The gray band running across the abdomen is not thoroughly marked in this whale. Between the penis and the umbilicus the mid-ventral line is white and the sides of the peduncle are beautiful light blue gray.

The dorsal fin is dark gray like the back and the flukes below are lined like those of a Blue Whale.

The bristles of the baleen are all white, very fine and thick; they do not have the usual gray edgings.

No. 34. Male. Length 1400 cm. Aikawa (Plates XXXII–XXXIX). The left upper lip is dark blue gray externally, and internally the same color in the upper half; the lower half is lighter dotted with dark gray. On the breast the folds are white but the furrows are flesh pink; on the left side of the throat an irregular blotch of gray 179 cm. from the mandibular symphysis comes to within 9 folds of the median line. Fifteen folds under the left fin are blue gray. The gray band across the abdomen is wide and is much darker than the sides of the body above and behind it. From the umbilicus to the anus the ventral region is pinkish, and from the anus to the flukes the mid-ventral line is light gray like the sides.

The pectoral fin is blue slate above. Below it has the anterior half light and the posterior half blue gray.

The bristles of the baleen, except at the tips, are white.

No. 35. Female. Length 1405 cm. Aikawa (Plates XXXII, XXXIV, XXXV, XXXVI and XXXVIII). A light whale. The right lower lip is blue gray shading into very light gray. There are many scars on the peduncle and sides.

The pectoral fin has the posterior half blue gray shading into very light gray (almost white) on the anterior half.

The flukes, below, are light blue gray like the sides of the peduncle; the posterior margins of the tips are dark gray.

No. 36. Female. Length 1465 cm. Aikawa (Plates XXXIV–XXXVI). The gray band across the abdomen is very noticeably darker than the sides of the body. The ventral edge of the peduncle from the anus to about 125 cm. anterior to the flukes is white marked with fine wavy gray lines. The pectoral fin is a little darker than usual on the anterior half. The flukes are light blue gray like the sides of the peduncle and have a narrow anterior and a wide posterior margin of dark gray.

The bristles of the baleen are all white with no gray even at the tips.

No. 38. Female. Length 1400 cm. Aikawa (Plates XXXII, XXXIII, XXXV and XXXVIII). The upper half of the left lip is gray and the lower half white; there is then a narrow area of grayish which shades off rapidly into the white of the throat. Under the corner of the mouth 14 folds are gray; the edges of this gray area are irregular and there is a patch-like extension which runs into the white of the throat about 100 cm. anterior to the corner of the mouth; another more prominent gray patch on the breast at a point about opposite the posterior insertion of the fin.

The gray abdominal band is well marked. From the umbilicus to the genitalia the ventral line is white with a very few wavy, gray markings; from the genitalia to the flukes the mid-ventral line is light blue gray like the sides of the peduncle.

No. 41. Male. Length 1360 cm. Aikawa (Plates XXXII–XXXVII). A light whale but without a bluish tinge. Head and back dark gray. Left lower lip dark gray, at the symphysis the color forms in a narrow area but gradually widens toward the corner of the mouth, where it lightens and shades off into the white of the throat. The dark abdominal band is well-marked. The sides of the peduncle are light gray, and from the penis to about 125 cm. anterior to the flukes the mid-ventral line of the peduncle is white.

The flukes, above, are slate and below are about the color of the sides of peduncle, except for a narrow band along the anterior and posterior margins.

No. 43. Male. Length 1470 cm. Aikawa (Plates XXXII, XXXIII, XXXIV and XXXIX). A very light whale. The right lip is gray shading into the white of the throat. The abdominal band is well marked and a narrow, dark stripe runs out of the right corner of the mouth for about 35 cm. The entire ventral surface of the body from the umbilicus to the flukes is very light gray, almost white.

No. 51. Female Length 1465 cm. Aikawa. A light whale and strongly bluish. The head and back are dark blue gray. There is a gray blotch just in front of the corner of the mouth and a narrow, very light gray line runs backward out of the ear on the right side. In several patches on the throat the bottoms of the furrows are purplish but this does not extend on to the folds.

The umbilicus is 115 cm. posterior to the longest furrow.

No. 61. Female. Length, 1524 cm. Aikawa. A strongly bluish whale. Head, back and upper sides dark blue gray; the dark color occupies the upper fourth of the peduncle and shades off gradually into light blue gray. On either side a white band extends from the anterior insertion of the fin obliquely down and back, ending at the mid-ventral line about 45 cm. in front of the furrows and running parallel with their ends. (This is the anchor like mark which Collett records on the Atlantic specimens). The gray band extending across the abdomen is pronounced. From the umbilicus to the genitalia the ventral line is white and from the genitalia to the flukes it is light gray like the peduncle sides; there are many small patches of white about the genitalia and numbers of *Penella* scars on the peduncle. The sides of the peduncle are beautifully marked with gray, but about 60 cm. anterior to the flukes the markings cease leaving this area plain gray.

No. 62. Female. Length 1285 cm. Aikawa. The top of the head, back and upper sides are dark blue gray and the under edges of the snout for about 36 cm. on each side are pinkish. The right lip is gray shading into very light gray on the ramus; this extends to the fin and the area just above it including the eye. The gray spreads outward and backward covering 10 folds between the corner of the mouth and the fin. The entire ventral line from the end of the furrows to the flukes is light pink, this area becoming narrower posteriorly. There is no gray band across the belly and but little gray on the sides. All the folds of the central throat and breast are tinged with pink and those of the belly are almost white; the furrows are deep pink.

The general color of the flukes below is pinkish. They have a narrow posterior edging of gray and the remainder of both lobes is pinkish thickly and finely lined with gray. The fine gray lines run from the anterior edge in a curve across the lobe bending in toward the notch; in the distal portion of the lobe they curve across from the anterior edge and turn sharply inward down the posterior margin.

No. 63. Male. Length 1280 cm. Aikawa (Plates XXXIV and XXXVII). The top of the head and the back are dark blue gray. The right lip is gray shading into lighter gray on the ramus which is similar in color to the entire throat and anterior breast; the furrows are dark gray and the folds lighter. On the left side, below, from a point about 60 cm. anterior to the pectorals to about 180 cm. from the end of the furrows, the folds and the furrows are strongly pinkish; this is a comparatively small area and there is a second still smaller pink patch just below the mandibular symphysis. The pink ventral area comprises 16 folds, and those posterior to it on the abdomen are gray tinged with pink.

The peduncle is light blue gray and scattered gray markings extending over the posterior ends of the furrows. The flukes, below, have the central portion very light gray; a wide posterior and a very narrow anterior margin is dark gray. Above, the flukes are blue gray like the head, back and dorsal fin. The blubber is a delicate pink.

Nos. 65, 66, 67, 68. Aikawa. These whales were killed while I was at sea on the S/S Go Hogei Maru and the notes were taken as soon as the animals had been captured.

Nos. 65, male, length 1220 cm., and 66, female, length 1250 cm., each had the throat, breast and abdominal *folds* light pink but the *furrows* were dark gray, except in two or three instances where they were pink like the folds. No gray band extended across the abdomen and the general body color did not have a bluish tinge. The sides of the peduncle were very light gray shading into pink on the ventral region.

The top of the rostrum from the tip of the snout to the eye was clear gray (not very dark). From the eye this color extends in a curve up and back over the dorsal surface of the body; there was a space about 60 cm. wide directly above the pectoral fin on each side which was a much lighter shade of gray than that of the back. Nos. 67, male, length 1371 cm., and 68, female, length 1463 cm., both had the throat and breast folds white and the furrows dark gray; No. 67 had a broad area of mouse gray on the abdomen. In both whales the general color of the body was much darker than in Nos. 65 and 66.

No. 69. Male. Length 1413 cm. Aikawa. A light individual. The throat folds are white and the right lip is light gray shading into pinkish white on the lower portion of the ramus.

No. 70. Male. Length 1265 cm. Aikawa. The folds of the entire throat, central breast and abdomen are light pink, and the furrows are deep pink. Between the corner of the mouth and the fin are seven light gray folds and opposite the middle of the fin laid back a short light gray band runs obliquely downward and backward. The ventral region of the peduncle is pink to about 180 cm. anterior to the flukes.

No. 72. Female, juv. Length 940 cm. Aikawa. The entire ventral surface of this whale is light pink, except for a few gray furrows on the right side of the throat.

No. 73. Female. Length 1315 cm. Aikawa. A very dark whale. Both lower lips are rather dark gray shading into lighter gray on the jaws. The entire throat and breast to the anterior insertion of the fins have the folds gray tinged with pink and the furrows all dark gray. The central breast, from the anterior insertion of the fins to opposite the tips of the fins laid back, has both the folds and furrows deep pink. From the tip of the fin laid back to the umbilicus the abdomen is gray tinged with pinkish.

The usual gray band from the fin to the end of the furrows is but slightly emphasized, and the 'anchor-like' light marking is absent.

No. 75. Female. Length 1417 cm. Aikawa. The general color has a slight bluish tinge. The right lip is all gray and the ramus is a little lighter. The folds of the throat are whitish and the furrows all dark gray; the folds of the breast are white tinged with pink but the furrows are dark except eleven in the mid-ventral line. Below the right fin eight folds are grayish tinged with pink. The gray band across the abdomen is only suggested, and the area from the navel to the genitalia is pinkish. The ventral line of the peduncle is gray like the sides.

PLATE XXXV.

PLATE XXXV.

Balænoptera borealis.

Fig. 1. Ends of furrows of Sei Whale No. 35, showing the 'anchor-like' white marking.
Fig. 2. Umbilicus of Sei Whale No. 35.
Fig. 3. Breast of Sei Whale No. 36, showing the 'anchor-like' white marking.
Fig. 4. Posterior portion of Sei Whale showing 'patch-like' markings.
Fig. 5. Umbilicus of Sei Whale No. 35; cut by the right edge of the photograph.
Fig. 6. " " " " " " under the rope crossing the body.

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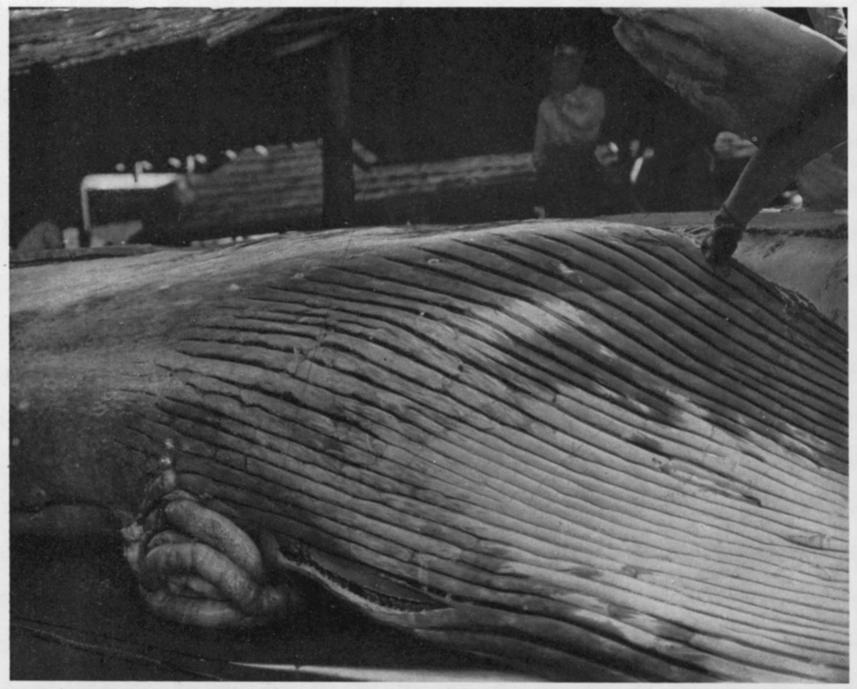

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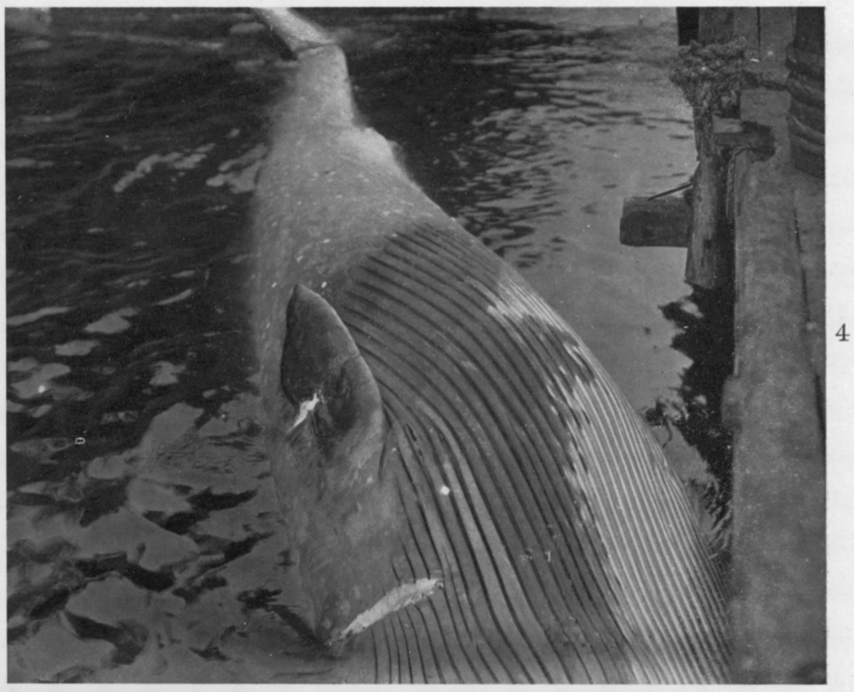

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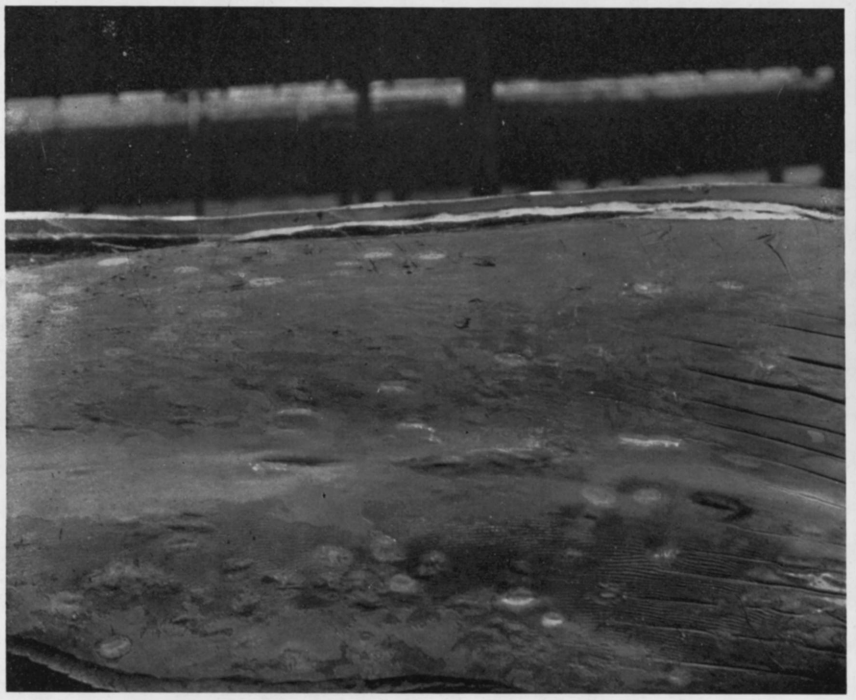

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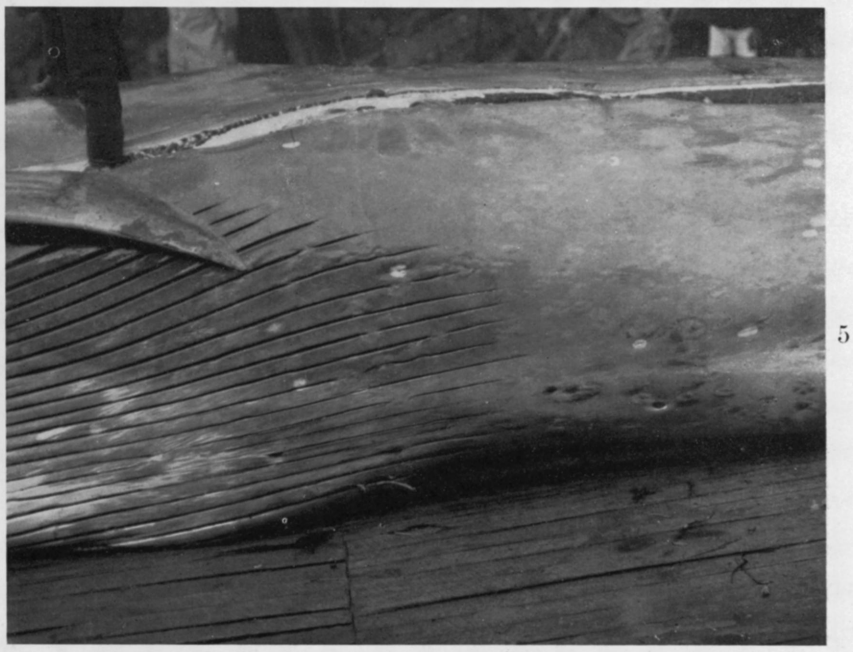

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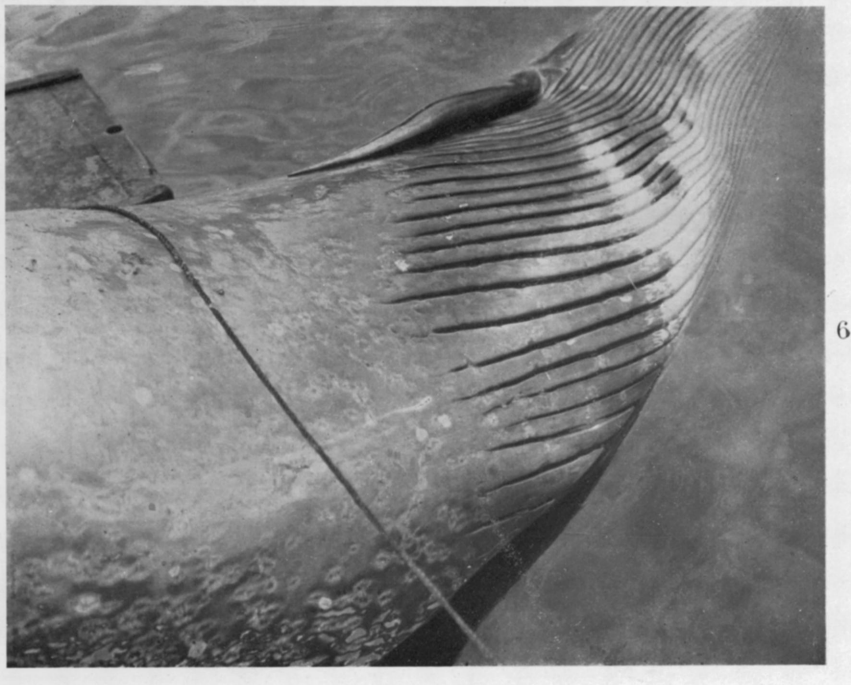

BALÆNOPTERA BOREALIS.

Proportions.

Plates XXXII–XL.

Size.— In the following tables are given data relative to the length of Pacific specimens of *B. borealis*, both from my own measurements and from statistics kindly furnished by the Toyo Hogei Kabushiki Kaisha. The total length of the specimens taken while I was at the stations during 1910 have been given in full but the data sent by the whaling company for the years 1912, 1913, 1914 has been summarized in Tables IV, V and VI. For comparison with these Pacific records we have the measurements of Atlantic Sei Whales published by Cocks, Haldane, and Collett in Finmark and Scotland.

Table I.— Lengths of 20 Males from Japan taken during 1910.

Date	Place	Total Length Cm.	Total Length Feet	Date	Place	Total Length Cm.	Total Length Feet
Aug. 5, 1910	Aikawa (R. C. A.)	1473	48′ 4″	Aug. 22, 1910	Aikawa (R. C. A.)	1189	39′
July 2, "	" "	1470	48′ 3″	Apr. 6, "	Oshima, "	1007	33′ 1″
June 11, "	" "	1455	47′ 9″				
" 22, "	" "	1400	45′ 11″	July 19, 1910	Aikawa (By whalers)	1463	48
" 12, "	" "	1380	45′ 3″	June 24, "	" "	1432	47
Aug. 3, "	" "	1371	45′	" 23, "	" "	1310	43
June 30, "	" "	1360	44′ 7½″	" 26, "	" "	"	"
" 8, "	" "	1350	44′ 3½″	" 29, "	" "	"	"
Aug. 1, "	" "	1280	42′	July 13, "	" "	"	"
" 18, "	" "	1265	41′ 6″	June 24, "	" "	1280	42
" 2, "	" "	1219	40′				

Table II.— Lengths of 18 females from Japan taken during 1910.

Date	Place	Total Length Cm.	Total Length Feet	Date	Place	Total Length Cm.	Total Length Feet
July 20, 1910	Aikawa, (R. C. A.)	1524	50	July 31, 1910	Aikawa (R. C. A.)	1285	42′ 2″
June 24, "	" "	1465	48′ 1″	Aug. 2, "	" "	1249	41′
July 20, "	" "	"	"	" 20, "	" "	940	30′ 10″
Aug. 3, "	" "	1463	48				
Apr. 13, "	Ōshima, "	1460	47′ 11″	July 22, "	" (By whalers)	1493	49
Aug. 23, "	Aikawa, "	1417	46′ 6″	" 9, "	" "	1463	48
June 22, "	" "	1405	46′ 1″	" 16, "	" "	1432	47
" 26, "	" "	1400	45′ 11″	" 20, "	" "	"	"
Apr. 6, "	Ōshima, "	1350	44′ 3½″	June 19, "	" "	1219	40
Aug. 20, "	Aikawa, "	1315	43′ 2″				

Table III.— Lengths of 9 specimens from Japan, sex unrecorded, taken during 1910.

Date	Place	Total Length	Total Length
		cm.	feet
Jan. 20, 1910	Nikishima (by whalers)	1463	48
Feb. 23, "	Oshima, "	"	"
Mar. 4, "	" "	1432	47
Nov. 13, 1908	Nikishima, "	1341	44
Feb. 19, 1910	Oshima, "	1250	41
Sept. 30, 1909	Nikishima, "	1219	40
Feb. 4, 1910	" "	1127	37
Feb. 16, "	Oshima, "	1066	35
" 4, "	" "	844	29

Summary of Tables I, II, III.

Number captured during each month		Number captured at each station		Average length of all specimens, 1332 cm..(43′ 8½″)
January	1	Oshima, Kiushiu	8	Average length of all females, 1321 cm. (43′ 4″)
February	5	Aikawa	35	
March	1	Nikishima	4	Average length of all males, 1328 cm. (43′ 7″)
April	3			
June	14	Females	18	Maximum length of females, 1524 cm. (50′)
July	10	Males	20	
August	11	Sex unknown	9	Maximum length of males, 1473 cm. (48′ 4″)
September	1			
November	1	Total	47	Minimum length of females, 940 cm. (30′ 10″)
				Minimum length of males, 1007 cm. (33′ 1″)

Table IV.— Summary of data relating to B. borealis taken by the Toyo Hogei Kabushiki Kaisha during 1912.

Number captured during each month		Number captured at each station		Average length of all specimens, 1249 cm. (41′)
January	4	Nikishima	5	Maximum length, 1615 cm. (53′)
February	5	Oshima, Kiushiu	67	Minimum length, 884 cm. (29′)
March	5	" Goto	2	
April	4	Shimizu, Tosa	8	
May	5	Muroran	1	
June	43	Hidakatsu	1	
July	23	Hososhima	1	
August	10	Same	5	
September	3	Aikawa	15	
October	1			
December	2	Total	105	

Table V.— Summary of data relating to B. borealis taken by the Toyo Hogei Kabushiki Kaisha during 1913.

Number captured during each month		Number captured at each station		Average length of all specimens, 1249 cm. (41′)
May	5	Oshima, Goto	74	Average length of all females, 1279 cm. (42′)
June	59	" Kiushiu	13	
July	33	Aikawa	48	Average length of all males, 1218 cm. (40′)
August	3	Same	3	
September	21	Nikishima, Kiushiu	1	Maximum length of females, 1615 cm. (53′)
October	17	Izu, Koura	2	
November	6	Hidakatsu, Tsushima	2	Maximum length of males, 1524 cm. (50′)
		Shimpo, Korea	1	
		Females	69	Minimum length of females, 762 cm. (25′)
		Males	75	
		Total	144	Minimum length of males, 640 cm. (21′)

Table VI.— Summary of data relating to B. borealis taken by the Toyo Hogei Kabushiki Kaisha during 1914.

Number captured during each month		Number captured at each station		Average length of all specimens, 1371 cm. (45′)
January	3	Hososhima	3	Average length of all females, 1402 cm. (46′)
May	1	Oki Is.	1	
June	2	Aikawa	19	Average length of all males, 1310 cm. (43′)
July	7	Same	19	
August	30	Muroran	1	Maximum length of females, 1615 cm. (53′)
		Females	27	Maximum length of males, 1493 cm. (49′)
		Males	16	
			—	Minimum length of females, 975 cm. (32′)
		Total	43	
				Minimum length of males, 610 cm. (20′)

Table VII.— Summary of Measurements of Pacific and Atlantic specimens.

	Pacific				Atlantic
Year	1910	1912	1913	1914	
Number of specimens	47	105	144	43	♀ 251, ♂ 291
Average length of all specimens	cm. 1332 ft. 43′ 8½″	cm. 1249 ft. 41	cm. 1249 ft. 41	cm. 1371 ft. 45	—
Average length of all females	cm. 1321 ft. 43′ 4″	—	cm. 1279 ft. 42	cm. 1402 ft. 46	cm. 1331 ft. 43′ 8″
Average length of all males	cm. 1328 ft. 43′ 7″	—	cm. 1218 ft. 40	cm. 1310 ft. 43	cm. 1300 ft. 42′ 8″
Maximum length of females	cm. 1524 ft. 50	—	cm. 1615 ft. 53	cm. 1615 ft. 53	cm. 1737 ft. 57
Maximum length of males	cm. 1473 ft. 48′ 4″	—	cm. 1524 ft. 50	cm. 1493 ft. 49	cm. 1707 ft. 56
Minimum length of females	cm. 940 ft. 30′ 10″	—	cm. 762 ft. 25	cm. 975 ft. 32	cm. 1097 ft. 36
Minimum length of males	cm. 1007 ft. 33′ 1″	—	cm. 640 ft. 21	cm. 610 ft. 20	cm. 783 ft. 25′ 8″

The averages of 251 females and 291 males from the Atlantic given in the above tables are Haldane's figures for the Sei Whales taken at the Scotland stations during the years 1906–1907, and it will be seen that they agree very closely indeed with the averages of the Pacific specimens, although in the former case the figures were drawn from a somewhat larger number of individuals than in the latter.

The largest whale of either sex in the Japan records are several females 1615 cm. (53′) in length; the longest specimen from the Atlantic is a female recorded by Haldane which reached a length of 1737 cm. (57′) and must have been a very exceptional individual. The smallest Sei Whale in the list from Japan measured 610 cm. (20′), and in the European records is Fischer's specimen from Biarritz, France, which was 783 cm. (25′ 8″) in length.

Very much to my surprise, in the whaling company's statistics for 1913 a female Sei Whale taken at Shimpo, Korea, Oct. 12, 762 cm. (25′) long, is recorded as being pregnant at the time of capture. The rate of growth of the young of large cetaceans is so rapid during the first months after birth that this specimen could have been but little more than one year old, and the 610 cm. (20′) individual had probably been born but a few months.

In regard to the length of the Finmark specimens, Collett says:

"Most of the examples caught were between 40 and 50 feet in length. The usual length was 44–45 feet or thereabouts. The largest specimens measured 52 feet (16.3 metres). The six specimens which I examined thoroughly were 43 to 49½ feet in length. The last of these (a male) was considered to be one of the largest caught; so that it may be laid down as a rule that they rarely exceed 50 feet (15.6 metres).

"The smallest specimens this summer that I know of were 35–37 feet, but these were exceptional. A single specimen was caught in July at Mehavn (by Foyn), the length of which was said at the place to be 32½ feet (10.1 metres).

"Both sexes seem to attain about the same size; the largest female specimen that I examined was 47 feet long (14.7 metres). One of the managers stated that if there were any difference, the female was the largest and fattest, at any rate during the whaling season.

"The size appeared the same throughout the season, and it was remarkable to notice how uniform it was, and how evidently the whales were all of about the same age" (*l. c.*, p. 248).

Since the statistics of both the Pacific and Atlantic specimens show a slightly greater length for the females, and the largest individuals from both oceans are of this sex, it is probably true that, as in other Balænopteras, the female of this species slightly exceeds the male in size. The difference in maxima between the specimens from the Pacific and Atlantic is not of especial importance when it is recalled that many more individuals from Europe than from Japan were recorded. If an equal number from the Pacific were measured even such an exceptionally large specimen as Haldane's 1737 cm. (57′) whale would probably be found.

In Table VIII are given the dimensions of 21 individuals which I examined in Japan, together with such measurements of Atlantic specimens as have thus far been published. The latter include Collett's six examples and four recorded by Rudolphi, Fischer, Turner, and Flower. The measurements of the Atlantic whales are very incomplete but I have come to believe that measurements, either actual or proportional, are of but little value in specific determinations because of the great individual variation among cetaceans.

In Table IX the ratio to the total length of certain measurements has been given. This

Table VIII.— Measurements of Specimens from Japan and Europe.

Locality	Japan, 1910. Andrews																				Finmark, 1885. Collett						1819. Rudolphi's specimen. Measurements from Lilljeborg	1876. Fischer	1872. Firth of Forth, Scot. Turner	1883. River Crouch, Eng. Flower
	No. 2, Oshima Apr. 6 ♀ jv.	No. 4, Oshima Apr. 13 ♀	No. 5, Oshima Apr. 13 ♀	No. 19, Aikawa June 8 ♂	No. 24, Aikawa June 11 ♂	No. 26, Aikawa June 12 ♂	No. 34, Aikawa June 22 ♂	No. 35, Aikawa June 22 ♀	No. 36, Aikawa June 24 ♀	No. 38, Aikawa June 26 ♀	No. 41, Aikawa June 30 ♂	No. 43, Aikawa July 2 ♂	No. 51, Aikawa July 20 ♀	No. 61, Aikawa July 30 ♀	No. 62, Aikawa July 31 ♀	No. 63, Aikawa Aug. 1 ♂	No. 69, Aikawa Aug. 5 ♂	No. 70, Aikawa Aug. 18 ♂	No. 72, Aikawa Aug. 20 ♀ jv.	No. 73, Aikawa Aug. 20 ♀	No. 75, Aikawa Aug. 23 ♀	No. 1, Vardö ♀	No. 2, Vardö ♀	No. 3, Vardö ♀	No. 4, Vardö ♂	No. 5, Vardö ♂	No. 6, Vardö ♂	♀ jv.	♂ jv.	....	♂ jv.
	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.
Total length, snout to notch of flukes	1007	1350	1460	1350	1455	1380	1400	1405	1465	1400	1360	1470	1465	1524	1285	1280	1473	1265	940	1315	1417	1350	1375	1475	1400	1450	1533	985	783	1128	884
Tip of snout to eye	195	280	287	270	275	265	265	287	283	295	270	290	295	330	279	270	282	....	185	269	274	....	....	....	....	....	....	....	....	....	....
" " " " blowholes (center)	155	220	....	225	225	200	221	237	240	248	230	250	243	....	236	223	216	....	147	209	236	210	....	....	....	....	....	....	104	....	....
" " " " axilla	350	465	....	490	505	470	468	505	....	510	....	503	....	....	371	....	....	397	....	413	....	....	....	475	....	425	....	....	....	....	....
" " " " dorsal fin	717	....	1015	940	1025	960	1010	....	....	988	924	....	1055	....	....	....	....	....	....	....	....	934[2]	....	1080[2]	980[2]	1030[2]	1098[2]	610	515	....	....
Distance from eye to ear	60	....	....	73	77	74	....	77	78	....	70	....	85	....	....	....	....	....	....	....	....	....	66	....	69	....	....	....	....	....	....
" " " " axilla	155	185	....	220	230	205	203	218	....	215	....	213	....	....	....	....	....	....	....	....	....	....	....	180.3	172.4	....	185	....	....	....	....
" eye is above ear	10	....	....	9	9	6	....	6	....	....	10	8	6	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Length of eye opening	7	8	7	7.5	8	7	....	8	8	....	8	9	8	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
" " ear "	....	....	....	.5	1.5	3	....	....	1.5	....	6	.5	.5	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Notch of flukes to post. edge dorsal fin	290	....	445	410	430	420	390	....	....	412	436	....	410	483	368	376	432	....	....	391	394	....	....	390.6[1]	....	....	....	....	....	....	....
" " " " axilla	670	890	....	920	950	890	935	920	985	....	920	....	980	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
" " " " anus	....	....	....	365	365	360	365	370	....	355	345	400	375	434	366	361	363	335	248	....	361	....	....	....	....	....	....	....	....	....	....
" " " " clitoris or penis	....	....	....	430	....	....	....	....	....	....	....	525	....	....	....	411	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
" " " " mammæ	....	385	425	....	....	....	....	403	....	400	....	....	421	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Length of pectoral, tip to head of humerus	142	187	193	180	200	....	177	....	200	195	....	....	200	218	178	175	....	....	....	175	180	....	....	....	....	....	....	....	....	147	114
" " " " " " post. insertion	95	152	....	117	130	....	115	134	125	126	....	....	130	145	120	122	....	....	84	117	127	....	129	....	....	....	133	112	95	....	....
" " " " " " anterior "	121	165	170	146	164	....	150	184	165	165	....	....	180	183	157	152	....	....	119	152	157	....	....	....	....	....	....	....	....	....	....
Greatest breadth of pectoral fin	27	40	37	38	40	....	39	40	42	40	....	....	40	46	35	35	....	....	28	38	38	35	35	37	37	38	38	21	....	....	23
Height of dorsal fin (vertical)	32	....	44	45	53	52	44	50	45	42	48	54	46	53	30	28	46	....	25	31	31	57	51	50	67	....	....	42	26	28	28
Ant. post. length of base of dorsal fin	45	....	80	....	60	....	75	65	....	....	....	....	....	....	....	....	....	....	....	....	....	81	80	....	....	....	123	48	....	....	40.6
Flukes, tip to tip	245	....	355	330	340	....	....	....	....	340	....	....	355	....	348	303	....	....	238	320	356	....	....	....	....	....	....	190	200	264	....
" greatest breadth ant.-post	....	90	....	98	97	....	97	90	104	....	96	98	....	112	....	....	....	....	....	....	....	....	....	....	....	....	111	....	....	74	....
" depth of notch	15	....	....	20	....	....	18	....	20	....	20	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	13	....
" length of right lobe axially	....	170	....	178	190	175	....	....	....	....	....	....	....	....	193	....	....	....	....	....	....	....	....	180.3	....	....	182	....	....	....	....
" " " left " "	132	....	195	185	....	....	....	....	....	....	....	....	....	....	190	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
" greatest thickness at insertion	....	17	....	22	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Depth of peduncle at flukes "	....	78	85	70	....	....	....	....	....	....	....	....	....	94	....	....	....	....	....	....	....	....	....	86	....	71	....	....	....	....	....
" " " between flukes and anus	....	....	135	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Length of right blowhole (straight)	....	....	....	36	....	....	32	....	....	40	41	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
" " left " "	27	....	....	36	....	....	34	....	....	....	37	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Dist. apart of blowholes anteriorly	2.5	....	....	4	....	....	3	....	....	5	3	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
" " " " posteriorly	16	....	....	23	....	....	20	....	....	22	23	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Anus to clitoris or penis	....	....	....	....	....	....	100	....	....	....	90	....	....	....	....	....	....	....	....	....	....	....	78	....	....	....	....	....	....	....	....
Length of mammary slit	....	....	18	....	....	....	....	....	....	....	....	....	17	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Distance between mammæ	....	12	18	....	....	....	....	....	....	....	....	....	14	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Length of baleen row (straight)	....	275	285	263	280	270	265	....	285	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
" " longest baleen plate (inside)	55	70	73	75	75	75	73	....	73	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Number of plates of baleen	293	315	....	290	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Lower jaw extends beyond upper	....	....	....	....	17	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Number of furrows between fins	42	32	40	50	32	....	44	....	....	40	54	48	60	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....

[1] Subtracting 80 cm. as ant. post. length of base of dorsal from 470.6 cm. the dist. from flukes to *ant.* edge of dorsal.

[2] As Collett's measurement is probably from the snout to the *anterior edge* of the dorsal fin and my own are to the *posterior* edge, I have added to his measurement in each case the length of the base of the dorsal fin where given; where not given I have added 80 cm.

Table IX.— Proportional Measurements of Pacific and Atlantic Specimens.

	Japan, 1910. Andrews																				Finmark, 1885. Collett						1811, Holstein, Rudolphi	1876, Blainville, France. Fischer	1872, Firth of Forth, Scot. Turner	1883, River Crouch, Eng. Flower
	No. 2, ♂ juv., Oshima	No. 4, ♀, Oshima	No. 5, ♀, Oshima	No. 19, ♂, Aikawa	No. 24, ♂, Aikawa	No. 26, ♂, Aikawa	No. 34, ♂, Aikawa	No. 35, ♀, Aikawa	No. 36, ♀, Aikawa	No. 38, ♀, Aikawa	No. 41, ♂, Aikawa	No. 43, ♂, Aikawa	No. 51, ♀, Aikawa	No. 61, ♀, Aikawa	No. 62, ♀, Aikawa	No. 63, ♂, Aikawa	No. 66, ♂, Aikawa	No. 70, ♂, Aikawa	No. 72, ♀ juv., Aikawa	No. 73, ♀, Aikawa	No. 75, ♂, Aikawa	No. 1, ♀, Vardö	No. 2, ♀, Vardö	No. 3, ♀, Vardö	No. 4, ♂, Vardö	No. 5, ♂, Vardö	No. 6, ♂, Vardö				
	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.
Total length	1007	1350	1460	1350	1455	1380	1400	1405	1465	1400	1360	1470	1465	1524	1285	1280	1473	1265	940	1315	1417	1350	1375	1475	1400	1450	1533	985	783	1128	884
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Tip of snout to eye	19.36	20.74	19.65	20.00	18.90	19.20	18.92	20.42	19.31	21.07	19.85	19.72	20.13	21.65	21.71	21.09	19.14	....	19.68	20.45	19.33	....	....	....	....	....	....	....	....	....
" " " " blowholes	15.39	16.29	....	16.65	15.46	14.49	15.78	16.86	16.38	17.71	16.91	17.00	16.58	....	18.36	17.42	14.66	....	15.63	15.89	16.65	15.55	....	....	....	....	....	....	13.28	....	....
" " " " axilla	34.75	34.44	....	36.26	34.70	34.05	33.42	35.94	....	36.42	....	34.21	....	....	28.87	....	....	31.38	....	31.40	....	....	....	32.20	....	29.31	....	....	....	....	....
" " " " dorsal fin	71.20	....	69.52	69.62	70.44	69.56	72.14	....	....	70.57	67.94	....	72.01	....	....	....	....	....	....	....	....	69.18	....	73.22	70.00	71.03	71.62	61.92	65.77	....	....
Notch of flukes to posterior edge of dorsal	28.78	....	30.47	30.37	29.55	30.43	27.85	....	....	29.42	32.05	....	27.98	31.69	28.63	29.37	29.32	....	....	29.71	27.80	....	....	26.42	....	....	....	....	....	....
" " " " anus	....	....	....	27.00	25.08	26.08	26.07	26.33	....	25.35	25.36	27.21	25.59	28.47	28.48	28.20	24.64	26.48	26.38	....	25.47	....	....	....	....	....	....	....	....	....
Length of pectoral, tip to head of humerus	14.10	13.85	13.21	13.40	13.70	....	12.64	....	13.65	13.92	....	....	13.65	14.30	13.85	13.65	....	....	....	13.30	12.70	....	....	....	....	....	....	....	....	13.03	12.89
" " " " " axilla	9.43	11.26	....	8.66	8.93	....	8.21	9.53	8.53	9.00	....	....	8.87	9.51	9.32	9.53	....	....	8.93	8.89	8.94	....	9.38	....	....	....	8.67	11.37	12.13	....	....
Greatest breadth of the pectoral	2.68	2.96	2.53	2.81	2.74	....	2.78	2.84	2.86	2.85	....	....	2.73	3.01	2.72	2.73	....	....	2.97	2.88	2.68	2.59	2.54	....	2.64	2.62	2.48	....	....	....	2.60
Height of the dorsal fin	3.17	....	3.01	3.33	3.64	3.76	3.14	3.55	3.07	3.00	3.52	3.67	3.13	3.47	2.33	2.18	3.12	....	2.65	2.35	2.18	4.22	3.70	3.39	4.78	....	....	4.26	3.32	2.48	3.16
Flukes, tip to tip	24.32	....	24.31	24.44	23.36	....	....	....	....	24.28	....	....	24.23	....	27.08	23.67	....	....	25.31	24.33	25.12	....	....	....	....	....	....	....	25.54	23.40	....
" length of right lobe axially	....	12.59	....	13.18	13.05	12.68	....	....	....	....	....	....	....	....	15.01	....	....	....	....	....	....	....	....	12.20	....	....	11.87	....	....	....	....
Depth of peduncle at flukes	....	5.79	5.82	5.18	....	....	....	....	....	....	....	....	....	6.16	....	....	....	....	....	....	....	....	....	5.83	....	4.89	....	....	....	....	....

PLATE XXXVI.

PLATE XXXVI.

Balænoptera borealis.

Fig. 1. Ventral view of female Sei Whale, showing genitalia and mammæ.

Fig. 2. Mammæ slits and vulva partially dilated, showing clitoris of female Sei Whale No. 35.

Fig. 3. Male genitalia of Sei Whale No. 36, showing rudimentary mammæ, concealed in the two short oblique slits just posterior to the penis slit.

Fig. 4. Posterior side view of Sei Whale No. 36.

Fig. 5. Female genitalia of Sei Whale.

Fig. 6. Male genitalia of Sei Whale No. 34.

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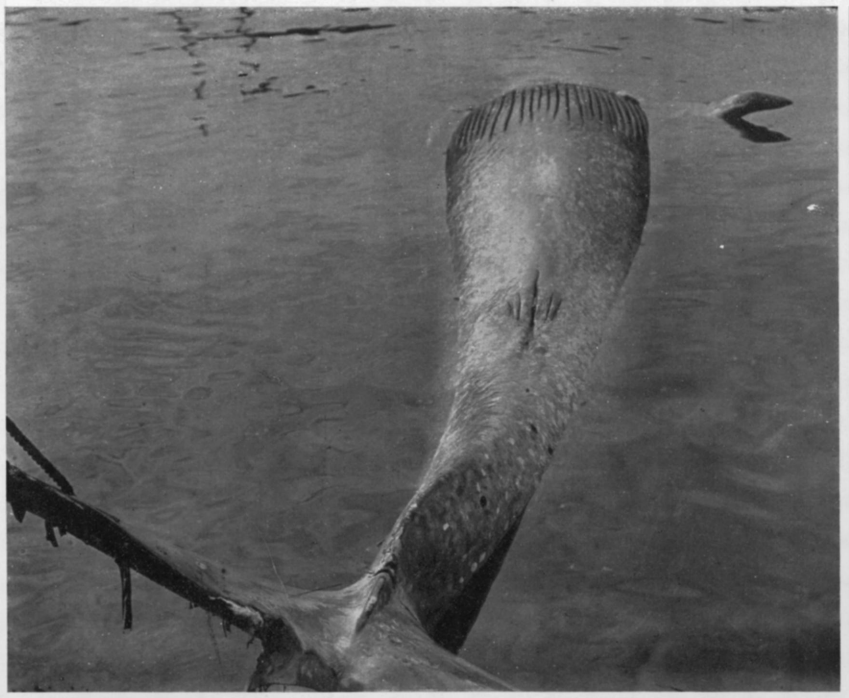

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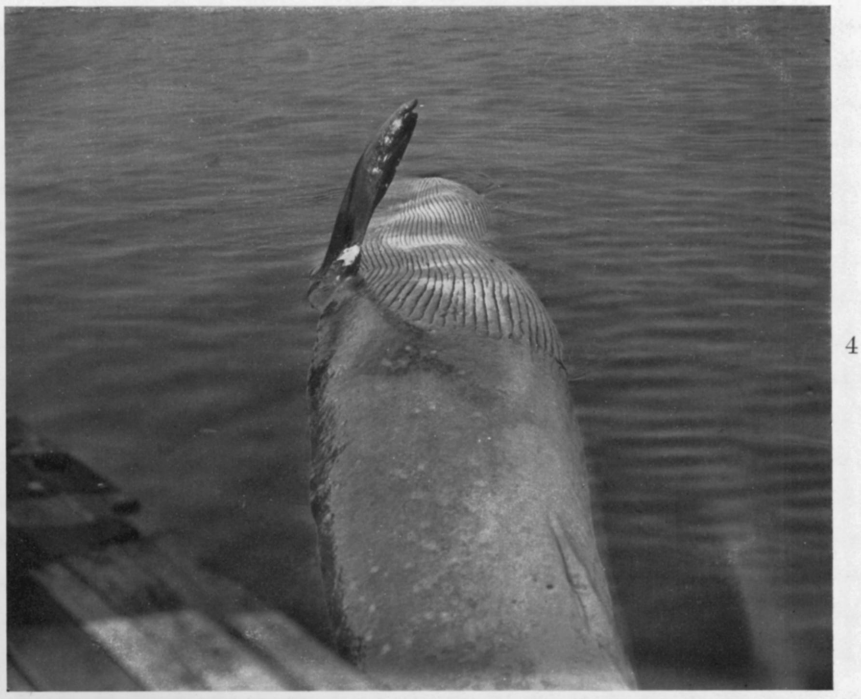

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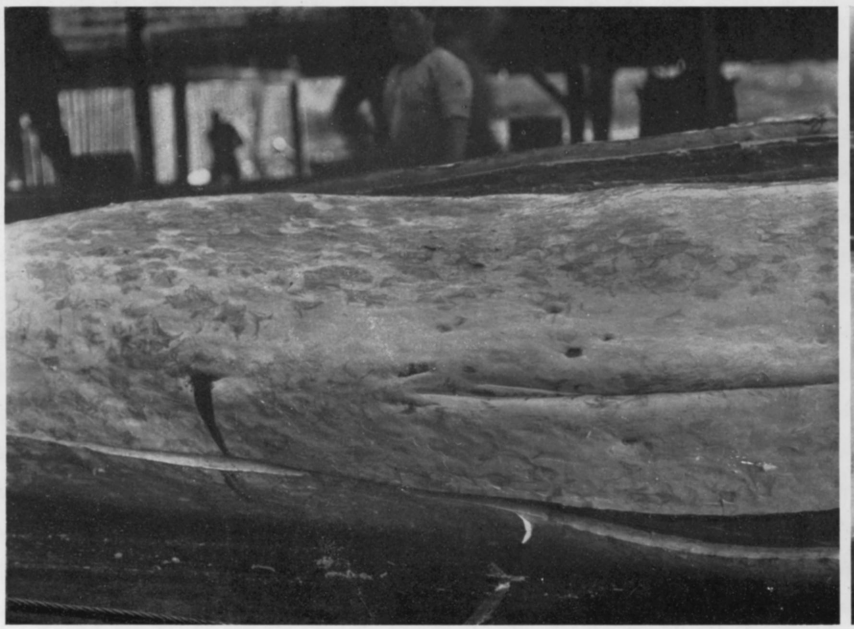

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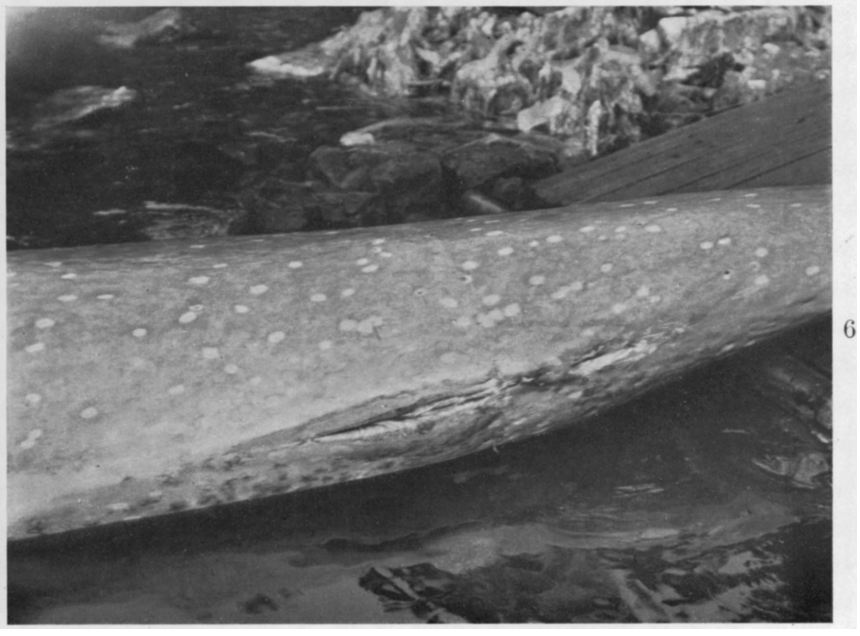

BALÆNOPTERA BOREALIS.

Table shows a very close agreement in the proportions between the Pacific and Atlantic whales whenever measurements of the latter are available for comparison. The distance from the snout to the blowhole in the Biaritz, France, example, and from the snout to the dorsal fin both in this and Rudolphi's type specimen are somewhat less than in others of the Pacific and Atlantic series, but both these whales were very young and would undoubtedly change in proportions with increasing age. The proportional length of the pectoral from the tip to the head of the humerus is remarkably constant in both the Pacific and Atlantic specimens while the measurement from the tip of the pectoral to the axilla varies considerably. In the first the points of measurements are definite and would be located alike by all observers while in the second "the axilla" varies somewhat according to the position of the fin, etc. I believe that often much of the variation which appears to be individual is in reality due to differences in the manner of taking the measurements rather than in the specimens themselves. This is probably true of the "height of the dorsal fin" which in three of the Atlantic specimens is proportionately higher than in mine from the Pacific, for there are several ways in which the height of the dorsal can be secured.

General body form.— The Sei Whale is the best proportioned species of the genus *Balænoptera*. It is neither as slender as the Finback nor as 'chunky' as the Little Piked Whale (*B. acuto-rostrata*), and although it resembles the Blue Whale in some particulars is much more graceful in its general proportions. The body is deepest about opposite the middle of the pectoral fins and, as in other members of the genus, the peduncle is strongly compressed, forming a thin dorsal and ventral ridge and joining the flukes abruptly; Collett says that in the deepest part of the body the depth is about as 1 to $5\frac{1}{2}$ or 6, and that immediately under the dorsal fin it is one-eighth the total length.

External Anatomy.

Hairs.— The adult Sei Whale, like other species of the genus, has two or more vertical rows of hairs at the mandibular symphysis. The blubber at the symphysis of one specimen was sent to the Museum and contains on the right side 11 hairs in a fairly straight row; on the left are 13 hairs in an irregular vertical row. Each hair is whitish, about 7 mm. long and situated in a small pit surrounded by a blackish ring. The rows of hair are 4 cm. apart. (See also Schulte, below).

Collett,[1] who had an opportunity to examine carefully several fœtal specimens, says of the hairy covering: "This consisted in an adult female of 11 hairs on each side of the lower jaw, each about 10 millim. long, and two other hairs on each side, situated somewhat behind these; altogether 26 hairs. In the fœtus the covering of hair was more plentiful. On the smallest of the fœtuses described further on (No. 1), the total length of which was $1\frac{1}{2}$ meters, the hairs were visible, but quite short.

"In fœtus No. 3, the total length of which was not quite $2\frac{1}{2}$ metres, they were arranged on the lower jaw in three rows, comprising 3 hairs in the upper and lower rows respectively and 11 in the central row; altogether on each side 17 hairs.

"On the upper jaw there were only 7 hairs situated in a single row, the two first rather

[1] Proc. Zool. Soc. London, 1886, p. 255.

further from each other than the rest. Altogether this specimen was provided with 34 hairs on the lower and 14 hairs on the upper jaw."

Eye (Plate XXXVIII).— The eye forms a slight swelling directly above the corner of the mouth; the lids are thin and the eyeball prominent. Six cm. above the eye is a convex furrow which was, in whale No. 19, 18 cm. in length; between this furrow and the upper lid are two short lines or creases. Five cm. below the eye is a furrow 24 cm. in length, similar to the one above it. Two furrows 6 cm. long run forward from the anterior commissure of the eye.

The pupil is elliptical and the iris is a dark brown band 12 mm. wide; encircling the iris a bluish white ring is suggested which edges a ring of black 19 mm. wide, the latter shading off into the gray of the eyeball.

The iris is darker brown than is that of the Finback Whale and the eyeball itself is much more elliptical in shape. Measurements of the eye of whale No. 5, are as follows: Length of the pupil 15 mm.; diameter of the pupil 11 mm. Length of the iris 38 mm. and diameter of the iris 25 mm. Circumference of the eyeball 310 mm.

Auricular orifice.— The ear is an elliptical opening situated behind and below the eye. The auditory meatus itself is very small but the external orifice varies in size from 5 mm. to 30 mm.

By reference to Table VIII where measurements of the distance from the eye to the ear, and of the eye above the ear, are given it will be seen that there is considerable variation in the relative position of the ear opening.

Blowholes. (Plate XXXVIII).— In front of the blowholes there rises a strong median ridge which gradually lessens in prominence anteriorly but continues to the tip of the snout; just anterior to the blowholes this ridge is highest and abruptly forks, the nostrils being situated between the two branches. Externally the blowholes appear as two long, slightly curved slits closely approaching each other anteriorly but diverging posteriorly. In whale No. 19, 1350 cm. long, the nostrils were each 36 cm. in length, stood 4 cm. apart anteriorly and 23 cm. posteriorly.

The inner edges are thin but the outer margins are high and thick, being formed by the two branches of the median ridge between which the nostrils lie. There is a deep furrow directly between the blowholes, the posterior end of which usually extends considerably beyond the ends of the openings themselves.

The blowholes, thus being situated on the summit of the head, are the first part of the body to reach the surface when the whale ascends. In the dead specimens the nostril-tubes are tightly closed and give little indication of the extent to which the blowholes can be opened during the act of inhaling. (Plate XXX, Fig. 4).

Baleen. (Plate XXXVIII).— The baleen of the Sei Whale *when fresh*, is deep blue black in color and the plates possess on both sides a marked iridescence; when held in the sun, in one position the blade is blue and at another angle the color changes to light green. This is a distinctive character of the baleen of *B. borealis*, for it does not appear in the whalebone of related species. The dark portions of the Finback baleen plates when held in the sunlight have a slight iridescence but that of the Blue and Humpback Whales showed no trace of it. After drying, however, the baleen of *B. borealis* becomes a rather dead blue black.

Along the inner edge of the base, the majority of the baleen laminæ have a longitudinal band of yellowish white which shades into gray and finally runs imperceptibly into the blue black of the main portion of the plate; some slabs have a white band 3 or 4 cm. wide shading into a gray

PLATE XXXVII.

PLATE XXXVII.

Balænoptera borealis.

Fig. 1. Anterior back and head of Sei Whale No. 38.

Fig. 2. Peduncle of Sei Whale.

Fig. 3. Gray markings on the peduncle of Sei Whale No. 41.

Fig. 4. Back and pectoral fin of Sei Whale No. 26.

Fig. 5. Breast of Sei Whale No. 63 — very dark.

Fig. 6. Gray markings on peduncle of a Sea Whale. The white scars have been produced by the parasite *Penella antarctica.*

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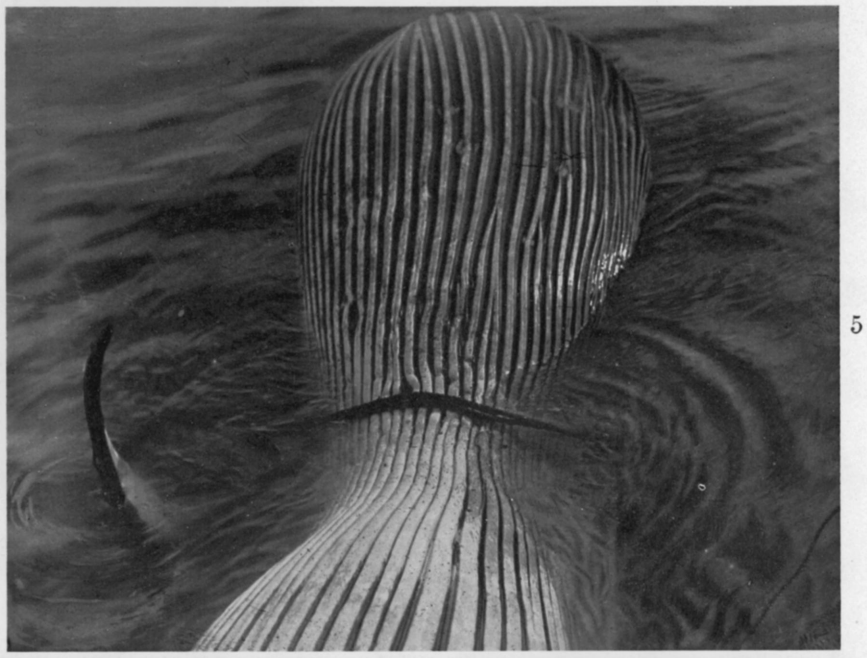

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BALÆNOPTERA BOREALIS.

stripe of similar breadth. The plates with the widest white and gray stripes are in the most anterior portion of the baleen row, the stripes gradually decreasing in breadth posteriorly until they disappear entirely.

Whale No. 4 had 315 laminæ on the left side, the first 207 of which showed more or less white or gray along the inner edges, the remainder of the series being entirely dark. All the laminæ are transversely rugose, the ridges being about as prominent in proportion to the size of the plates as are those of the Blue and Finback Whales and, as in those species, are most pronounced in the proximal half of the slab.

Along the inner base of each of the baleen rows for their entire length as they stand in position is a row of small, white, bristle-like laminæ from 5 cm. to 7 cm. high and 2 cm. wide which produce a white band along the base of the whalebone. The bristles of the anterior fourth of the baleen row are all white, those of the second fourth have the upper portion tinged with grayish for about 10 cm., the third fourth have about 20 cm. of the upper portion gray and the bristles of the posterior fourth are almost all grayish except for the white base line.

The color of the bristles as well as the number of striped plates in the baleen row is open to the same individual variation as are the other parts of the body; in some specimens the bristles were almost entirely white, only a very small section of the posterior end being gray while other specimens had nearly the entire posterior half grayish. The bristles of this species are very fine and inclined to be curly.

In regard to the baleen of the Atlantic Sei Whales, Collett[1] says: "The colour of the baleen is usually black and the bristles white; in some individuals, however, a small number of the foremost rows were white, or mottled with white, but not symmetrically in each ramus. Besides the baleen in the six specially examined specimens, I examined a considerable quantity of whalebone which lay heaped up on the beach at the different establishments. Amongst all this, I only found two specimens which differed from the others in having some white mottled plates; in all the others it was entirely black. Of these two individuals, one had on the right side 58, and on the left 53 of the foremost baleen-plates mottled.

"The second specimen had on the right side 52 white plates, on the left only 5.

"The number of the plates was about 330 in each jaw, in some individuals 320, in others as many as 340. No. 2 for instance had on its right side only 318, on its left 328. The number appears to be rarely the same in the two jaws of the same individual.

"The front plates were small, almost rudimentary, and formed double rows; these were difficult to count. The greatest length was attained at the commencement of the latter third of the series, where as a rule they measured 550 to 600 millim.

"From these measurements [not quoted] it appears that the length and number of the plates are not constantly greater in the right than in the left jaw, also that there is no constant difference between the plates in the two sexes.

"The hair-like bristles in which each plate terminates, and which form the most effective part of the straining-apparatus, are in this species unusually fine, somewhat resembling silky wool, and white in colour. They form on the inner edges of the baleen-plates a dense, rather curly covering, which appears to indicate that the food of this species consists of only very small animals."

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[1] Proc. Zool. Soc. London, 1886, pp. 253–255.

Cocks says of the baleen of *B. borealis:* "All the saleable portion of the baleen plates were black, but the small inner portion of many of the plates were white, with from one to two inches of blue-grey between. The bristles would be more accurately described in this species as hair, being soft and fine, and quite white. The longest baleen plates measured about 31 in. by 12 in." (*l. c.*, 1886, p. 130).

R. C. Haldane remarks of the baleen of specimens from Scotland: "The baleen of these whales is naturally smaller than the Finners. A blade before me measures 25 inches by 8 inches. It is black with a fringe of white hairs. The length, including the hair, is 29 inches. At the smaller end there is one line of white.

"One of the Seihvalen killed at the Olna station in 1905 had curious baleen. Instead of being black it is marked longitudinally, for half the breadth, with pale yellow-gray bands. The manager told me he had never seen anything resembling it before. The hair fringing the baleen of this species is exceedingly fine and soft" (*l. c.*, 1906, p. 136).

In 1882, Prof. Turner [1] reported upon a specimen of *B. borealis* taken ten years earlier in the Firth of Forth and says in regard to its baleen: "The baleen consisted of numerous plates, the biggest of which were about 1 foot 3 inches in length and about 6 inches wide. They were black, striped with grey and white, and the hairs projecting from the lower free border were grayish white" (*l. c.*, p. 472).

J. G. Millais, has given an excellent photograph of a slab of baleen from a Shetland specimen of *B. borealis.* This plate has a wide strip of the inner margin in the proximal two thirds light-colored and the bristles white except at the tip where they become darker. The caption of this photograph is as follows: "5. Rudolphi's Rorqual. Shetland. 20 by 8 in. from gum; bristles, 4 in.; plate, slate and cream; bristles of fine texture, and for the greater part cream, except those near the point, which are black with cream ends" (*l. c.*, plate to face p. 226, fig. 5).

From the observations on the Atlantic Sei Whales quoted above it will be seen that their baleen is usually described as black, and that more or less of the plates are striped on the inner border, as I have noted in the Japan specimens. It might appear that the baleen of the Pacific examples was striped to a greater extent than in those from the Atlantic but I believe that this is not the case. If only the whalebone which has been cleaned for commercial purposes is examined comparatively few striped plates will be found, for only the largest blades are selected for sale [2] and the smaller and more anterior of the series, where the light color is most pronounced, are usually destroyed. Again the inner edges of the plates are usually more or less mutilated when the baleen is removed from the roof of the mouth and the white strips are thus cut away.

In order to accurately describe the baleen of any whale it is necessary to examine it *in situ,* because the color and general appearance change greatly in drying.

My description of the baleen of the Japan specimens given above was written at the whaling station from fresh material, but a set of the whalebone which was shipped to the Museum and is now before me presents quite a different appearance. The blades are dead blue black, the outer thin 'skin' has peeled off in places, and the bristles are entirely grayish; yet this baleen was probably more carefully packed and handled than that which generally reaches museums.

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[1] Jour. Anat. and Phys., Vol. XVI, 1882, p. 472.

[2] See Cocks's description quoted above.

PLATE XXXVIII.

PLATE XXXVIII.

Balænoptera borealis.

Fig. 1. View of dorsal portion of head of a Sei Whale. The elongated depression in the left side of the rostrum is probably a harpoon-scar.

Fig. 2. Eye of Sei Whale No. 35.

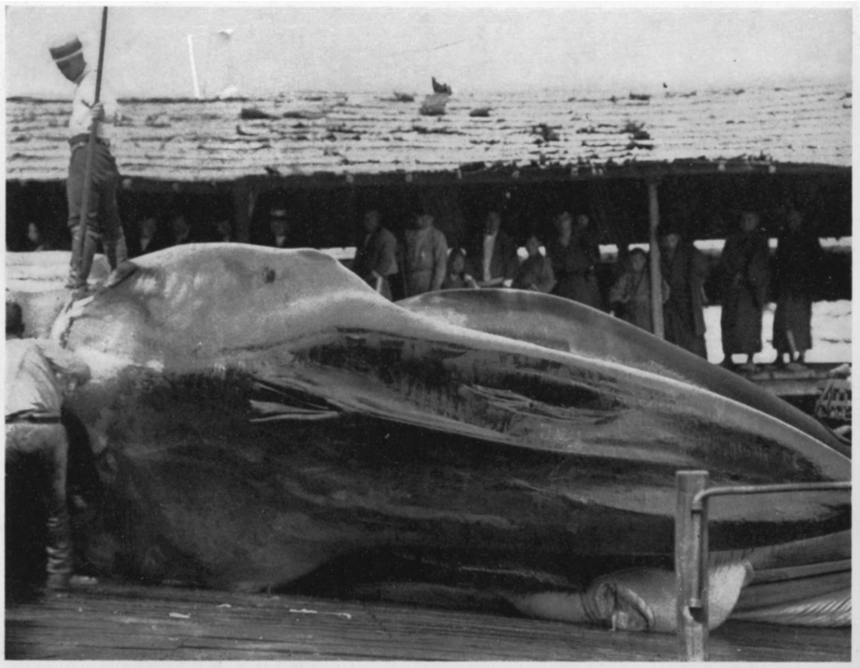
Fig. 3. View of inner edges (bristles) of baleen rows of Sei Whale No. 26.

Fig. 4. Blowholes of Sei Whale No. 34.

Fig. 5. " " " " " "

Fig. 6. Inner view of a single baleen row after removal from Sei Whale No. 2.

1



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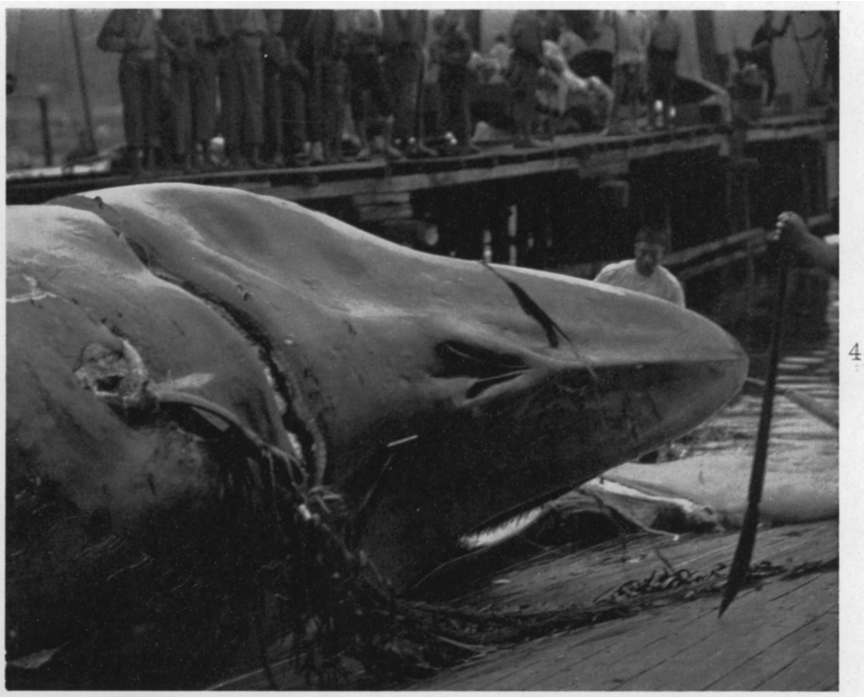

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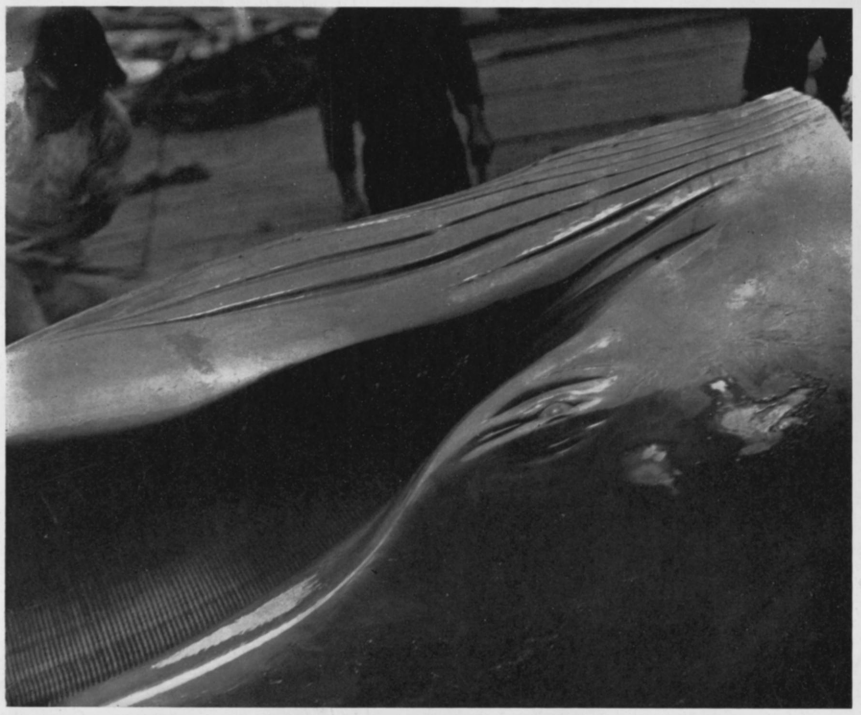

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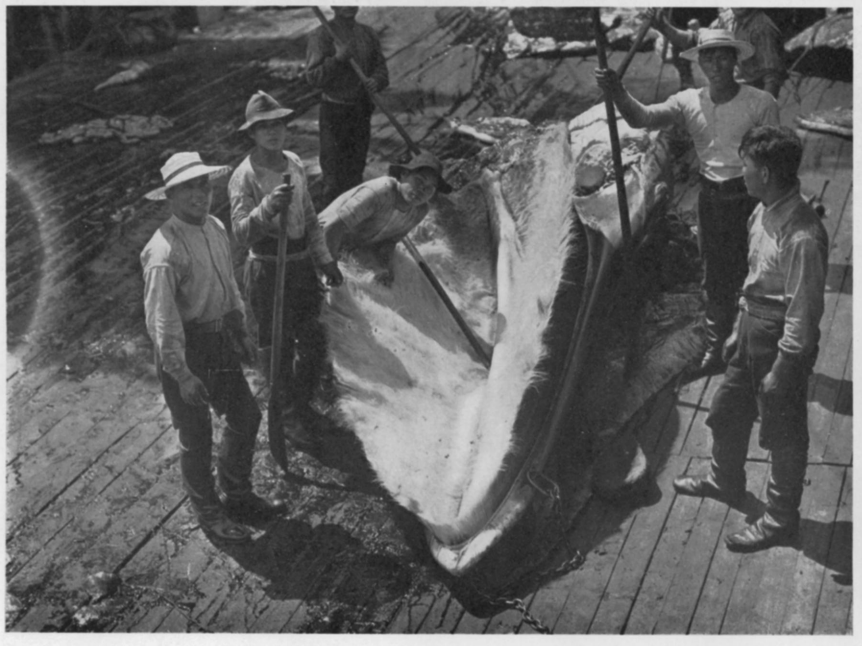

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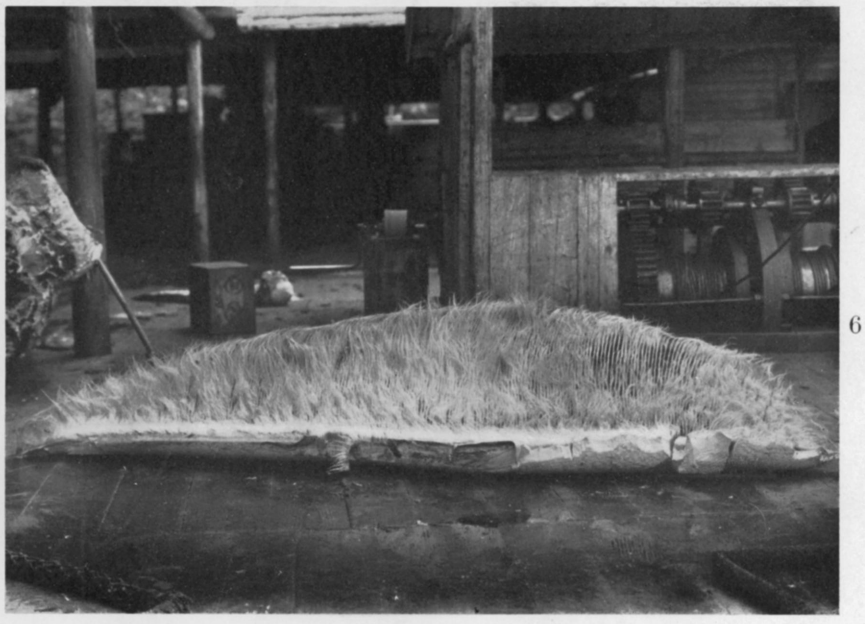

BALÆNOPTERA BOREALIS.

Millais's photograph and one presented by Haldane in 1907 (see his plate iv) are identical in shape, size and color with many blades of baleen from Japanese Sei Whales.

It appears to me to be satisfactorily demonstrated that the baleen of the Atlantic specimens of *B. borealis* can not be distinguished from that of Pacific examples.

Ventral furrows (Plates XXXII–XXXV).— The ventral furrows of *Balænoptera borealis* are present on the throat, breast and abdomen, but instead of extending posteriorly to the umbilicus, as in *B. physalus* and *B. musculus* they end half way between the tip of the pectoral fin laid back and the umbilicus; viz., about 115 cm. anterior to the umbilicus, which is usually a rather indistinct scar. They run along the entire length of both mandibular rami from the symphysis to the angle of the mouth and extend close up to the base of the pectoral fins. On each side two short furrows run out of the corner of the mouth, and below them seven or eight somewhat longer furrows do not quite reach the anterior base of the fin; those remaining are long and, as in other species, anastomose frequently. The folds on the throat are narrow but posteriorly become gradually wider reaching on the abdomen about twice their original width; they are consequently much more numerous on the anterior than on the posterior part of the body.

By referring to Table VIII it will be seen that there is considerable variation in the number of folds on different specimens, the least being 32 and the greatest 60; this has no relation to sex or age but seems to be purely individual. The number of folds was ascertained by beginning at the mid-ventral line *between the pectoral fins*, counting up to the base of the flipper and doubling the number thus obtained.

Collett records an exactly similar arrangement for the furrows of the Atlantic Sei Whales, and gives their number as from 38 to 58. He says: "In addition, the eye is surrounded by two very short horizontal furrows, and in some examples there were also found (as in No. 4) traces of from 20 to 30 short, oblique furrows anterior to the dorsal fin. The furrows permit the body to expand to nearly double its normal girth" (*l. c.*, p. 255).

Pectoral limbs (Plate XXXIX).— The flippers of *Balænoptera borealis* are relatively shorter than in any other member of the genus, and in shape are slender and narrowly lanceolate. The anterior edge is evenly and slightly convex and the posterior margin from the tip swells gradually outward and backward until a little behind the middle it turns inward; this is the point of greatest breadth and indicates the beginning of the manus. At this 'angle' the anterior edge of the fin is thickest, thence tapering gradually to the tip; the posterior margin from the axilla to the angle is soft skin but from the angle to the distal end the edge is fairly rigid, although thin. When not in use the flippers lie so closely to the body that they are hardly noticeable. This is well shown by Plate XXXIX, Figs. 2 and 3.

Collett's description of the flippers of Atlantic specimens of *B. borealis* agrees in detail with those from the Pacific.

Dorsal fin. (Text Figs. 4–9).— The dorsal fin is high, deeply falcate, and situated further forward than in any other member of the genus *Balænoptera*, being just anterior to a point opposite the anus. In shape and position it most resembles that of *Balænoptera acuto-rostrata*. There was much less variation in the form of the dorsal fins of the specimens which I examined than in the case of the Blue and Finback Whales, the greatest individual differences appearing in the convexity of the anterior margin and the consequent antero-posterior breadth of the fin at the middle of its height. The figures show six dorsal fins, which were photographed at the stations

after having been removed from the animals' bodies; Fig. 7 is the most typical shape. Collett says: "The dorsal fin is possibly higher in the male than in the female, although the difference cannot be great," but by referring to Table VIII it will be seen that measurements of the Japan specimens do not bear this out, and that there appears to be no constant difference in the fins of the two sexes.

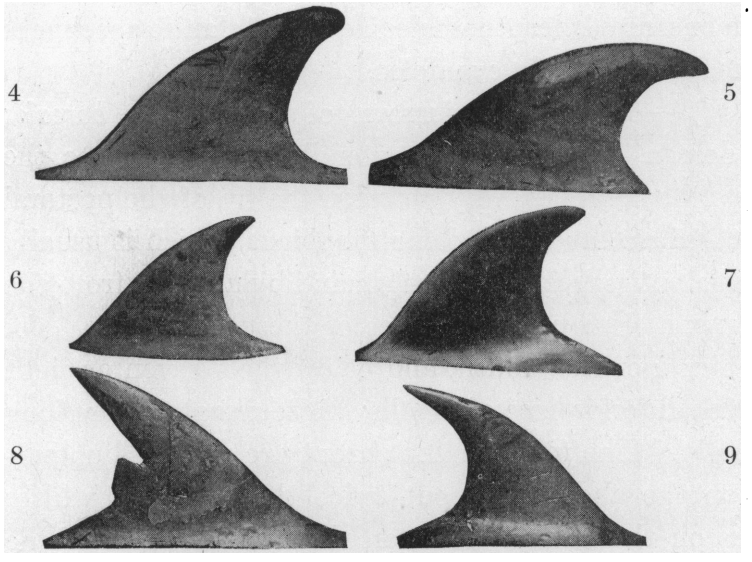

Fig. 4. Dorsal fin of Sei Whale No. 35.
Fig. 5. " " " " " " 2.
Fig. 6. " " " " " " 24.
Fig. 7. " " " " " " 38.
Fig. 8. " " " " "
Fig. 9. " " " " "

Genitalia and Mammæ. (Plate XXXVI).— The genital opening of the female Sei Whale appears as a long median slit situated just anterior to the anus, with two small furrows running out of it at the posterior end. On either side, opposite the opening of the vagina, are the slits containing the mammæ, and just outside each is a short furrow; the teats themselves are about 5 cm. long. In whale No. 5, 1460 cm. in length, the mammary slits were 18 cm. long and 18 cm. apart.

The penis of the male is contained in a sheath, as in all cetaceans, and withdrawn within the body. The orifice of the penis-sheath has the appearance of a deep furrow, and closely approximating the posterior end are two short, deep slits containing the rudimentary male mammæ. In whale No. 34, 1400 cm. long, the penis was situated 100 cm. anterior to the anus.

Flukes. (Plate XXXIX).— In shape each lobe of the flukes is roughly triangular. The anterior edge is slightly convex, being especially so in the proximal and distal portions; the posterior margin is nearly straight except for a slight concavity near the tip. The notch is deep and, although by no means open, the edges do not overlap as frequently as in Finback Whales. The flukes are set at a perceptible angle to the longitudinal axis of the body, and the dorsal and ventral edges of the peduncle unite with them very abruptly.

Osteology.

Plates XLI–XLII.

The skeleton of *Balænoptera borealis* has been so thoroughly discussed by Rudolphi, Flower, Van Beneden, Gervais, Turner, and others that the osteology is now well known and further description is unnecessary. In the following section the consideration of this subject will relate principally to a comparison of the Japan specimen and the Java skeleton, the type of *Balænoptera schlegeli* (Flower) with those from Europe for the purpose of definitely determining their specific relationship.

The available material from which to draw conclusions is far from satisfactory, consisting as it does in this species almost entirely of skeletons from young individuals. Unfortunately,

PLATE XXXIX.

PLATE XXXIX.

Balænoptera borealis.

Fig. 1. View of the anterior edge of the flukes of a Sei Whale.
Fig. 2. Right pectoral fin of Sei Whale No. 34.
Fig. 3. " " " " " " " 43.
Fig. 4. Inferior surface of flukes of a Sei Whale.
Fig. 5. " " " " " " " " No. 26.
Fig. 6. Outer surface of pectoral fin of Whale No. 19.
Fig. 7. Inner " " " " " " " "

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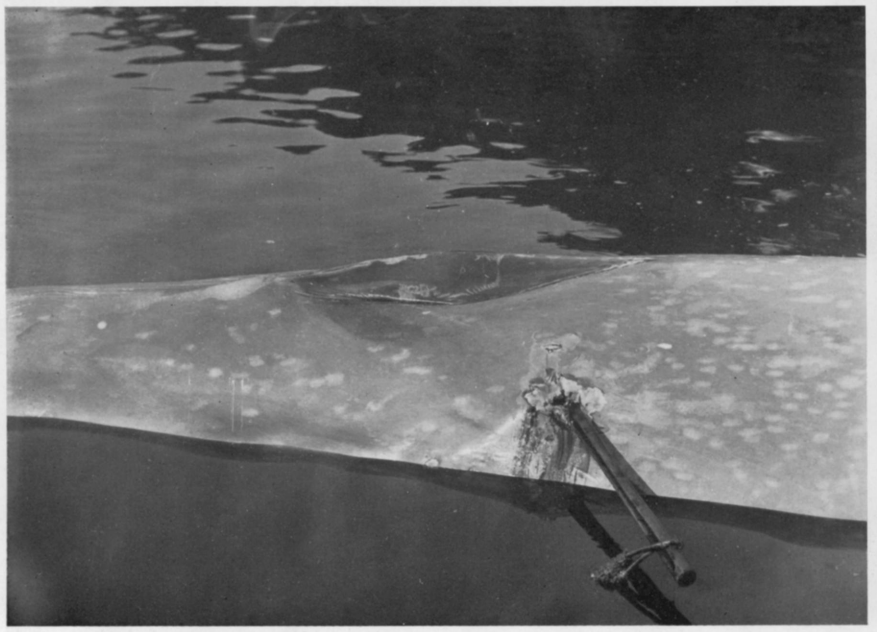

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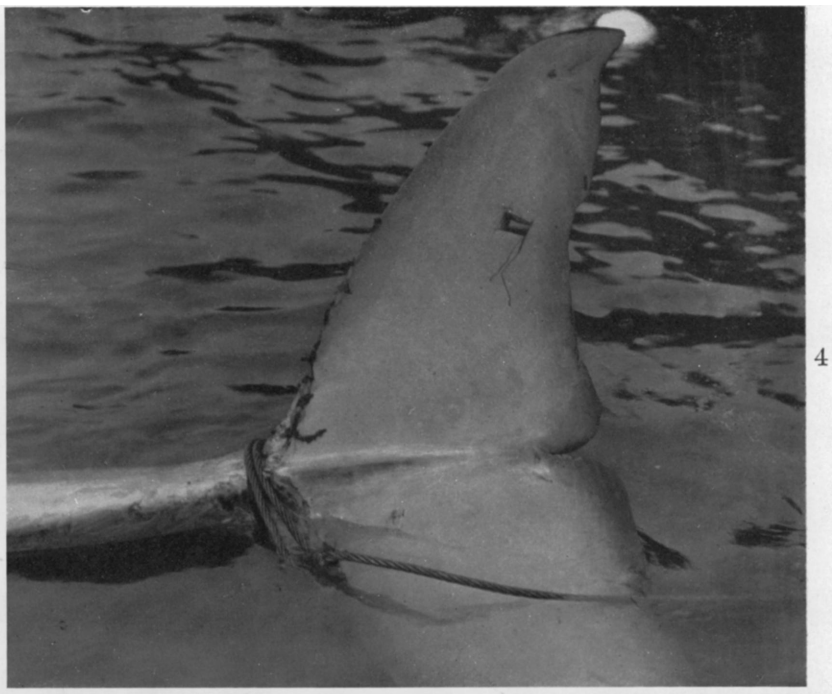

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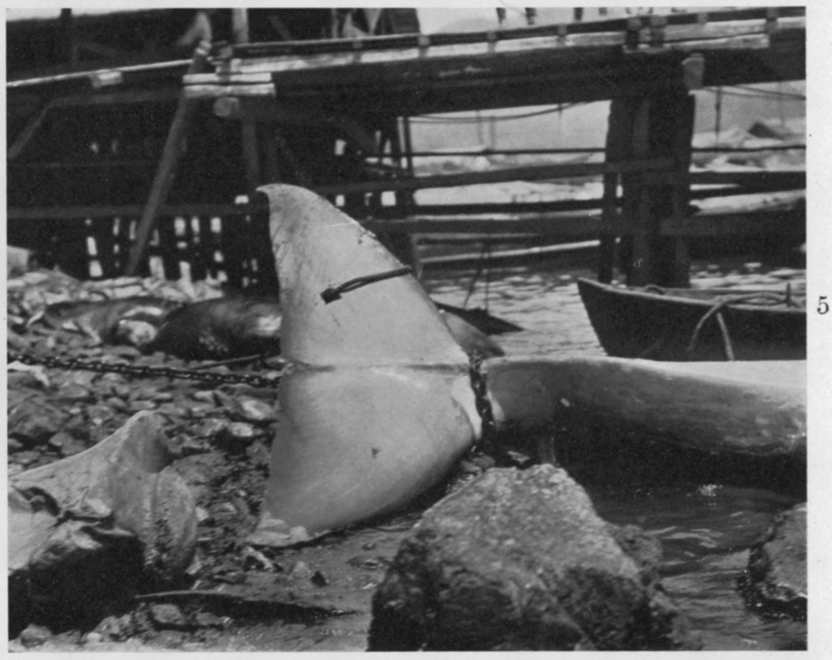

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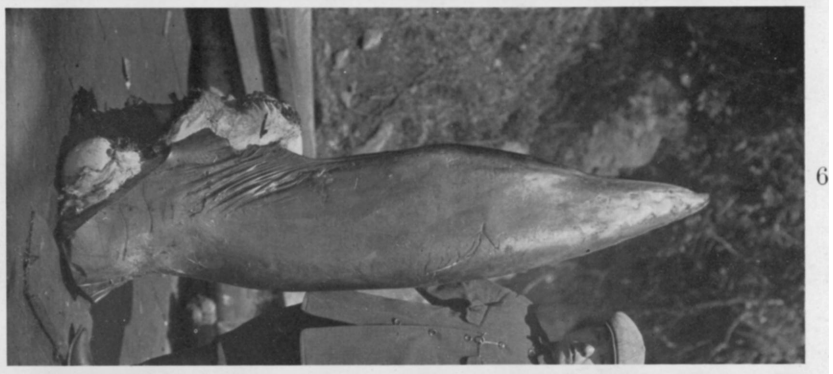

7

BALÆNOPTERA BOREALIS.

because of the European war, plans for visiting the foreign museums which contain specimens from the Atlantic had to be abandoned and I have personally examined only the skeleton of the adolescent individual collected at Oshima, Japan, which is now in the American Museum of Natural History, and parts of several fresh skeletons at the whaling stations. There were for comparison, however, figures and descriptions of five young skeletons from the Atlantic, including the type of *B. borealis*, in the Museums of Berlin, Brussels, Leyden, Bergen and Edinburgh; an adolescent individual from Java, type of *B. schlegeli* (Flower), in the Leyden Museum; and an incomplete skeleton from Cape Horn, and a skull from Japan in the Paris Museum.

The American Museum's skeleton from Japan (No. 34871) was taken from a whale measuring 1350 cm. (44′ $3\frac{1}{2}$″) in the flesh, its skeleton being 1259 cm. (41′ $3\frac{3}{4}$″) long; the vertebral epiphyses are all free and there are other evidences of youth. The length of the animal in the flesh, however, was almost as great as that of the type of *B. schlegeli* which Flower estimated to be 45 feet; the skeleton of the latter had the epiphyses of a number of the vertebræ ankylosed and would thus appear to be from a somewhat older individual than ours.

Since by consulting Tables I to VII it will be seen that the average length of *B. borealis* is about 1280 cm. (42′), it is evident that this species attains adult size at an early period. This tends to support my belief that all baleen whales grow very rapidly after birth until the adult size has been reached.

Skull.

Plates XL and XLI.

When comparing the proportions of the Atlantic and Pacific skulls it is difficult to determine whether the variations which appear are really individual or are due to differences in age or to the manner of taking measurements. No two persons will measure the same skull alike unless certain unmistakable points are emphasized between which the dimensions may be taken. Such measurements as the "width of the orbital process of the frontal at the outer end" have little comparative value, since both margins of the orbital process curve inward toward the orbital arc, and there are no definite points between which this measurement would always be taken. Some differences are also undoubtedly due to the warping while drying of certain bones of the skull. I am convinced, that much of the wide variation among both the Pacific and Atlantic skulls shown in Tables X and XI is due to differences in the method of taking the measurements, and that if all the crania were measured by the same person, according to a definite standard, many of the differences would disappear.

When *B. borealis* shows such an enormous individual variation in body proportions and external characters it is highly probable that numerous differences will also be found in the skeletons of different examples.

My own measurements of the Japan skull have been taken to conform to those of the Atlantic and Java specimens presented by Flower and Turner. The proportional measurements of Gervais's Japan skull and Rudolphi's Holstein specimen, the type of *B. borealis*, were taken upon the figures. Gervais's drawing appears to be accurate except for the fact that the mandible is represented as exactly the length of the skull; Rudolphi's plates are obviously incorrect in some details but in general appear to be reliable.

Table X.— Measurements of skulls of Balænoptera borealis.

	Japan: Am. Mus. Nat. Hist. (R. C. A.)	Japan: Paris Mus. (Gervais)	Java: Leyden Mus. Type of *B. schlegeli* (Flower)	Zuyder Zee, Holland: Leyden Mus. (Flower)	North Cape: Brussels Mus. (Flower)	Firth of Forth: Mus. Univ. of Edin. (Turner)
	adol.	ad.	adol.	juv.	juv.	adol.
	mm.	mm.	mm.	mm.	mm.	mm.
Length of skull (straight)	3390	4300	2946	2006	2032	2623
Breadth of condyles	265	....	266	254	228	355
" across squamosals	1460	....	1447	1015	965	1174
Orbital processes, breadth at distal end	390	....	381	305	279	....
Length of nasals	265	....	266	165	159	209
Breadth of two nasals, proximally	55	....	50	63	76	51
" " " " distally	130	....	152	101	101	127
Length of beak from middle of curved border of mx. to the tip of the pmx.	2270	....	2082	1346	1270	1752
Length of beak from proximal end of the maxilla to the tip of the premaxilla	2570	....	....	....	....	2057
Length of maxilla	2390	....	2285	1447	1397	1903
Breadth of maxilla at proximal ends	260	....	279	228	203	222
" " " across orbital processes (following curve)	1670	....	1600	1092	1092	1092
Breadth of beak at base (following curve)	1120	....	1066	762	762	762
" " " " middle " "	595	780	565	406	381	445
" " maxillæ at middle	190	....	152	101	101	....
" " pmx. " "	120	....	101	76	63	....
" " skull between orbits	1325	1800	....	....	....	....
Length of supraoccipital	749	....	749	546	533	610
Breadth of exoccipital	1041	....	1041	660	685	806
Length of tympanic bone	139	....	....	....	....	....
Breadth " " "	100	....	....	....	....	....
Length of mandible (straight)	3200	4100	....	1993	1929	2571
Height " " at coronoid	352	....	355	228	228	298
" " " at middle	204	....	241	184	....	....

Table XI.— Proportional measurements of skulls from the Pacific and Atlantic.

	Japan: Am. Mus. Nat. Hist. (R.C.A.)	Japan: Paris Mus. (Gervais)	Java: Leyden Mus. Type of *B. schlegeli.* (Flower)	Zuyder Zee, Holland: Leyden Mus. (Flower)	North Cape: Brussels Mus. (Flower)	Firth of Forth, Scot. Mus. of Univ. of Edin. (Turner)	Holstein, Ger.: Berlin Mus. Type of *B. borealis.*	Extent of individual variation among the Pacific skulls	Extent of individual variation among the Atlantic skulls	Average of the ratios of the Pacific skulls	Average of the ratios of the Atlantic skulls	Amount of difference between average ratios of Pacific and Atlantic skulls
	adol.	ad.	adol.	juv.	juv.	adol.	juv.					
	mm.	mm.	mm.	mm.	mm.	mm.	mm.					
Length of skull (straight)	3390	4300	2496	2006	2032	2623	....					
	%	%	%	%	%	%	%	%	%	%	%	%
Breadth across squamosals	43.0	45.0[1]	49.1	50.6	47.5	44.7	46.3[1]	6.1	5.9	45.7	47.0	1.3
" of skull between the orbits	39.0	42.8	....	....	....	42.1	....	3.8	....	40.9	....	....
" " maxillæ across orbital processes (following curve)	48.3	....	54.3	54.4	53.7	41.6	....	6.0	12.8	51.3	48.5	2.8
Breadth of orbital proc. of frontal distally	11.5	....	13.3	15.2	13.2	13.1	....	1.8	2.1	12.4	13.8	1.4
Length of nasals	7.8	....	9.0	8.2	7.8	7.9	....	1.2	.4	8.4	7.6	.8
" " beak from middle of curved border of maxilla to tip of premaxilla	66.9	67.5	70.6	67.0	62.5	66.8	64.2	3.7	4.5	68.3	65.1	3.2
Breadth of beak at base (over curve)	33.0	....	36.2	37.9	37.5	29.0	....	3.2	8.9	34.6	34.8	.2
" " " " middle " "	17.5	....	19.1	20.2	18.7	16.9	....	1.6	3.3	18.3	18.6	.3
Length of supraoccipital	22.0	....	25.4	26.6	26.2	23.2	....	3.4	3.4	26.7	25.4	1.3
Breadth across ex-occipitals	30.7	....	35.3	32.9	33.7	30.7	....	4.6	3.7	33.0	32.4	.6
Length of lower jaw (straight)	94.3	....	97.6[2]	99.3	95.0	98.3	99.3	3.3	4.3	95.9	97.9	2.0
Depth " " " at middle	6.0	7.2	8.1	9.2	....	....	....	2.1	....	7.1	....	....

[1] All measurements taken on the published figure.

[2] Measurements taken on the published figure in the 'Osteographie.'

PLATE XL.

PLATE XL.

Balænoptera borealis.

Fig. 1. Lateral view of a Sei Whale showing the most usual type of coloration.
Fig. 2. Ventral view of a Sei Whale showing the most usual type of coloration.
(Drawings by J. Henry Blake, under the direction of Roy Chapman Andrews.)

BALÆNOPTERA BOREALIS.

In the proportional breadth of the skull across the squamosals, the amount of variation among the European and Asiatic specimens respectively is 5.9% and 6.1%, and the difference between the average breadths of both series is 1.3%. The squamosal breadth among all members of the genus *Balænoptera* is open to considerable individual variation, and in the present instances probably some is due to difference in age. It will be seen that in almost every case the proportional measurements of individuals of one series can be nearly matched among those of the other.

There is an even greater variation among the examples from both oceans in the proportional breadth of the skull across the orbital processes of the maxillæ; in the Pacific specimens this amounts to 6.0% and in the Atlantic skulls to 12.8%. In the latter series Turner's Firth of Forth specimen is extraordinarily narrow at this point, differing widely from the other two younger skulls, which are nearly alike. The Java cranium is proportionately the widest of the Pacific series and agrees closely with the Zuyder Zee and North Cape skulls.

There is considerable variation in the length of the rostrum among the individuals from both oceans. The Java skull has a proportionately long beak and that of the specimen from the North Cape is unusually short; all the remaining crania of both series agree closely.

The breadth of the beak at the base shows a great individual variation among the Atlantic skulls, but the breadth at the middle is much less variable and I believe the difference is chiefly due to the taking of the former measurement across the curved edges of the rostrum base. The Atlantic and Pacific series do not show important differences in the width of the beak.

Flower remarked in his original description that the only character of importance which he could fix upon as distinguishing *B. schlegeli* from *B. borealis* was the fact that in the former the orbital plate of the frontal was narrower at its outer end than in the latter; Van Beneden and Gervais also consider this to be an important difference. By referring to the table of proportional measurements it will be seen that the Zuyder Zee specimen in the Leyden Museum, which presumably Flower directly compared with the Java cranium, has the orbit somewhat wider proportionately than in the latter but it is the only one of the Atlantic skulls where this is true. In the North Cape and Firth of Forth crania the proportional width of the orbital end of the frontal is *less* than in the Java specimen. It will also be observed that there is a great individual variation in both the Atlantic and Pacific skulls in this particular and I believe that some, at least, is due to differences in taking this measurement. The edges of the orbital process are curved and it is so difficult to fix upon definite points that probably no two persons would measure the same skull alike.

Van Beneden and Gervais say that the rostrum of *B. schlegeli* is comparatively less tapering than in *B. borealis*. Neither the actual nor proportional measurements bear this out. My Japan skull has a rostrum which the measurements show to be more tapering than that of any of the Atlantic whales; the Java and Zuyder Zee specimens are about alike, and Turner's Firth of Forth skull has a less tapering rostrum than any specimen of either series.

The fact that the superior maxilla forms a less regular curve about the anterior border of the frontal is a character in which Van Beneden and Gervais believe that *B. schlegeli* differs from *B. borealis*. I must confess that this does not appear to me to have great significance, especially as the Java and Japan skulls differ considerably in this respect.

Van Beneden and Gervais say that in *B. borealis* there is less difference between the two extremities of the nasal bones than in *B. schlegeli;* or, in other words, the nasals of the latter

are more wedge-shaped than are those of the former, but the measurements do not bear this out. The difference between the proximal and distal ends of the nasals of Turner's Firth of Forth specimen is 76 mm., but in the young Zuyder Zee and North Cape skulls it is considerably less. In the Japan skull it is 75 mm., while in the type of *B. schlegeli* the difference is 102 mm. Since this character does not appear to be constant in both Asiatic skulls, and as Turner's specimen has nasals fully as tapering as are those of my Japan cranium, it cannot be considered as especially important.

Van Beneden and Gervais remark in reference to the occipital: "L'occipital est beaucoup plus large à sa base que dans le *borealis* et notablement moins étendu d'arrière en avant, de manière que la boître crânienne gagne en largeur ce qu'elle perd en longueur" (*l. c.*, p. 222). What is said above regarding the length and breadth of the occipital is quite true of the Java cranium and justifies the conclusions of the authors of the 'Osteographie,' but is rendered invalid by the skull from Japan. Table XI demonstrates that the type of *B. schlegeli* has a proportionately shorter supraoccipital than any except Turner's Firth of Forth specimen, and that it is the widest of the entire series. The Japan skull is proportionately very narrow across the exoccipitals, this measurement being only 30.7%; it agrees exactly with the Firth of Forth cranium, and is less than either of the other two Atlantic skulls.

Flower, in his description of the type of *B. schlegeli*, gives a measurement of the mandible which is longer than the skull; this is probably a typographical error, for in Van Beneden's figure in the 'Osteographie' the jaw is drawn in its proper proportions. The statement in the 'Osteographie' that the mandible of *B. schlegeli* is comparatively more massive than is that of *B. borealis* is not borne out by the measurements. The mandible of the Zuyder Zee skull is heavier than is that belonging to the cranium from Java, and my Japan skull has an exceedingly light mandible.

An examination of the published figures of the Java and Atlantic specimens reveal certain differences of greater or less importance. They are as follows:

1. Two prominent rugosities are present upon the exoccipital bones of my Japan skull which are not shown in the figures of either the Java or Gervais's Japan specimen.

2. The outer margins of the orbital processes of the maxillæ are very similar in the two Japan skulls and Rudolphi's drawing, but have a different curvature in the figures of *B. borealis* and *B. schlegeli* published in the 'Osteographie.'

3. The outer edges of the rostral portion of the maxillæ in Gervais's Japan skull are slightly convex, while in Van Beneden's figures of *B. borealis* and *B. schlegeli*, and in my own specimen, they are practically straight. Rudolphi's drawing of the type skull shows the edges of the beak to be convex, about as in Gervais's specimen.

4. The exterior outline of the zygomatic processes of the squamosals are more convex in both Japan skulls than in the drawing of the Java cranium.

5. The processes of the maxillæ which extend backwards along the sides of the nasal bones appear to be somewhat broader and shorter in my Japan skull than in any of the other specimens.

6. The curve of the mandible is alike in both Japan specimens, but differs considerably from the figured mandible of the Java skull, as well as from Rudolphi's and Van Beneden's drawings of the jaws of their Atlantic examples. I suspect that this is largely due to the position in which the mandibles have been mounted and not to any real difference in the bones themselves. Flower, in commenting upon the Zuyder Zee specimen, says: "The inferior maxillaries have low,

PLATE XLI.

PLATE XLI.

Balænoptera borealis.

Fig. 1. Dorsal view of the skull of the specimen from Japan, No. 34871, in the Am. Mus. Nat. Hist.
Fig. 2. Ventral view of the same skull.

1 2

BALÆNOPTERA BOREALIS.

obtusely triangular coronoid processes. They are articulated too close to the head, and their upper edge rotated too much inwards. This position greatly diminishes their curve as seen from above, and causes their extremity to bend downwards. I was much interested in observing this, as it explains away a great peculiarity in the figure of the Whale in the Berlin Museum by Rudolphi (Abhandlungen Acad. Berlin, 1822), in which the same mode of articulating has caused

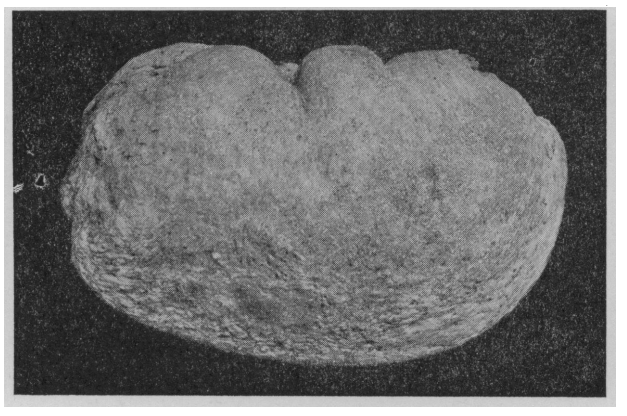

Fig. 10.

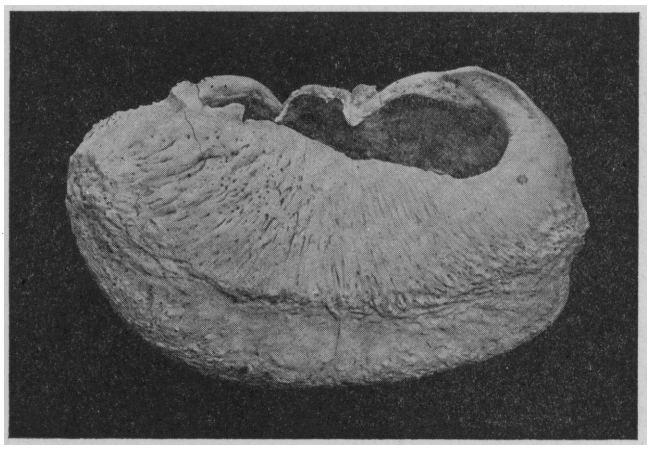

Fig. 11.

Fig. 10. Outer surface of left tympanic bone of *B. borealis*.
Fig. 11. Inner surface of left tympanic bone of *B. borealis*.

some misconception as to the character and relation of these bones, the more important to be rectified, as this is the only figure extant of the skull of any member of this genus" (*l. c.*, p. 398).

The tympanic bones of the American Museum skull from Japan do not show any variation of especial importance. They are somewhat larger and slightly narrower anteriorly than are those of the Java specimen, of which Flower remarks: "It is rather curious that the tympanic bones, though agreeing in general form, are acutally smaller in the Java than in the Zuyder Zee skeleton, being less in length by 0.3″, and in breadth by nearly the same amount" (*l. c.*, p. 407).

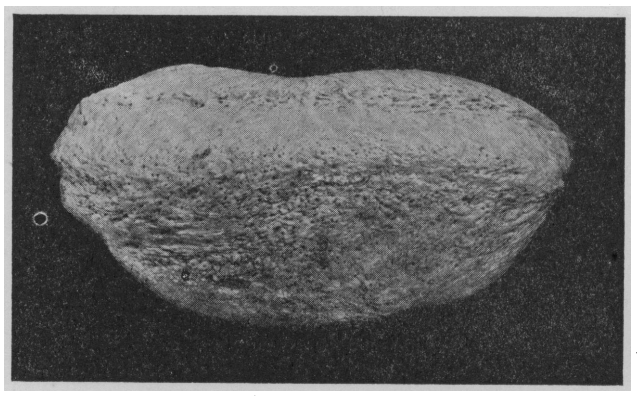

Fig. 12. Free border of left tympanic bone of *B. borealis*.

Gervais's figures of the tympanic bones of the specimen from Japan in the Paris Museum are so unusual in shape that there is ground to suspect they may not belong to the skull which he figures. The bones are exceedingly deep in proportion to the length and are not elongated, as is usual in *B. borealis*. The figures of the tympanic bone of Gervais's specimen from Cape Horn which he identifies as *B. schlegeli* agree very closely with our Japanese specimen. He gives the length of the tympanic as 13 cm. and the breadth as 67 cm.— the latter is undoubtedly a typographical error.

Hyoid bones.— The hyoid bones are interesting as showing the great individual variation which may occur in certain portions of the skeleton of this species. The ankylosed basihyal and two thyrohyals of my Japan specimen are almost identical in shape with Rudolphi's figure of these bones of the Holstein skeleton. They differ widely, however, from the figure in the 'Osteographie' of the young Zuyder Zee specimen, which shows the thyrohyals directed backward

instead of forward, and no posterior projection of the basihyal. The shape of the hyoids of the Java skeleton is somewhat intermediate between the Zuyder Zee and Holstein's skeletons, for the thyrohyals are horizontal and the posterior projection on the basihyal is well developed. The hyoids of Gervais's Cape Horn specimen agree well with ours from Japan, the stylohyals being almost identical in shape.

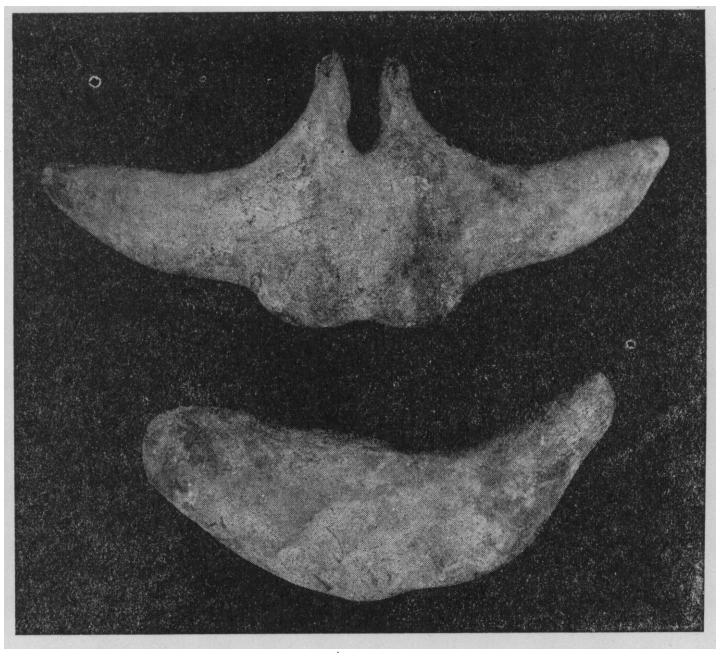

Fig. 13. Basihyal and one stylohyal of *B. borealis*.

I believe that the foregoing comparison has demonstrated that there are no important differences between the skulls of the Atlantic and Pacific specimens which indicate specific distinctness. I am fully aware that the osteological material from which to draw conclusions is most unsatisfactory, and that certain differences are apparent which it is difficult to believe are entirely individual. Nevertheless, when each series of skulls shows such enormous variation among its own units, and there is no constant difference in any particular between the crania from the two oceans, there seems to be no logical reason for specific separation upon the ground of skull characters. As has been stated above, I am far from believing that the differences which appear in the drawings and tables of actual and proportional measurements are all real, but on the contrary feel sure that they will be found to be largely due to such causes as age (for all of the skulls are young or adolescent), methods of measurement, and changes in the skull while drying.

The Java cranium differs in some of its proportions from both the Japan skulls and those from Europe but I can not bring myself to believe that any of its variations are of specific importance, but rather that it is merely an extreme type such as is Turner's Firth of Forth specimen.

Vertebral Column.

Vertebral formulæ.— The vertebral formulæ of the Atlantic specimens of *B. borealis* are often stated incorrectly, the difficulty arising in the accurate determination of the 1st caudal vertebra. The caudal series is quite properly considered to begin with the first vertebra which bears a chevron attachment on the posterior end of the centrum, inferiorly. The two anterior chevrons are, in the majority of cetaceans, very small, but the 3rd suddenly elongates and bears a large hæmal spine. Unless the preparation of the skeleton has been very carefully supervised the first two chevrons are usually lost. The first caudal can, however, be determined regardless of the chevrons themselves, for the inferior median carina, which is present in the lumbar vertebræ, begins to widen posteriorly on the last lumbar and bifurcates upon the 1st caudal, thus forming facets for the chevron attachments. This is a fairly safe, although not infallible, guide for determining the location of the 1st caudal when the chevrons have been detached from their

PLATE XLII.

PLATE XLII.

Balænoptera borealis.

Fig. 1. Lateral view of skull of the specimen from Japan, No. 34871, in the Am. Mus. Nat. Hist.
Fig. 2. Outer view of the right ramus of the mandible of the same skull.
Fig. 3. Inner view of the right ramus of the mandible.

BALÆNOPTERA BOREALIS.

respective vertebræ. Judging from Rudolphi's figure of the Berlin skeleton, apparently only the 1st chevron, the laminæ of which are usually not united distally, has been lost and thus the specimen has 14 lumbar vertebræ instead of 15. In Pander and d'Alton's figure, however, the small first chevron is shown in place and the skeleton is still given 15 lumbar vertebræ.

I suspect that the last pair of ribs, which are often unattached to the vertebral column, are also missing, and that the first vertebra posterior to those bearing ribs is really the last dorsal instead of the first lumbar. The vertebral formula of the Berlin skeleton would thus read C7, D14, L13, Ca21 = 55 instead of C7, D13, L15, Ca20.

Flower gives the vertebral formula of the Zuyder Zee whale in the Leyden Museum as C7, D13 or 14, L16 or 15, Ca19 = 55, but says "the last caudal is elongated, and really consists of two bodies ankylosed, with even a minute rudimentary third....There are thirteen pairs of ribs present but it is probable that the posterior pair are wanting" (*l. c.*, p. 397).

Of the skeleton in the Brussels Museum from the North Cape, Flower says: "There are 7 cervical, 14 dorsal, and 32 lumbo-caudal vertebræ present; about 5 of the latter are absent, which would make a total of 58.... There are 13 ribs present on the right side, and 14 on the left. The fourteenth is very much thinner than the others, twisted backwards at its lower end, with a very slender head, articulated to the transverse process of the vertebra" (*l. c.*, p. 417).

Evidently Flower did not correctly determine the beginning of the caudal series of the Leyden Museum skeleton, and the same error was made by Van Beneden and Gervais in both it and the Brussels specimen. Thus the identifications of all the caudal vertebræ of these whales which they figure in the 'Osteographie' are, unfortunately, badly mixed. They say in regard to the Brussels skeleton that it has 15 lumbar units "en comptant pour vertèbres caudales toutes celles qui portent ou sont suivies de celles qui ont un os en V" (*l. c.*, p. 205).

Flower thought that about 5 of the caudal vertebræ of the Brussels specimen were absent and that the total would be 58. The authors of the 'Osteographie' believe that this number is too great and that 55 or 56 is the correct formula. They, however, apparently agree with Flower in the determination of the vertebral units of the Leyden Museum whale, to which he assigns 15 or 16 lumbars.

My reasons for believing the lumbar and caudal series of the Brussels and Leyden Museum whales to be incorrectly determined are as follows: As stated above, the 1st chevron in the great majority of cetaceans is very small, the 2d but little larger, and the 3d very long with a prominent spine. In the 'Osteographie' the vertebra of both skeletons which is figured as the 1st caudal bears a large chevron bone with a long hæmal spine. Moreover, the vertebra of the Brussels Museum skeleton figured as the 1st caudal has the transverse process perforated by a vertical foramen. In *B. borealis* the first vertebra to be thus perforated is usually the 3d caudal and, so far as I am aware, never the 1st.

Professor Turner's Firth of Forth whale had the following vertebral formula: C7, D14, L14, Ca21 = 56.

According to Lilljeborg the young specimen in the Bergen Museum has 55 vertebræ, as follows: C7, D13, L14, Ca21 = 55.

Professor Fischer states that the young male *B. borealis* which was cast up near Biarritz in 1874, the skeleton of which is preserved in the Museum of Bayonne, had 54 vertebræ and 14 pairs of ribs.

Flower says of the type specimen of *B. schlegeli:* "The number of vertebræ present is 54;

and 3, or probably 4 of the caudal are wanting, raising the total number to 57 or 58. Of these, 7 are cervical, 14 dorsal, and about 13 or 14 lumbar; but, the articular surface for the anterior chevron bones not being well marked, I could not be certain where the tail should be considered to begin. There are 14 pairs of ribs" (*l. c.*, p. 401).

I think that Flower was right in the total and that 57 vertebræ would be the correct number.

The formula of the incomplete skeleton described in the 'Mission du Cap Horn' by H. P. Gervais and identified as *B. schlegeli* is C7, D14, L13, Ca4+. Our whale from Japan has the following formula: C7, D14, L13, Ca23 = 57.

Whale No. 36, taken at Aikawa, had 13 pairs of ribs and the fœtus dissected by Dr. Schulte had a like number (see below).

For convenience in comparison, the different formulæ are assembled in the appended table, together with the total length of the skeletons:

Table XII.—Vertebral Formulæ.

Locality	Total length		Age	C	D	L	Ca	Authority
	feet	cm.						
Holstein:								
Berlin Museum	31′ 1″	947	juv.	7	14	13	21+	Rudolphi [1]
North Cape:								
Brussels Museum	32′ 2″	980	juv.	7	14	13	19+	Flower [1]
Zuyder Zee:								
Leyden Museum	29′ 7″	902	juv.	7	14	13	21+	Flower [1]
Firth of Forth, Scot.:								
Edinburgh Museum	35′ 2¼″	1072	juv.	7	14	14	21+	Turner
Finmark:								
Bergen Museum	30′ 2″	919.5	juv.	7	13	14	21	Lilljeborg
Java, type of *B. schlegeli:*								
Leyden Museum	39′ 8″	1209	adol.	7	14	13	20+	Flower
Cape Horn:								
Paris Museum	——	——	ad.	7	14	13	4+	Gervais
Japan:								
American Museum	41′ 3¾″	1259	adol.	7	14	13	23	Andrews

It will be seen that a close agreement exists among the skeletons from different localities and that the normal vertebral formula for *B. borealis* is apparently C7, D14, L13, Ca22 or 23. The differences in the caudal series are undoubtedly due to the fact that the minute terminal vertebræ are usually lost.

Cervical vertebræ.— The seven neck vertebræ of our Japan skeleton are all free, and such is apparently the normal condition for *B. borealis* since, with a single exception, all specimens so far recorded have had free cervicals; Turner's Firth of Forth skeleton alone had "the right lateral mass of the atlas ankylosed to the body of the axis." In other members of the genus *Balænoptera* two or more of the cervical vertebræ usually become ankylosed.

The atlas presents all the distinctive characters of *B. borealis*, viz.: the short and much twisted transverse processes, the contracted neural canal, articular facets for the occipital condyles, which are not confluent at their inferior edges and, on the median inferior margin of the posterior face, the triangular bony projection which fits under the body of the axis. From a

[1] As corrected by R. C. A.

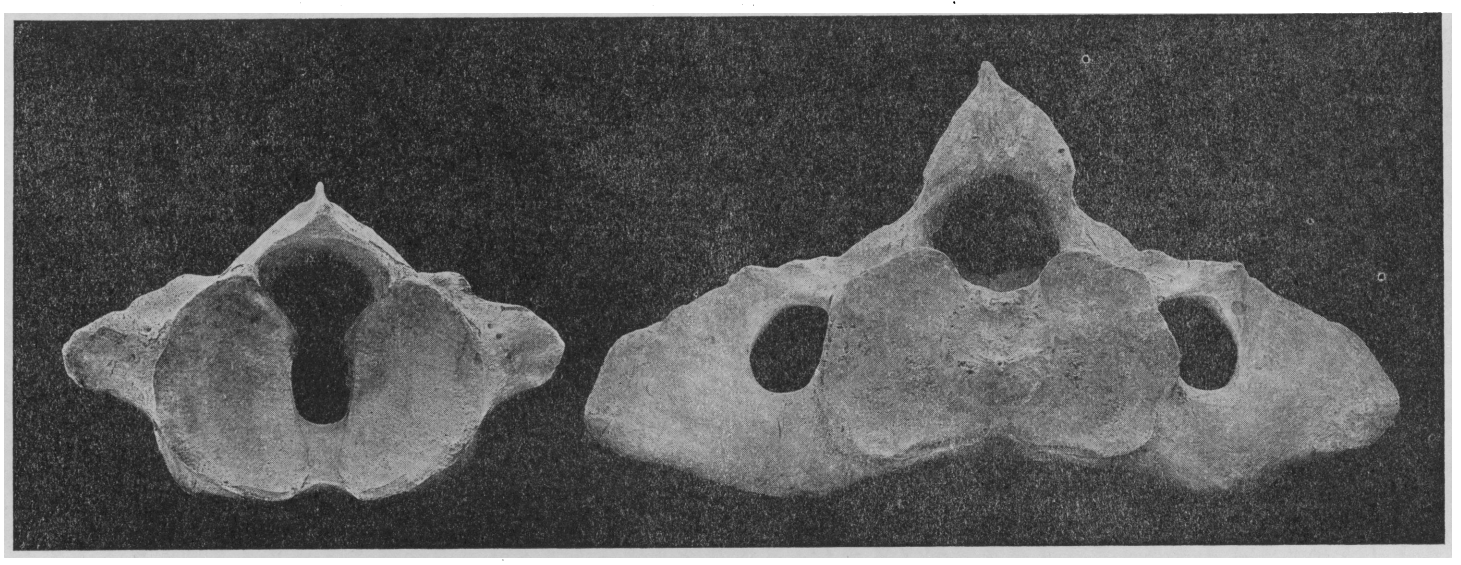

Fig. 14. Atlas and axis of *B. borealis* (left to right).

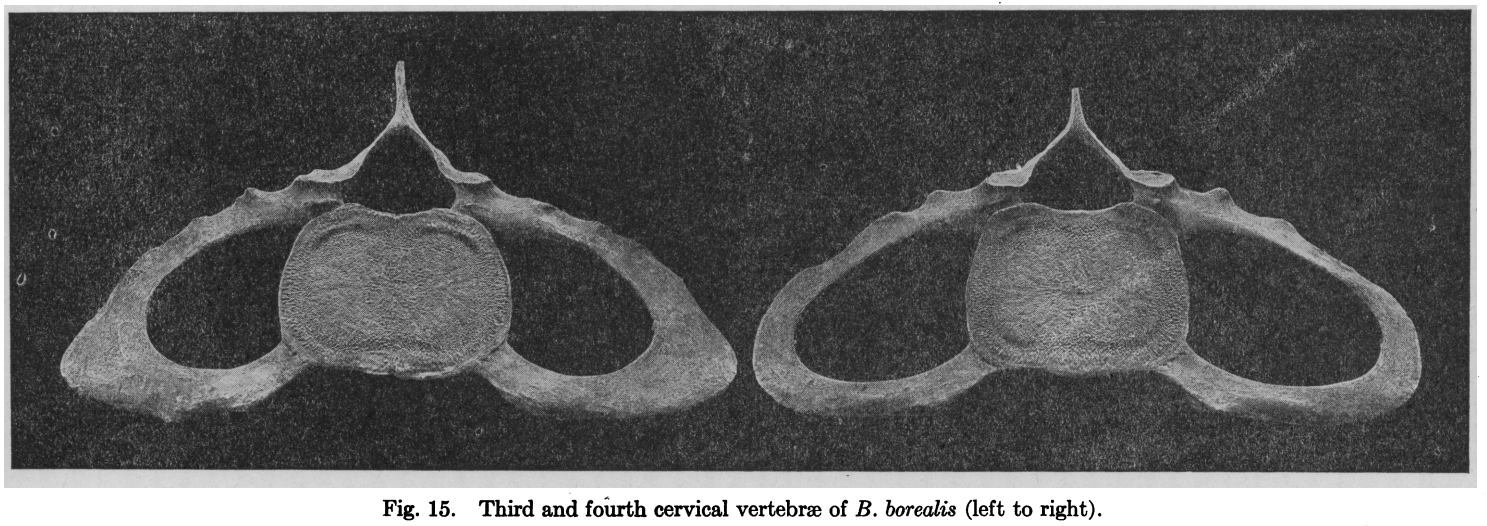

Fig. 15. Third and fourth cervical vertebræ of *B. borealis* (left to right).

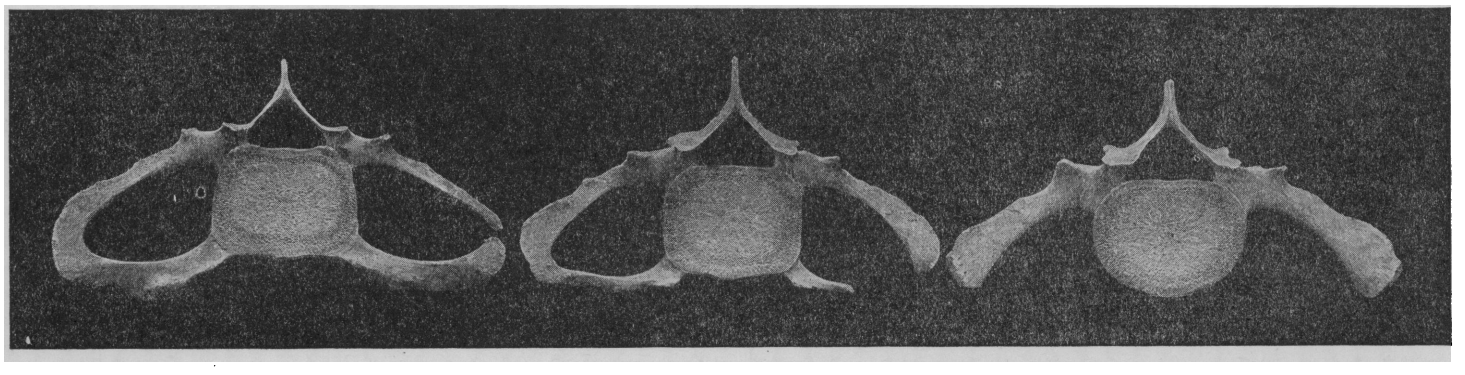

Fig. 16. Fifth, sixth and seventh cervical vertebræ of *B. borealis* (left to right).

lateral view, except for the spine, the atlas resembles that of the North Cape specimen in the Brussels Museum as figured in the 'Osteographie' (plate x and xi, fig. 20). The figure of the atlas from the Java skeleton (P. Z. S., 1864, p. 40) agrees well with ours in both the anterior and lateral views. The atlas of Gervais's Cape Horn specimen is interesting as presenting a marked asymmetry, the transverse process of the right side being deeper and more massive than that of the left; this is an unusual condition. The atlases of the Firth of Forth, Java and Japan skeletons agree closely in size and proportions.

The axis presents no characters of especial importance. It has the usual large wing like transverse processes, each perforated by an oval foramen, a fairly well-marked odontoid process, and a massive neural spine. The axis agrees closely with that of Gervais's Cape Horn skeleton and those of *B. borealis* figured in the 'Osteographie' except in the shape of the neural spine. This is such a variable character, however, that taken by itself it has little significance; in fact, none of the figures with which I am familiar agree in the shape of the spine of the axis.

The superior and inferior transverse processes of the third and fourth cervicals unite to form a ring; the fifth vertebra has the ring complete on the right side, but on the left the distal ends

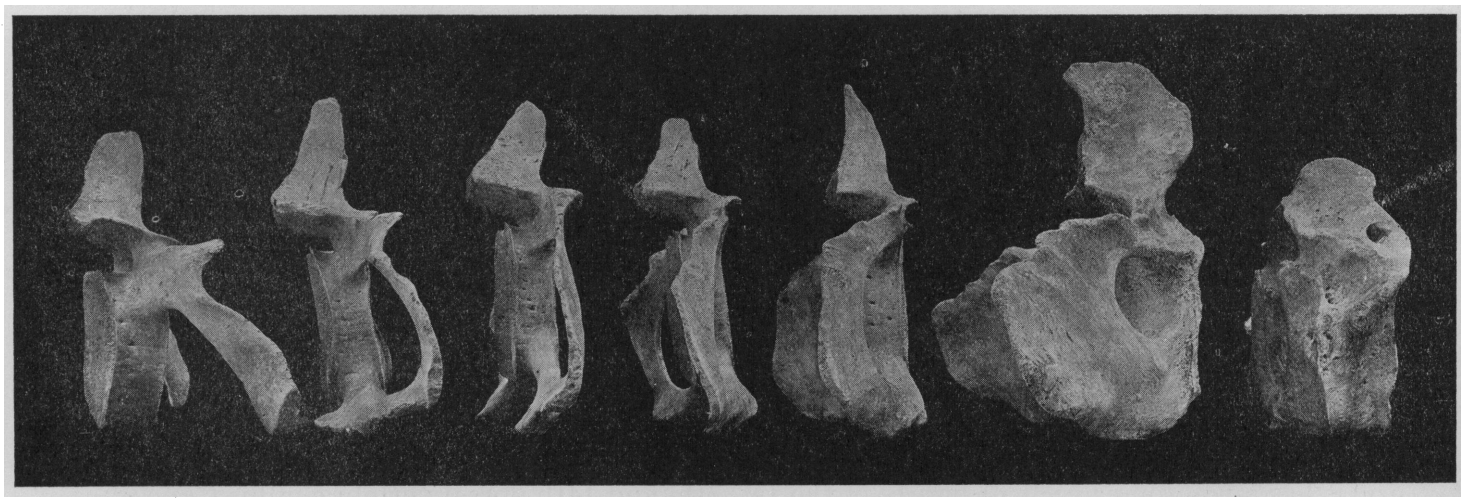

Fig. 17. Lateral view of cervical vertebræ of *B. borealis*.

of the two transverse processes are separated by an interval of 8 mm. This specimen seems to be the only one yet recorded in which the upper and lower transverse processes of the 6th cervical form a ring on either one or both sides. The ring on the right side of this vertebra is complete, but the lower process of the left side is represented by a short, flattened angular projection and is separated from the upper by a space of 96 mm. Both upper processes have the same length and direction, and it is evidently in the lower process that the growth has been arrested. In all other skeletons with which I am familiar both lower processes have the character of that on the left side of this specimen.

The upper transverse processes only of the 7th cervical are developed, these being heavy, expanded distally and curving downward and forward; there are no indications of lower processes. This seems to be the usual arrangement of the transverse processes of the 7th vertebra, but Turner remarks in regard to his Firth of Forth specimen: "in the 7th, whilst the superior limb is long and curved downwards and outwards, the inferior limb is represented by a mere tubercle. In the Leyden specimen the vertebrarterial foramen is incompletely bounded in the 2nd to

the 7th inclusive. In the Berlin and Bergen skeletons only the axis has the foramen completely bounded by bone. In the Brussels skeleton only the axis and 3rd vertebra" (*l. c.*, p. 476).

The material on record demonstrates that while the development of the transverse processes of the cervical vertebræ, up to a certain point, is influenced by age, they are open to considerable individual variation. In all probability this species normally has the upper and lower transverse processes of the 2nd, 3rd, 4th and 5th cervicals completely united; the inferior processes of the 6th vertebra are short, flat and angular, and separated from the upper processes by a considerable interval; the superior processes of the 7th cervical are heavy, down-curved, expanded distally and show no suggestion of inferior processes.

It appears that the transverse processes of the cervical vertebræ are of doubtful value as a diagnostic character of this species. This I found to be also true of the California Gray Whale (*Rhachianectes glaucus*). Two fully adult skeletons were collected at Ulsan, Korea, one of which had the lower transverse processes of the 7th cervical as well developed as in the other vertebræ of the series, while in the second skeleton these processes were represented only by tubercles.

Dorsal vertebræ.— Our specimen has fourteen thoracic vertebræ, the first thirteen of which have more or less well marked facets at the distal ends of the transverse processes for the articulation of the ribs; the posterior ends of the transverse processes of the 14th dorsal are slightly thickened where the pair of rudimentary last ribs was attached. The neural spines of all the dorsal vertebræ are high, those from the 5th to the 14th, inclusive, being very wide and thin with truncated summits.

The 6th dorsal vertebra of our Japan skeleton and that of the Brussels Museum specimen, as figured in the 'Osteographie,' agree well except in the distal ends of the transverse processes. In the former the ends of the processes are very thick and deeply excavated for the costal articulation, while in the latter there is little suggestion of a facet. Since the end of the transverse process of the last dorsal is represented as thicker than that of the 6th dorsal, the drawing is obviously incorrect or else the end of the process has been broken. The 6th dorsal vertebra of the Leyden specimen has thick processes similar to those of the Japan skeleton.

Gervais has given some excellent figures of the 1st, 7th, and 14th dorsal vertebræ of his Cape Horn specimen. The agreement of these figures with the respective vertebræ of our Japan skeleton is so close that no comment is required.

The 6th dorsal vertebra of the Java skeleton differs from that of our Japan specimen, and from all examples of *B. borealis* which I have seen figured, in the fact that the spine is directed strongly forward instead of being almost vertical. The distal end of the transverse process is almost horizontal to the axis of the centrum in this vertebra of the Java whale instead of being markedly oblique as in the other specimens. Again the last dorsal vertebra does not show the usual concave anterior and posterior margins and expanded distal end of the spine.

The differences in the 6th dorsal can not easily be accounted for and, if the figure is correct, are important, but those of the last vertebra of the series may be due to injuries to the bone. The anterior edge of the spine of the 7th dorsal of our Japan specimen was abraded during transit to the Museum and is now almost straight resembling that of the last dorsal of the Java skeleton.

The transverse processes of the first six dorsal vertebræ of our specimen are directed forward, those of the 7th and 8th outward, and those of the remaining six slightly backward. The Bergen Museum skeleton, according to Lilljeborg, had the transverse processes of the first seven

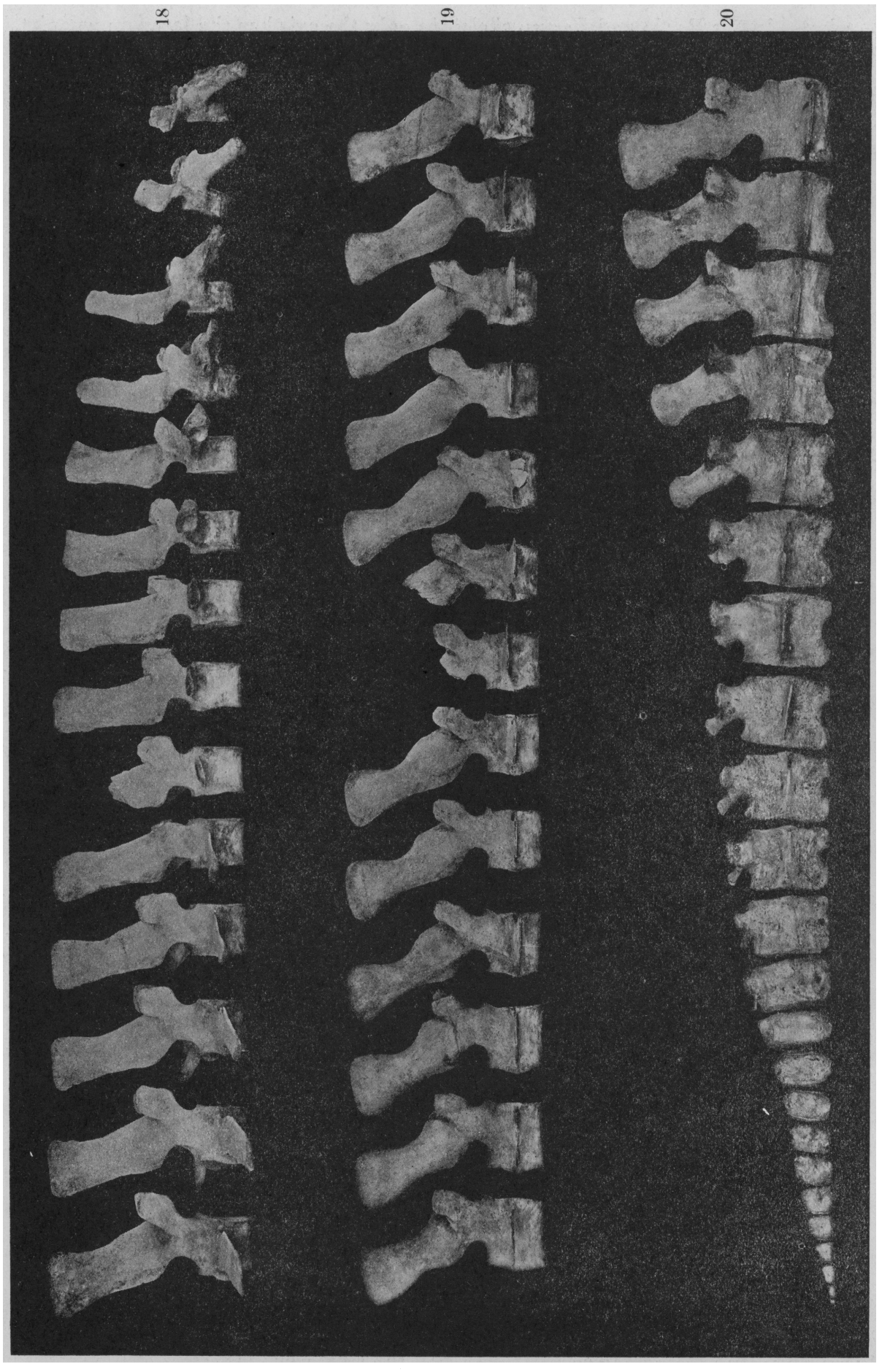

Fig. 18. Lateral view of dorsal vertebræ of *B. borealis*.
Fig. 19. " " " lumbar " " "
Fig. 20. " " " caudal " " "

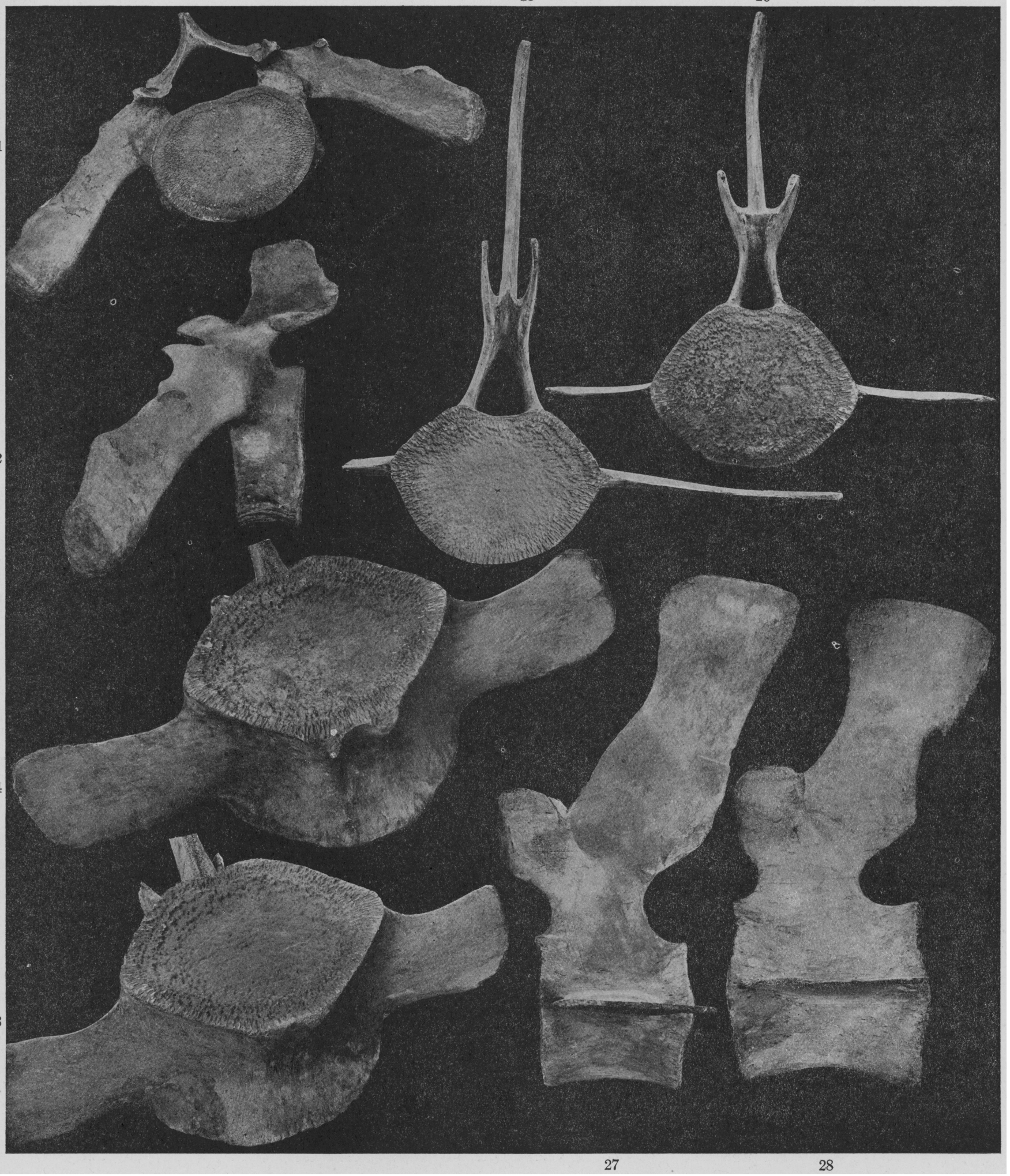

Fig. 21. Anterior view of 1st dorsal vertebra of *B. borealis*.
Fig. 22. Lateral " " " " " " " "
Fig. 23. Oblique ventral view of 1st caudal vertebra of *B. borealis*.
Fig. 24. " " " " 2nd " " " " "
Fig. 25. Anterior view of 1st lumbar vertebra of *B. borealis*.
Fig. 26. " " " " caudal " " " "
Fig. 27. Lateral " " " lumbar " " " "
Fig. 28. " " " " caudal " " " "

dorsals directed forward, those of the 8th and 9th projecting straight outward, and those of the four last backward.

Lumbar vertebræ.— The 13 lumbar vertebræ of our Japan skeleton present no features of especial importance. As usual the centra of all the vertebræ become more massive as the caudal region is approached and the transverse processes shorten and widen; the neural spines progressively broaden from before backward, have deeply concave anterior margins and expanded distal ends. Upon the center of all the vertebræ there is a well-marked inferior median carina, which bifurcates posteriorly on the first caudal for the chevron attachments.

The first lumbar of the Brussels Museum skeleton, as figured in the 'Osteographie,' differs from the corresponding vertebra of our Japan specimen in having the anterior margin of the neural spine less convex and a prominent tubercle on the posterior side of the neural arch. This tubercle is, however, not shown in the figure of the lumbar vertebræ of *B. schlegeli* or of Gervais's Cape Horn specimen, the first lumbar of which agrees closely with that of our Japan whale.

Lilljeborg says of the Bergen Museum specimen from Finmark: "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 2d–12th are directed forward. 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" (*l. c.*, p. 270).

The transverse processes of our specimen differ somewhat from those of the Bergen Museum skeletons. The processes of the first five and the last three lumbars project straight outward, and those of the 6th to the 10th inclusive are directed slightly forward.

Caudal vertebræ.— The caudal series includes 23 vertebræ, and since those within the flukes were sent intact to the Museum and afterward carefully dissected out, it is certain that all of the small terminal units, which are so frequently lost, were secured. The last vertebra measures 19 mm. in length by 22 mm. in width, is wedge-shaped and completely ossified but so exceedingly minute that it would almost certainly be overlooked unless unusual care were taken to secure it.

The inferior median carina is bifurcated on the posterior edge of the centrum of the 34th vertebra and forms two well-marked facets for the chevron attachments, thus indicating the beginning of the caudal series.

Gervais has figured the inferior surfaces of the first three caudal vertebræ of his Cape Horn specimen, but the numbers on the drawings have been misplaced, thus causing some confusion. Figure 22 refers to the 3rd, figure 22*a* to the 2nd, and 22*b* to the 1st caudals. On the same plate are anterior and lateral views of the 2nd caudal. The former agrees well with the corresponding vertebra of our Japan whale, but the lateral view shows the spine to be more erect than it is in our specimen.

I have given above my reasons for concluding that the vertebra of both the Brussels and Leyden Museum specimens which Van Beneden and Gervais have figured as the 1st caudal is in each case really the 3rd; it would naturally follow that those figured as the 8th, 9th and 10th caudals are the 10th, 11th and 12th. This seems to be true of the Brussels skeleton but there is further error in the figures of the Leyden specimen. The vertebra which is said to be the 8th caudal has a well-developed spine, neural arch and transverse processes and bears a large chevron. The one figured as the 9th, which next succeeds it, has entirely lost the spine and transverse processes and bears a very small chevron. This is obviously an error since the neural arches and processes of the caudal vertebræ of all Balænopteras decrease in size gradually and

never abruptly. It is difficult to understand how the vertebræ were thus confused. On the 10th caudal of the Brussels skeleton the neural arches and transverse processes have disappeared leaving only elongated tubercles.

On the 10th caudal of our Japan whale the zygopophyses are 38 mm. long, 68 mm. broad, and project straight upward; the neural spine is short, triangular and directed very obliquely backward, and the transverse processes remain as mere ridges. The inferior edge of the vertebra in the center of the body is perforated by an incomplete transverse foramen, which becomes entirely enclosed in the next succeeding vertebra. The figure of the 10th caudal of the Brussels whale shows no suggestion of this foramen although it appears in the 11th well up in the side of the centrum.

Two vertebræ, said to be the last lumbar and the 1st caudal of the type skeleton of *B. schlegeli*, are figured in the 'Osteographie,' but these bones have been misidentified and are really the 1st and 2d caudals. The vertebra figured as the 1st caudal has a large chevron indicated as attached to its posterior end and the inferior surface of the centrum is too concave; also, in the anterior view, the zygopophyses are seen to diverge widely instead of slightly, and the facets for the articulation of the chevron are very prominent. These are all characters of the 2d caudal. The figures of these two vertebræ agree remarkably well with the 1st and 2d caudals of our Japan skeleton.

The disappearance of the several processes and the appearance of the foramina, while open to much individual variation, nevertheless furnish interesting comparative data which are assembled below:

	Holstein, Berlin Museum	North Cape, Brussels Museum	Firth of Forth, Edinburgh Museum	Japan, American Museum	Cape Horn, Paris Museum
Last vertebra to bear a neural spine	12th Ca.	10th Ca.	10th Ca.	12th Ca.	——
First vertebra to have the transverse process perforated by a vertical foramen	3rd Ca.	3rd Ca.	3rd Ca.	3rd Ca.	3rd Ca.

Chevrons.— Although but 13 chevron bones were secured with the skeleton, it is obvious that 2 are gone and that the series originally consisted of 15. Those missing are the 2d and 14th. The 1st chevron is composed of two thin laminæ 148 mm. long by 99 mm. wide, the distal ends of which are free. The 3d is 222 mm. long by 125 mm. wide, and its laminæ unite in a spine 99 mm. in depth. The 3d, 4th, 5th and 6th chevrons have an almost uniform length but their spines increase gradually in breadth, that of the 6th being the widest of the series. The facets on the proximal ends for articulation with the vertebral bodies increase gradually in breadth from the 1st to the 8th. The last chevron is exceedingly small and would be discovered only by very careful dissection; it measures 18 mm. long by 23 mm. wide.

Pander and d'Alton's figure of the type skeleton of *B. borealis* in Berlin shows 15 chevron bones, and the series appears to be complete.

In Rudolphi's figure of the same specimen, however, it lacks the 1st chevron, only 14 being shown. This appears to be the only skeleton in which the series of chevrons is complete, for according to Flower only 10 were secured with the Leyden Museum specimen, and Lilljeborg states that the whale in the Bergen Museum had but 11. Turner also records 11 for his Firth of Forth skeleton.

Table XIII.— Measurements of Vertebræ of American Museum skeleton of Balænoptera borealis from Japan.

				mm.
Atlas,	greatest		breadth across transverse processes	433
"	"		depth	275
"	"		breadth across condylar facets	280
"	"		depth of " "	195
"	"		breadth " " "	275
"	"		depth " neural canal	149
Axis,	"		breadth across transverse processes	737
"	"		depth	336
"	"		" of centrum	155
"	"		breadth " "	295
"	"		length of right transverse process	302
"	"		" " foramen in transverse process	104
5th	cervical,	greatest	breadth across transverse processes	615
"	"	"	depth	292
"	"	"	" of centrum	162
"	"	"	breadth " "	197
"	"	"	length of foramen in transverse process	176
6th	"	"	breadth across transverse processes	587
"	"	"	depth	320
"	"	"	" of centrum	164
"	"	"	breadth " "	195
"	"	"	length of foramen in transverse process	165
7th	"	"	breadth across transverse processes	600
"	"	"	depth	305
"	"	"	" of centrum	164
"	"	"	breadth " "	208
1st	dorsal,	greatest	breadth across transverse processes	603
"	"	"	depth of centrum	160
"	"	"	breadth " "	225
6th	"	"	" across transverse processes	759
"	"	"	depth	600
"	"	"	" of centrum	159
"	"	"	breadth " "	195
14th	"	"	" across transverse processes	911
"	"	"	depth	660
"	"	"	" of centrum	174
"	"	"	breadth " "	250
1st	lumbar,	greatest	depth	670
"	"	"	" of centrum	179
"	"	"	breadth " "	251
13th	"	"	depth	642
"	"	"	" of centrum	220
"	"	"	breadth " "	280
1st	caudal,	"	depth	650
"	"	"	" of centrum	232
"	"	"	breadth " "	280
3rd	"	"	" across transverse processes	590
"	"	"	depth	605
"	"	"	" of centrum	250
"	"	"	breadth " "	290

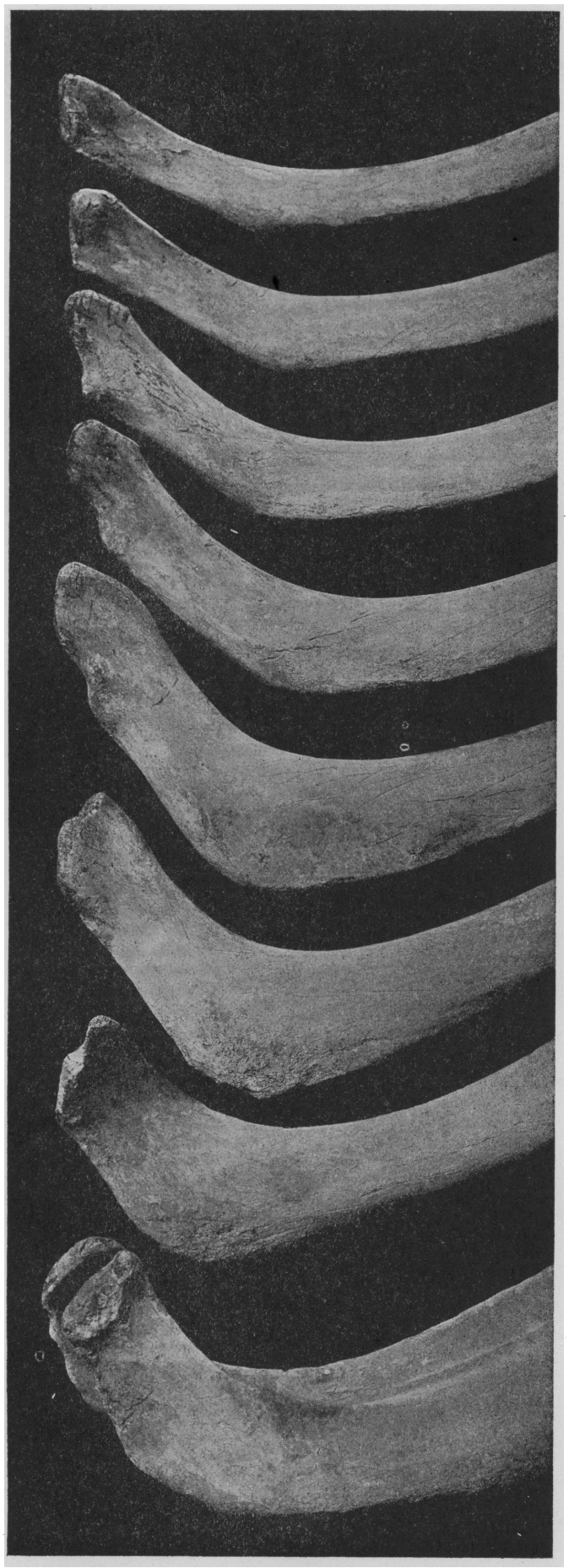

Fig. 29. Proximal portions of first right ribs of *B. borealis*.

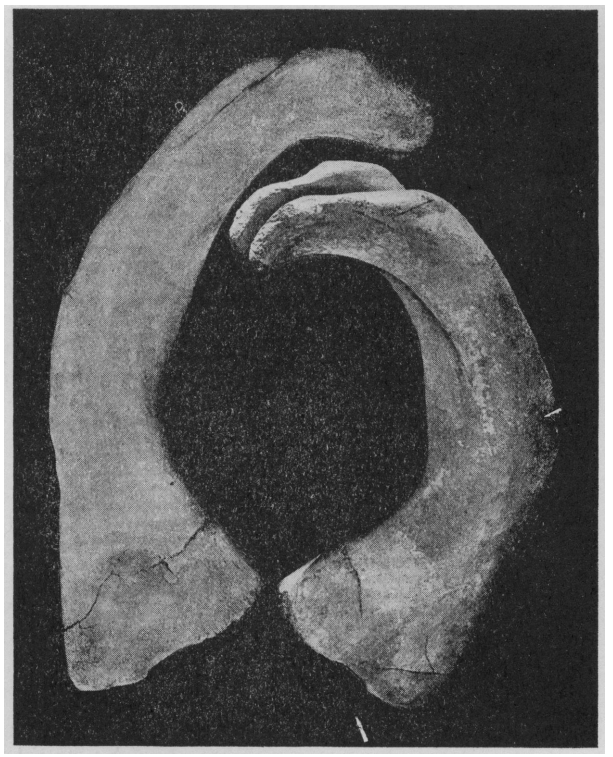

Fig. 30. Lateral and oblique dorsal view of first rib of *B. borealis*.

Ribs.

Our Japan skeleton has 14 pairs of ribs. The 1st rib on either side is deeply bifurcated proximally, so that two distinct heads are formed, and very widely expanded distally. The 2nd and 3rd ribs are of equal width throughout, so greatly compressed that they are almost slab-like, and possess heads and necks. Their proximal portions are bent at right angles to the shafts and the necks, which show no distinct constrictions, and are turned sharply inward.

The angle formed by the neck with the shaft of the remaining ribs becomes less and less acute until in the posterior members of the series it is entirely lost and the ribs are regularly curved. The last rib on the left side is very slender and much twisted; that of the right side is very short, straight, and abruptly narrows to a long slender point; these ribs are probably becoming functionless.

The 5th rib of the right side has a greatly swollen head, which is divided into two unequal prongs; this condition is also present

to a less extent in the 6th rib and is slightly indicated in the 7th. It is unquestionably pathological.

The morphological significance of the bifurcation of the first rib has been more widely discussed than any other question in the anatomy of *B. borealis*. All specimens of this species from whatever locality, with the exception of the Firth of Forth whale, have had the proximal ends of the first pair of ribs deeply bifurcated. This has given rise to the belief that it might be considered as a specific character and Dr. J. E. Gray even deemed it of generic importance. Professors Flower, Van Beneden and Turner regarded the supplementary part of the first rib as a cervical rib and this view is supported by our specimen. The proximal portion of the left is divided to an extent of 225 mm. but below this point is firmly coalesced. The line of union of the two ribs is plainly indicated on both the anterior and posterior surfaces for somewhat over half their length, but in the distal portion becomes lost.

While in Japan I examined a number of fresh skeletons with this point in view and, without exception, all possessed double-headed first ribs. This question is more fully discussed by Dr. Schulte in his dissection of the fœtus of *B. borealis* (see below).

Sternum.

As far as I have been able to discover the sterna of the Zuyder Zee, Java and Cape Horn skeletons are the only ones which have thus far been figured or described.

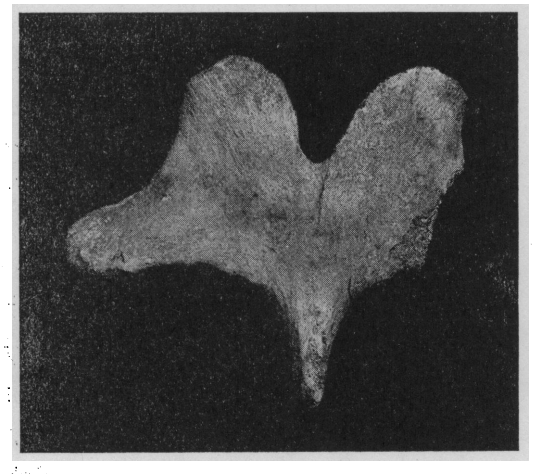

Fig. 31. Sternum of *B. borealis*.

The sternum of Gervais's Cape Horn specimen is quite regularly cross-shaped but that of our Japan whale has the superior ramus of the 'cross' deeply bifurcated and very broad, thus producing a bone of quite a different outline. In the Zuyder Zee sternum the upper and lower arms of the cross are undeveloped and a lozenge-shaped bone is the result. The sternum of the Java skeleton shows no definite separation between the superior and lateral rami of the cross but the inferior branch is well differentiated.

Although the sterna of these four skeletons differ widely yet it may be seen that they are all variations of the cross type. Such almost rudimentary bones, however, are of little value in specific comparisons for they are subject to extraordinary individual variations.

Pectoral Limb.

Scapula.— Each scapula of our Japan skeleton is fan-shaped with a long acromion and well developed coracoid process, and the width is nearly twice the height. The shoulder blade agrees remarkably well with the figure given by Gervais of the scapula of his Cape Horn specimen and that of the type skeleton of *B. schlegeli* from Java published in the 'Osteographie.'

The drawing of the Brussels scapula, however, differs in several particulars from the three just mentioned. It shows the superior margin of the bone to be regularly convex while in the

other specimens it is considerably flattened in the central portion. Also the coracoid is but slightly developed, the acromion is somewhat more expanded distally than in the others and is directed upward instead of straight outward. All three specimens, however, are older than the Brussels whale and that two, at least, of these differences are probably due to age is suggested by the scapula of a young Sei Whale No. 2, a photograph of which I took at Oshima, Japan, in March, 1910. The superior margin of the shoulder blade of this whale is evenly convex and the coracoid is but slightly developed. It resembles the Brussels scapula except that the acromion has not the expanded distal end and does not project upward.

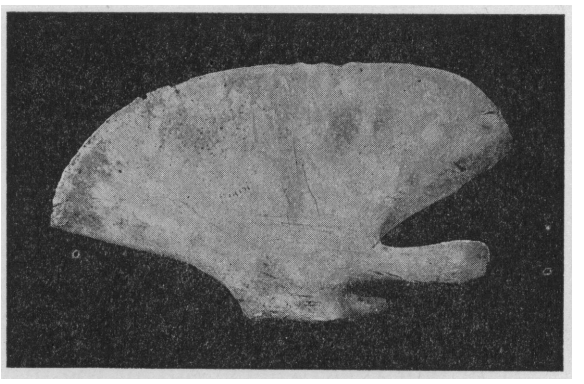

Fig. 32. Outer surface of right scapula of *B. borealis* (Am. Mus. Nat. Hist. No. 34871).

A photograph of the scapula of whale No. 19, exactly the length of the American Museum specimen (1350 cm.) and presumably of nearly the same age, shows that the superior margin of the bone was greatly flattened and that the acromion projected upward about like that of the Brussels scapula.

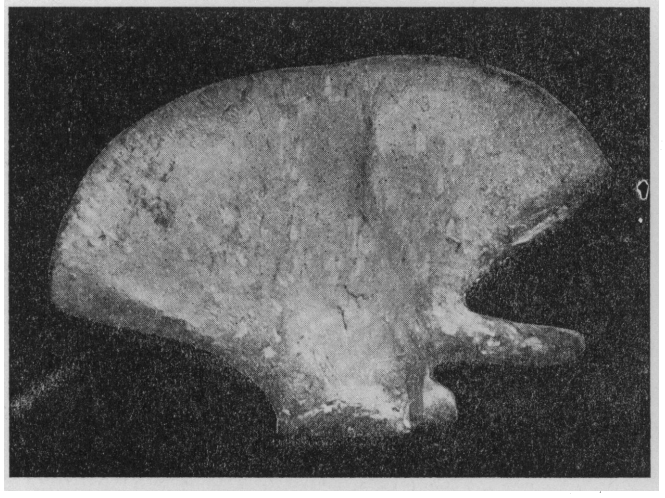

Fig. 33.

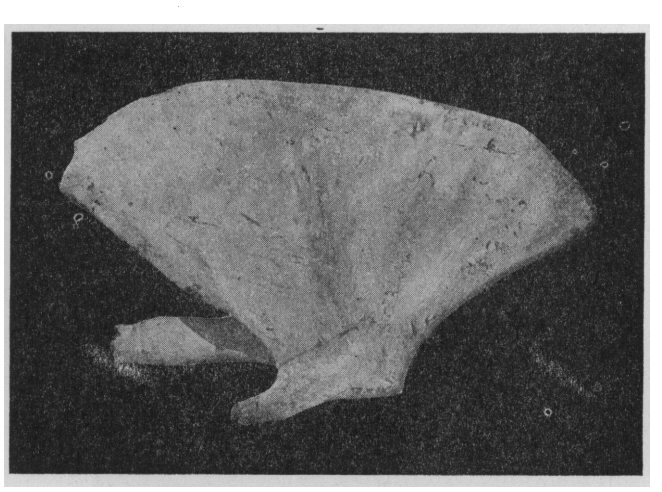

Fig. 34.

Fig. 33. Outer surface of right scapula of *B. borealis* (Whale No. 2, photographed at Oshima).
Fig. 34. Inner surface of right scapula of *B. borealis* (Whale No. 19, photographed at Aikawa).

It is probable, therefore, that the differences exhibited by the shoulder blade of the Brussels specimens are due to individual variation.

The table in which is indicated the proportion of the height to the breadth of the scapula of Atlantic and Pacific specimens gives little information of value except to show that an extraordinary variation exists in the proportions of this bone in different individuals and that it is apparently not the result of sex or age.

Humerus, radius, ulna, and carpus.— Besides the pectoral fins of the American Museum skeleton from Japan we have a photograph of the fore limbs of Sei Whale No. 2, taken at Oshima, for comparison with the flippers of the Brussels Museum and Java skeletons figured in the 'Osteographie.'

All four agree well, showing the straight humerus, the long slender radius and ulna, and

Table No. XIV.— Measurements of scapulæ of B. borealis.

	Japan, American Museum. R.C.A.	Japan, Whale No. 2 juv. Measured at station. R.C.A.	Japan, Whale No. 18 adol. Measured at station. R.C.A.	Java, Leyden Museum. Flower	Cape Horn, Paris Museum. Gervais	Scotland, Edinburgh Museum. Turner	Finmark, Bergen Museum. Lilljeborg	North Cape, Brussels Museum. Van Beneden & Gervais — from figure
	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.
Breadth of scapula	965	665	960	1015	1200	736	660	——
Height " "	540	400	575	577	660	445	365	——
Length of acromion	260	150	260	254	330	170	——	——
Breadth " "	93	——	90	127	140	101	——	——
Length of coracoid	120	65	110	101	140	18	——	——
Breadth " "	53	——	40	——	50	56	——	——
Proportion of height of scapula to breadth	% 55.9	% 60.1	% 59.9	% 56.8	% 55.0	% 60.4	% 53.3	% 61.1

the strongly developed olecranon process which characterizes the pectoral fin of *B. borealis*. The olecranon process of the ulna of the Java skeleton differs slightly in shape from that of the Brussels Museum specimen, but both of the Japan whales agree with the latter.

Fig. 35. Humerus, radius and ulna of *B. borealis* (Am. Mus. Nat. Hist. No. 34871).

I dissected with extreme care the carpus and manus of a flipper of whales Nos. 2 and 19 at the stations, and the dried flippers belonging to the skeleton from Japan are now in the Museum with all bones *in situ*. All three exhibited five carpal ossifications, three in the proximal row parallel to the ends of the radius and ulna, and two smaller ones in the distal row opposite the ends of the 3rd and 4th digits. This is the same arrangement found in the Bergen specimens and the Brussels flipper which Flower states is "a natural skeleton of the hand." The pisiform cartilage of No. 19 had begun to ossify and was 75 mm. in length, while in the younger whale (No. 2) no evidence of bony structure in this portion was to be found (see Schulte, below).

Manus.— The manus of each whale was dissected with especial reference to securing a correct formula for the phalanges and, although it will be seen that the three individuals differ in this respect, I am nevertheless positive that all are correct. The formulæ are as follows:

	II	III	IV	V
Japan, Am. Mus. Skeleton	4	7	6	3
" Whale No. 2	4	6	5	2
" " " 19	4	7	5	3
North Cape, Brussels Mus.	3	5	5	3
Finmark, Bergen "	3	6	5	2
Faroe Is., Copenhagen Mus.	3	5	4	2

I do not believe that the differences in the phalangeal formulæ of the Japan whales are due to age, but rather to individual variation. It is very probable that the formulæ of the Brussels

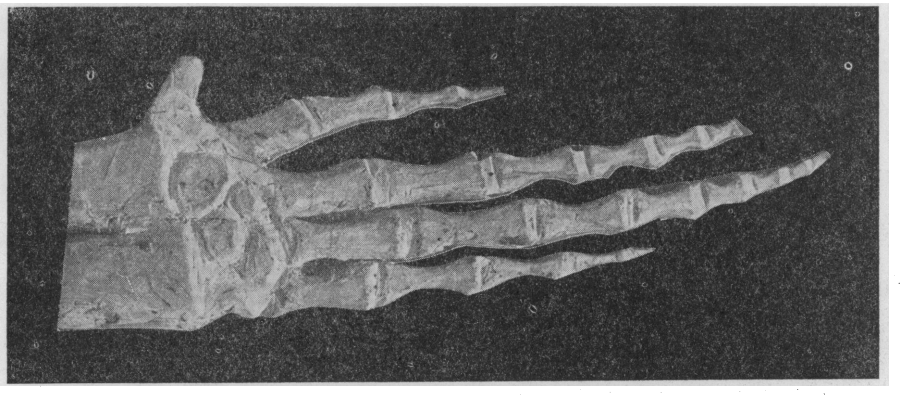

Fig. 36. Manus of *B. borealis* (Whale No. 19, photographed at Aikawa).

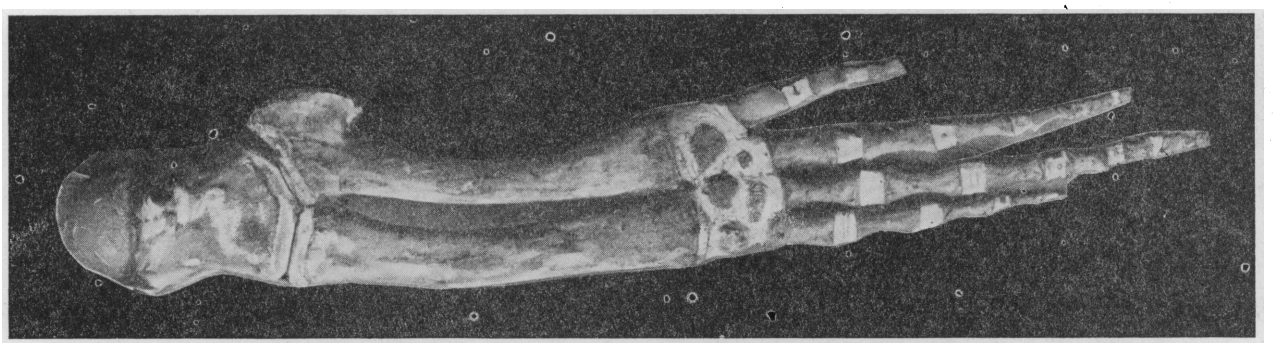

Fig. 37. Flipper of *B. borealis* (Whale No. 2, photographed at Oshima).

and Bergen Museums flippers are not correct, since it is only by the most careful dissection of fresh specimens that one can be sure that all the minute terminal phalanges have been secured.

Other data relative to the manus of whale No. 19 follow:

	mm.
Length of 2nd digit (including metacarpal)	480
" " 3rd " " "	710
" " 4th " " "	600
" " 5th " " "	340
" " last phalanx of 2nd digit	25
" " " " " 3rd "	15
" " " " " 4th "	40
" " " " " 5th "	30

The last phalanx of the 3rd digit was 16 mm. from the extreme tip, and that of the 4th digit was 60 mm. from the edge of the flipper.

Pelvic Rudiments.

It is especially fortunate that the pelvic elements of our Japan whale were preserved, since these bones have only once been described or figured since Rudolphi's and Pander and D'Alton's drawing of the pelvic rudiment of the type skeleton. In 1893, Dr. John Struthers published a valuable paper on the 'Rudimentary Hind-Limb of a Great Fin Whale (*Balænoptera musculus*) in comparison with those of the Humpback Whale and the Greenland Right Whale,'[1] in which he gave an account of the pelvis of a specimen of *B. borealis*, 36 feet long, which was beached alive at St. Margaret's Hope, Orkney, in November, 1884. Dr. Struthers says: "As the length of this species may reach 45 feet or even 50 feet, the figure cannot be regarded as representing the full grown pelvic bone, but it may be taken as showing the general form in contrast with that of B. musculus [= *B. physalus*]. The bone of both sides is figured, as there is considerable a-symmetry. The chief differences are, that the bone of the right side has a well-marked promontory, that it presents a marked flattening and expansion towards the anterior end, and that it is somewhat broader generally, so that it is altogether more robust than the left, rendering it about a fourth heavier than the left. The total length was about 7 inches, of which the cartilages made $1\frac{1}{2}$ inches.

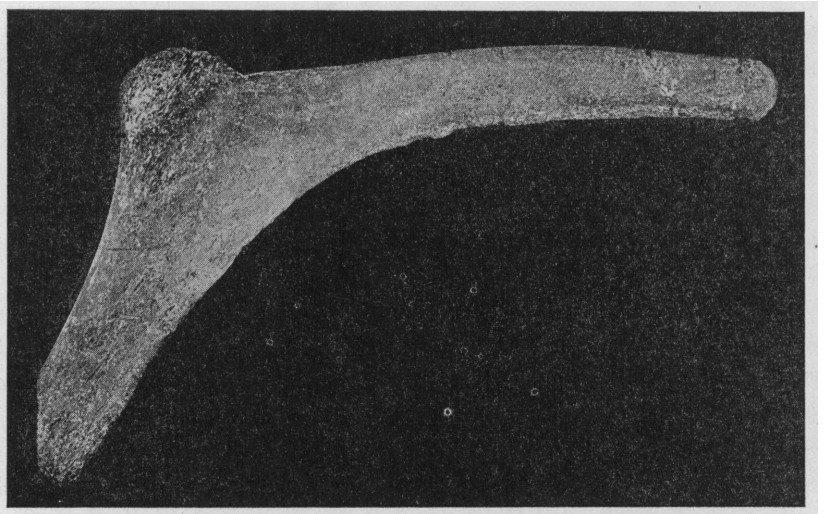

Fig. 38. Left pelvic element of *B. borealis*.

"On the bone possessing the considerable promontory, that of the right side, there is on the promontory a marked oval area corresponding exactly to the area where the *acetabular cartilage* lies in the B. musculus [= *B. physalus*] and in the Right-whales. It is here $\frac{1}{2}$ inch in length by $\frac{1}{3}$ inch in breadth, and lies entirely on the under surface of the promontory, not extending round the edge of the bone. The surface is irregular, mostly excavated, and is quite like a surface which had sustained a cartilage. On the left bone, on which the promontory is but little developed, this mark is not present. The outer border of the promontory is thicker than that of the right bone, and along it there is a longitudinal depression, not reaching to the under surface of the bone. It does not look as if it had supported a cartilage, but rather to be the result of the growth of its margins. It may be that a well-developed promontory and the presence of an acetabular cartilage stand related. At fully $\frac{1}{2}$ inch in front of the promontory there is a notch in the outer border of the bone, deepest and narrowest in the left, the least broad of the two bones. This notch corresponds in position exactly to the oval foramen noticed in the 64-feet-long B. musculus [= *B. physalus*] as seen in fig. 9. One would expect such a foramen to be vascular, but in the B. musculus it was occupied by fat."

Since the pelvic rudiments of our specimen are from a much larger whale, it may be assumed

[1] Jour. Anat. & Phys., Vol. XXVII, 1893, p. 324–325.

that they more nearly represent the normal adult shape of these elements than do Struthers's figures. The right bone is nearly perfect and although the left lacks the distal half of the ilium, sufficient remains to indicate that the two bones were almost identical in shape; the left, however, is slightly broader through the pubic region than is the right. The pubis in both specimens remains as a rounded and somewhat thickened promontory which is much more strongly developed than it appears in Struthers's figures. No indications of an acetabulum are present in either of our specimens, and neither is there any trace of the notch in the outer border of the bone just anterior to the pubis which Struthers records. If femoral rudiments were present they have been lost, but the probabilities are that there were none (see Schulte, below). The total length of the right pelvic bone is 220 mm., the ischium is 117 mm., and the ilium 165 mm. long.

Opinions of European Writers regarding the Specific Identity of *B. schlegeli* and *B. borealis*.

Even at the time Prof. Flower described and named the Java whale *Sibbaldius schlegelii* he was not convinced that it was specifically distinct from *B. borealis*, and yet could not bring himself to believe that two animals so widely separated geographically could belong to the same species. In his original description he says: "In the present case I have carefully compared the skeletons (that from Java and those from the European coast) together. I have even had the advantage of placing many of the bones of the two in the Leyden Museum side by side; and I confess that, allowing for difference of age, it is difficult to fix upon any characters in which they decidedly differ. The stylo-hyoids in the first, it may be said, are broader than in the Berlin or Brussels specimens, the sternum larger and of more definite cross-like form than in the Leyden skeleton, the transverse processes of the vertebræ are more developed and united at their ends than in either of these; but such characters are of no value for specific distinction. One, however, does appear to me of some importance; and that is the form of the orbital plate of the frontal, so decidedly narrower at the outer end in the Javan cranium than in the three specimens from Europe; but it is possible that even here age may cause the difference. Eschricht has laid great stress upon the little dependence that can be placed upon the proportions of the bones of the head in making out the specific characters of Whales. It is rather curious that the tympanic bones, though agreeing in general form, are actually smaller in the Java than in the Zuyder Zee skeleton, being less in length by 0.″3, and in breadth by nearly the same amount....

"On the whole I have no hesitation in rejecting the name of *gigas* for this Java specimen, and, on account chiefly of its peculiar habitat, have some difficulty in placing it with *laticeps*. The question can only be definitely solved when far more is known of the habits and wanderings of the Cetacea than at present. The tendency of modern naturalists is decidedly to the idea that the geographical range of each species is much more strictly limited than was formerly supposed. Even Eschricht, who at one time strongly held the opposite opinion, and maintained that some species were cosmopolitan, was, as Prof. Van Beneden informs me, decidedly changing his views before his lamented death. We have, however, here an important alternative: either a species of Whale found in the North Sea, between the North Cape and the south coast of England, is found also on the coast of Java, without being known (at present at least) in any intermediate locality, or, on the other hand, in the specimen which I now bring

before the notice of this Society we have a species new to science. As I know that the latter opinion will be adopted by many cetologists, I propose to call this specimen provisionally by the name of *schlegelii*, in honour of my distinguished friend, by whose influence the specimen has been made accessible to European naturalists, and who has himself made valuable contributions to this department of zoology" (*l. c.*, pp. 407–408).

In 1876, Prof. Paul Gervais published a description and plates of a skull which the Paris Museum had received from Japan and concluded that it and the Java specimen in the Leyden Museum named *B. schlegeli* by Flower belonged to the same species. Six years later Sir Wm. Turner discussed the question of the identity of *B. borealis* and *B. schlegeli* in a paper upon a whale captured in the Firth of Forth and says: "The comparison which I have so far made of the Bo'ness whale with other specimens has been with skeletons admittedly those of *B. borealis*, and obtained in the North Atlantic. But in the Leyden Museum is a skeleton brought from the north-west coast of Java, named, after Professor Schlegel, *Balænoptera Schlegelii*, which Professor Flower, who first described it, regarded as closely allied to, if not specifically identical with, *B. borealis*, though, on account of its *habitat*, he had a difficulty in placing it with *borealis*. This skeleton was more perfectly ossified than in my specimen, and belonged to an animal probably about 45 feet long. I have compared my skeleton with Professor Flower's description and figures, and with the additional description and illustrations of its skeleton in pl. xiv and xv, and on p. 221 of the *Ostéographie des Cétacés*, and without doubt the resemblance is in many particulars very striking. . . .

"At the time when Professor Flower wrote his description, there was a greater tendency, on the part of cetologists, to limit the area of distribution of the individual species of cetacea, than now exists, and to confer specific value upon specimens which, though in many respects similar in characters, yet came from distant seas. The wider range of distribution of some of the species of the marine mammals is now more generally recognized, and the remoteness of the *habitat* of Schlegel's *Balænoptera* ought not, if the anatomical arrangements correspond, to bar its association with *B. borealis*." [1]

At the time Professors Van Beneden and Gervais published their great work, the 'Ostéographie des Cétacés,' they compared in detail the skeleton of *Balænoptera schlegeli* with that of *B. borealis* and came to the conclusion that the former was not specifically identical with the latter. Their opinion was based upon certain osteological differences which are summarized in the following paragraph:

" M. Flower a soigneusement comparé ce squelette de Java avec ceux d'Europe, et il reconnaît qu'il est difficile de déterminer les caractères par lesquels il diffère de la *Balænoptera borealis*. Ce que M. Flower trouve de plus caractéristique, c'est que la portion sus-orbitaire du frontal est plus étroite dans le crâne de Java que dans la borealis d'Europe.— Nous croyons pouvoir ajouter que les os propres du nez sont plus longs et plus étroits à la base dans la *Balænoptera Schlegelii*, et que l'occipital est notablement plus large à la base, moins étendu en avant et ne présente pas cette forme lobeé dans la partie qui recouvre les os frontaux.— Nous trouvons des différences également dans le maxillaire inférieur, dans les vertèbres cervicales et le sternum. Enfin les apophyses épineuses des dorsales et des lombaires nous paraissent plus longues et plus fortes.

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[1] Journ. Anat. and Phys., Vol. XVI, 1882, pp. 483–484.

"Il est inutile de faire remarquer, que le squelette de Java, qui indique une longueur au moins de 45 pieds, dépasse notablement la taille de la *Balænoptera borealis* ou *laticeps*, qui n'atteint pas au delà de 35 pieds, et qu'au lieu de 13 côtes comme la *Balænoptera borealis*, cette espèce en a 14" (*l. c.*, pp. 224–225).

In the section of this monograph devoted to 'Ostéology' the points of difference indicated by the authors of the 'Ostéographie' have been considered and I believe it has been demonstrated that none are of specific importance; moreover, in later years both authors of the 'Ostéographie' came to believe in the cosmopolitan distribution of the Balænopteras and to realize that many of the characters of *B. schlegeli* which appeared to be of specific value were due to individual or other variations and were of but little importance.

Prof. Van Beneden expressed his later views in the following words, quoted from his 'Histoire Naturelle des Balénoptères' published in 1888: "Contrairement aux Baleines véritables, les Balénoptères sont probablement toutes cosmoploites, et on trouve les quatre formes de nos régions septentrionales, aussi bien dans l'Atlantique méridonale, que dans l'océan Pacifique, la mer des Indes et l'océan Austral" (*l. c.*, pp. 11–12).

In 1891, although describing a skeleton from the vicinity of Cape Horn as *B. schlegeli*, Dr. H. P. Gervais repeatedly states that he considers this species identical with *B. borealis*. He concludes his paper as follows: "La découverte de ce squelette, appartenant à une espèce qui n'avait pas encore été signalée dans les mers du Sud, présente donc un grand intérêt scientifique. Elle permet en effet de compléter la liste des Mysticètes qui vivent dans ces parages et d'établir d'une façon certaine que tous les Baleinoptères qui fréquentent les mers de l'hémisphère nord sont représentés dans l'hémisphère sud avec des caractères identiques. Ce fait avait déjà été constaté pour les *Balænoptera musculus* et *B. rostrata;* il nous a été permis de le mettre en lumière pour la *Balænoptera Sibbaldii* ainsi que pour la B. Schlegelii, espèce qui n'est autre chose que la *B. borealis*, nom auquel on devrait substituer désormais celui de *B. laticeps*, proposé autrefois par le Dr. J. Gray et qui rappelle un des caractères saillants de ce Cétacé, celui d'avoir un crâne proportionellement plus large que celui de tous les autres Baleinoptères" (*l. c.*, pp. M. 54–M. 55).

Dr. J. Liouville in his book on the cetaceans of the Antarctic published in 1913 was the first author to formally include *B. schlegeli* in the synonymy of *B. borealis*. In his introduction to the species he says: "L'Expédition française l'a rencontré à diverses reprises, principalement autour des Shetlands Australes: rien dans son aspect extérieur, rien dans ses mœurs, rien dans les coupes de fanons qu'en retiraient les baleiniers, n'autorisait à le nommer autrement que *B. borealis* Lesson" (*l. c.*, p. 101).

It is evident from the matter quoted above that those cetologists who critically considered the relationship of *B. schlegeli* and *B. borealis* were unanimously of the opinion that the two were specifically identical and I have little doubt that had Prof. Flower studied the Java skeleton in the later years of his life, he would not have considered that its *geographical position* prevented its association with *B. borealis*.

Doubtful Species related to *B. borealis*.

Balænoptera edeni Anderson.

In his great work, 'Results of the Yunnan Expeditions,' Dr. John Anderson [1] described a whale from the Bay of Bengal as *Balænoptera edeni*. The animal had been stranded in a wide inlet and the skull and certain bones of the skeleton which were recovered and transferred to the Indian Museum, Calcutta, proved that the specimen was in the 'adolescent' stage.

In discussing *B. edeni* I shall continue to use the name *B. schlegeli* for the Java specimen for the sake of convenience, although I believe it has been satisfactorily demonstrated in the preceding pages that *B. borealis* and *B. schlegeli* are synonymous.

Dr. Anderson says in describing *B. edeni*:

"The leading characteristics of the skull, pl. xliv, as compared with the skulls of known *Balænoptera*, are the great length of the maxillary portion and the *little downward shelving of the upper surface* of the maxillæ....There can be no doubt about this Whale being closely allied to *B. schlegeli*, but I cannot reconcile the form of the skull with the figure of the skull of the type given by Van Beneden and Gervais. I have reproduced three drawings taken from a photograph of the skull (pl. xliv, figs. 1, 2, 3), and it will be observed that although it bears a strong resemblance to the skull of *B. schlegeli*, it differs from it materially in the character of its beak, which is long and slender, and much more forwardly directed than the beak of *B. schlegeli*, and also in the *absence of the curvature of the external margin of the maxilla* which distinguishes *B. schlegeli*. The beak of the latter is also *much more downwardly shelving at its base* than is the maxillary of this form from the Bay of Bengal, and the skull has greater depth, as is shown by the circumstance that the orbital process of the maxilla in *B. schlegeli* is below the level of the base of the skull, whereas in this skull it is above it. The opening of the posterior nares also is much narrower than in *B. schlegeli*. The length of this skull compared with the type of *B. schlegeli*, is only about three inches longer, but notwithstanding the additional length it has less breadth and less occipital length associated with a shorter maxilla, less maxillary breadth, and a narrower beak. Its lower jaw also differs considerably in its length from that of *B. schlegeli*, being nearly 4 inches shorter, although its skull is longer than the skull of that type, which, according to Professor Flower's measurement, has the lower jaw longer than its skull, whereas in Van Beneden's and Gervais figure the lower jaw is represented as shorter than the skull. The lower jaw of *B. schlegeli* is much deeper and heavier than the jaw of this Whale, as is seen by the accompanying table of measurements, and *the curve also differs materially*, the latter being much more outwardly curved than the former"(*l. c.*, pp. 554–555).

It will be noticed that in the first portion of the quoted matter, Dr. Anderson says that in comparison with other known *Balænoptera* the great length of the maxillary portion of *B. edeni* is remarkable, and later states that "it has less breadth and less occipital length associated with a shorter maxilla" than has *B. schlegeli*. The fact is that the measurements of both the Sittang and Arakan specimens of *B. edeni* do show a relatively shorter beak than *B. schlegeli*, but my specimen from Japan has a beak of very nearly the same proportional length as the two India skulls. Also the difference between the ratios of the length of the beak to the total length of

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[1] Anatomical and Zoological Researches: comprising an account of the Zoölogical Results of the Two Expeditions to Western Yunnan in 1868 and 1875. London, 1878, pp. 553–564, pl. xliv.

the skull of *B. schlegeli* and the Sittang skull is 5.3% and in three skulls of *B. borealis* from Europe it is 4.5%; this is certainly not beyond the range of individual variation.

The same is true of the proportional breadth of the beak at the base. The difference between this ratio in *B. schlegeli* and the Arakan skull is 8.1%, and the individual variation in the three skulls of *B. borealis* from Europe amounts to 8.9%; moreover, my Japan specimen is intermediate between the Java and India skulls. The apparently narrower beak of each India specimen is not constant throughout its entire length, as the proportional breadth at the middle is very similar in the Java, Sittang and Arakan skulls.

The proportional breadth across the squamosals is less in the Japan skull than in the Java, Sittang and Arakan specimens. Between the Java and Arakan skulls the difference is 2.4%, while in the series from Europe there is a variation of 5.9%.

Somewhat similar conditions are presented in the proportional breadth of the maxillæ across the orbital processes, for the individual variation in the European series amounts to 12.8%, which is far greater than the differences between the skulls from India and Java.

Although the differences in proportion between the skulls from Java and India are not beyond the range of individual variation I must confess that I consider measurements to be of very little value in distinguishing closely allied species.

The breadth of the outer end of the orbital process of the Sittang and Arakan specimens agree closely and differ considerably from the narrow orbit of *B. schlegeli*. I am inclined to believe that the very narrow orbit of which Flower has spoken in *B. schlegeli* is an individual difference which will not be found to be constant in other whales from the same waters.

Flower gives the mandibular length in a straight line of *B. schlegeli* as 117 inches, while the skull length, straight, is only 116 inches; there is of course, some mistake in the record of this measurement. The figure in the 'Ostéographie des Cétacés' (pll. xiv–xv) shows the mandible in its proper proportions as somewhat shorter than the skull.

The points which Dr. Anderson makes regarding the little downward shelving of the upper surface of the maxilla and the forwardly directed beak of *B. edeni* are of considerable importance if they have not been exaggerated in the drawings. Both characters are readily apparent when comparing the figure of the skull of *B. edeni* with either the drawing of the skull of *B. schlegeli* or the photographs of my Japan cranium. If Dr. Anderson had not called attention to these points with the specimen itself at hand I should be inclined to doubt the accuracy of the drawing since both features are so unusual.

Dr. Anderson says that the skull of *B. edeni* is distinguished by the "absence of the curvature of the external margin of the maxilla which distinguishes *B. schlegeli*." This difference is so slight that it certainly is not a character of value and, moreover, the edges of the maxilla in the Japan skull are almost straight.

The skeleton of *B. edeni* presents some interesting features. The vertebral formula is given as C7, D10, L14, Ca21, but there was almost certainly some error in the determination of the dorsal series, for it is exceedingly unlikely that the specimen had only 10 pairs of ribs. Dr. Anderson says of the atlas of *B. edeni:* "The notch for the reception of the odontoid swelling of the axis lying below it is much contracted. The transverse process of the atlas is well-defined, rather long, but basally shallow; very different from the deep wing-like twisted transverse process of *B. schlegeli*, as figured and described by Flower. The articular surfaces for the axis practically meet below, being separated from each other by 0.25 inch in the dried bone, and have thus no facet between them as in *B. schlegeli*" (*l. c.*, p. 558).

The figure of the atlas of *B. edeni* shows a bone quite unlike that of either the Java or my Japan specimen, the most important difference appearing, as Dr. Anderson has remarked, in the transverse processes and facets. It is difficult to believe that this can be within the range of individual variation.

The axis and remaining cervicals do not show any characters of especial importance. Dr. Anderson has remarked that the 7th vertebra of *B. edeni* differs from that of *B. schlegeli* in the presence of a well-defined nodular rudiment of the inferior transverse process. My work upon the California Gray Whale (*Rhachianectes glaucus*), however, has demonstrated that the presence or absence of the lower processes of the 7th vertebra, at least in that species, is purely an individual character. And since it has been shown that in *B. borealis* the formation of a complete ring in the cervicals between the axis and the 7th by the ossification of the transverse processes is not entirely dependent upon the age of the specimen, it would appear that the presence of a rudimentary inferior transverse process on the 7th vertebra is of no importance.

The descriptions and figures of the remaining vertebræ of *B. edeni* agree very closely with those of my Japan whale, and none of the points of difference from *B. schlegeli* which Dr. Anderson detects are to be seen in the Japanese specimen.

Dr. Anderson states that a fragment of the left first rib, comprising a portion of the shaft and of the head and the tubercle, was preserved and that the rib was single-headed. This is very interesting since, except for a single specimen, all skeletons of *B. borealis*, including the Java whale, have had bifurcated first ribs.

The figures of the 6th rib, humerus, and hyoid bones do not differ in any important particulars from the corresponding portions of the skeleton from Japan.

While from the foregoing discussion of *B. edeni* it is evident that this species is either identical with, or closely allied to, *B. borealis*, I feel that without further information no positive assertions can be made regarding it. The characters of the skull and atlas which have already been pointed out are certainly of importance and to my mind can not be disregarded or explained upon the grounds of individual variation. Since Dr. Anderson especially noted them from the specimen itself it would appear that they have not been exaggerated in the published figures. It is highly desirable that this skeleton be reëxamined in the light of present knowledge of the large Cetacea, but until this is done, or other specimens have been obtained from the same waters, it appears to me that it is wisest to leave *Balænoptera edeni* as a very doubtfully established species.

It is especially unfortunate that Mr. Ørjan Olsen, who has recently described *Balænoptera brydei* from South African waters, did not furnish osteological details with his external descriptions. Further information regarding both these whales will be awaited with interest since it is not improbable that the two may prove identical, or both be synonyms of *B. borealis*. At present, however, the wisest course is to leave them as they are.

Balænoptera brydei Olsen.

In a Norwegian newspaper 'Tidens Tegn,' dated November 12, 1912, Ørjan Olsen, Esq., described a whale from the coast of South Africa, naming it *Balænoptera brydei*, and in 1913 republished his account, with illustrations, in the 'Proceedings of the Zoological Society of London,' pages 1073–1090.

Mr. Olsen states that "when the Norwegian whalers started their trade in South Africa

they were doubtful as to whether they should consider this species to be a fin-whale or a 'sei'-whale (*B. borealis*). In Durban many of them preferred to call it a 'sildehval' (herring whale), because it hunted herrings. But as the colour and size were most like that of the 'seihval,' they generally called it so, although they knew that it was not the proper 'seihval'" (*l. c.*, pp. 1085–1086).

Twelve specimens were examined by Mr. Olsen during his stay at Durban on the East, and Saldanha Bay on the West coast, but he remarks that the largest numbers were captured near the latter station.

The account is confined to the external anatomy and habits and it seems advisable to consider the relationship of this species to *B. borealis* in the light of the material which has been gathered in the preparation of the present monograph. The points in which Mr. Olsen believes *B. borealis* and *B. brydei* differ, and in which I do not concur, will be first considered.

The average total length of *B. brydei* is given as 13 meters, or a little over, and the maximum as almost 15 meters. My tables show that the average for *B. borealis* is about 13.30 meters and that of the Pacific specimens the maximum is 15.24 meters; for the Atlantic it is 17.37 meters but this is very extraordinary. Thus in respect to size *B. borealis* and *B. brydei* are alike.

The distance from the tip of the snout to the blowhole in *B. brydei* is given as 15.3% of the total length; in *B. borealis* it averages practically the same.

The distance from the tip of the snout to the flippers in *B. brydei* is 30.6% to 32.7%: in *B. borealis* my measurements were taken to the posterior edge of the pectoral instead of the anterior, and the average distance is about 34%; about 32% when taken to the anterior edge of the fin.

The distance from the tip of the snout to the anterior edge of the dorsal fin of *B. brydei* is 65% to 70% of the total length; of *B. borealis* from the snout to the *posterior* edge of the fin it is 67.94% to 73.22%. This equals about 65% to 71% when taken to the anterior edge, as in the case of *B. brydei*.

The length of the pectoral fin from the tip to the axilla of *B. brydei* is given as 8% to 10.6%; in *B. borealis* this measurement is 8.21% to 11.26%.

The greatest breadth of the pectoral fin of *B. brydei* is 2.6% to 2.7% of the total length, while in *B. borealis* it is 2.5% to 3.01%.

The distance from the notch of the flukes to the anus in *B. brydei* is 27.2%; in *B. borealis* it is 24.6% to 28.4%.

After learning what an enormous amount of variation in proportions exists among individuals, all of which I have personally measured, I am coming to regard measurements as a basis for specific distinctions as of much less importance than I formerly supposed them to be.

None of the differences in proportion of the two species as shown above are beyond the range of individual variation, but, on the contrary, the agreement is remarkably close. Olsen calls attention to the facts that the dorsal fin of *B. brydei* is placed further back and that the anus is situated more posteriorly than in *B. borealis*, but it will be seen that the proportional measurements do not bear out these statements; neither is he correct in saying of *B. brydei:* "The *eyes* are comparatively larger than in the fin-whale, and placed just above the angle of the mouth, in the same place as in the fin-whale, but further back than in *B. borealis*." In the latter species, as I verified from a fœtus, the eyes are placed directly above the corners of the mouth.

The color of *B. brydei*, as far as I can learn from Mr. Olsen's description, is somewhat like

that of several specimens of *B. borealis* which I examined in Japan. The gray throat with the lighter belly I have seen in two or three individuals of *B. borealis* at Aikawa, although it is rather unusual, and the "bluish gray belt running across the stomach" is of course a character of the Sei Whale. Olsen mentions several peculiarities of the color of *B. brydei* which I have never observed in *B. borealis* but which cannot be considered to be especially important. He says: "In the dark area below the flippers some isolated white spots may sometimes be seen; similar white patches are occasionally distributed along the centre of the under side of the lower jaw, and more rarely a small white line runs out from the white area on the belly to within one metre or less behind the tip of the lower jaw. On the border between the dark colour of the throat and the white belly there are often a number of bluish gray patches or stripes, and these are more thickly sprinkled towards the front, and then gradually form a more uniform dark color in front of the angle of the mouth" (*l. c.*, p. 1081). These are without doubt individual peculiarities which probably would not be found in the majority of specimens.

The points in which Mr. Olsen believes *B. brydei* and *B. borealis* differ, and with which I concur, will now be considered.

The dorsal fin is said to be of very moderate size, smaller than in the Finback (*B. physalus*) and very different from the large dorsal of *B. borealis* or *B. acuto-rostrata;* its vertical height is given as about 2.2% to 2.4% of the total length, which is less than the *average* for *B. borealis* although five of the Pacific specimens which came under my examination had dorsals from 2.18% to 2.65% of the total length of the animals. Nevertheless it appears to me significant that Mr. Olsen has commented upon the smaller size of the dorsal fin of *B. brydei*, since in *B. borealis* it is one of the most striking characters of the species.

The statements that the body of *B. brydei* resembles *B. physalus*, and is of less powerful build than that of *B. borealis* or *B. acuto-rostrata*, and that the tips of the snout and of the lower jaw are more acute than in *B. borealis*, are interesting.

But what appears to me to be the two most important characters presented by Olsen as distinguishing *B. brydei* from *B. borealis* are the extent of the ventral furrows and the character of the baleen. Mr. Olsen states, and his photographs show, that the ventral furrows of *B. brydei* extend posteriorly to the umbilicus, as in both *B. physalus* and *B. musculus*, whereas in *B. borealis* the furrows end on the abdomen at a point half way between the tip of the pectoral fin laid back and the umbilicus. This is a very important fact and one which can hardly be explained on the grounds of individual variations.

A second important character is the baleen. Mr. Olsen says: "The *baleen* of *B. brydei* is very distinctive of this species, and compared with the size of the whale, very small. The longest baleen-plates measured by me, and from a female specimen of nearly 15 metres in length, were only 0.49 metre long (the bristles not included), while baleen from a Rudolphi's whale of the same size attains a length of about 0.70 metre. The baleen differs remarkably in shape from that of *B. borealis;* whereas the baleen-plates of *B. borealis* are very long and slender, those of *B. brydei* are comparatively very broad and curve inwards along the inner margin....

"The *bristles* are longer than in *B. borealis* and thick and stiff, not curling, and on the whole of very strong construction, even comparatively stronger than in the fin-whale. Their average thickness is about 1 mm.; a little more at the distal end of the baleen, and perhaps a little less at the base....

"The *colour* of the baleen in the anterior part of the jaws, and about 0.70 metre backwards

from the tip of the snout, is as a rule more or less white, sometimes perfectly white, but more frequently with grey stripes; further back it is greyish black, and after death perfectly black. The bristles are grey, whitish grey or yellowish in the anterior part of the mouth. The colour of the baleen is on the whole rather similar to that of the fin-whale, and the whalers told me that in some cases they had even seen the white colour asymmetrically placed, as in the fin-whale. The baleen might in one jaw be white over a comparatively large area, and in the other jaw fairly uniformly dark-coloured" (*l. c.*, pp. 1079–1080).

As Mr. Olsen says, the baleen plates of *B. borealis* usually measure about 70 cm., and in seven adult specimens which I examined in Japan, 73 cm. was the average. Baleen measuring only 49 cm., as in the case of *B. brydei*, is remarkably short, and his photographs show how strikingly different in shape is the baleen of the two species. If the figured baleen-laminæ of *B. borealis* and *B. brydei* were taken from *corresponding portions* of the baleen row, the whalebone of the two species could not easily be confused. His photographs also show the remarkable difference in the character of the baleen bristles of *B. brydei* and *B. borealis*; this he has described in the portion of his account quoted above.

As far as can be judged from the external characters given by Mr. Olsen it appears to me that *B. brydei*, although very similar in proportions and color and closely allied to *B. borealis*, is probably distinct from that species. It is to be regretted that no osteological details are supplied in Mr. Olsen's account, and cetologists will look forward to a fuller description of the anatomy of this interesting whale, for until more information is given its general acceptance will be only provisional.

Conclusions.

In this section is given a summary of the most important conclusions reached in the foregoing pages:

1. The Sei Whale, *Balænoptera borealis* Lesson, has a cosmopolitan distribution, and the names *Balænoptera arctica* Schlegel and *Balænoptera schlegeli* (Flower) which have been applied to the Pacific Sei Whale are synonyms of *B. borealis* Lesson.

2. *Balænoptera borealis* is now being taken, or has been recorded, from the following localities: In the North Atlantic from the coasts of Europe, Newfoundland, Massachusetts, and Labrador; in the South Atlantic along the shores of South Africa and of South America from latitude 20° S. to the Shetland Islands. In the North Pacific from Japan, and possibly from Vancouver Island; in the South Pacific from Java and Chili.

3. In the North Atlantic and North Pacific the Sei Whales appear to have more or less regular migrations, arriving at and leaving certain localities at about the same time. In both the North Atlantic and North Pacific June and July are the months of greatest abundance, but a few individuals spend the winter along the coasts of Japan.

4. *Balænoptera borealis* has a roving disposition and travels great distances, at times appearing suddenly in localities where it has never before been known. *B. borealis* is apparently indifferent to temperature and its wanderings probably are not greatly influenced by warm or cold water.

5. Parasites taken from Sei Whales killed near Japan have been found to represent an Antarctic species and indicate that *B. borealis* at times travels from the South Atlantic or Antarctic waters to the North Pacific and North Atlantic.

6. The small oval spots which are found in greater or less abundance on the bodies of Sei Whales, and heretofore considered to be a peculiarity of coloration, are the scars left by a parasitic Copepod of the genus *Penella*.

7. Although in nearly all localities the food of the Sei Whales appears to consist of small crustaceans, at times, when near the Japan coast, it eats small fish. The Japanese vernacular name for *B. borealis* is *Iwashi Kujira* (Sardine Whale).

8. The color variation of *B. borealis* is enormous, and is apparently purely individual, not being influenced by sex or age.

9. The average length of *B. borealis* is about 1249 cm. (42′); the maximum size yet recorded for specimens from the Pacific is 1615 cm. (53′), and from the Atlantic 1737 cm. (57′). A female 762 cm. (25′) in length taken in Japan was pregnant, according to data furnished by the whaling company; therefore sexual maturity must be reached long before the animal is fully grown. Since the average size of the Sei Whale is about 1280 cm. (42′) and in two specimens of 44′ and 45′ in length the skeletons show that the animals were in the adolescent stage, this species must reach adult size at an early period. This substantiates the theory that baleen whales grow very rapidly after birth until practically their full size has been reached.

10. The normal vertebral formula for *B. borealis* appears to be C7, D14, L13, Ca22 or 23.

11. There is a certain amount of individual variation in the phalangeal formula of the pectoral limbs.

12. The double-headed first rib consists of a cervical rib which has ankylosed with the true first rib. All specimens so far recorded, except Turner's Firth of Forth skeleton, exhibited bifurcated first ribs, and in this species the presence of cervical ribs appears to be the rule.

13. *Balænoptera edeni* Anderson and *Balænoptera brydei* Olsen are species very closely related to *Balænoptera borealis* Lesson or identical with it; their status can not be definitely determined until further information concerning them is available.

Specimens of *Balænoptera borealis* in Museums.

Berlin Anatomical Museum; type skeleton from Holstein, 1819.

Leyden Museum; skeleton from Moniken-Dam, Zuyder Zee, 1811.

Leyden Museum; skeleton from Java, type of *B. schlegeli* (Flower), 1864.

Royal Museum of Brussels; skeleton from East Finmark, 1861.

Anatomical Museum of Edinburgh; skeleton from the Firth of Forth, Scotland, 1872.

Museum of the Royal College of Surgeons, London; skeleton from the coast of England.

British Museum (Natural History); skeleton from the River Crouch, England, 1883.

Museum of Cambridge University, Cambridge, Eng.; skull and one scapula from the mouth of the River Clyde.

Bergen Museum, Norway; 2 skeletons; one from Loffoden Islands and one from Altenfjord, west Finmark, 1861.

Museum of Christiana, Norway; a fœtus, and a skull and scapula.

Tønsberg Museum, Tønsberg, Norway; skeleton from Mehavn, Finmark, 1898.

University Museum, Copenhagen, Denmark; skeleton from the Faroe Islands, Scotland, 1907.

Paris Museum; a skull from Japan, and an incomplete skeleton from Staten Island, near Cape Horn.

Museum of Bayonne, France; a skeleton from Biarritz, 1874.

American Museum of Natural History, New York; a skeleton from Aikawa, north Japan, 1910.

Brooklyn Institute of Arts and Sciences, Brooklyn, New York; some blades of baleen from Newfoundland.

Museum of Comparative Zoölogy, Cambridge, Mass.; one jaw bone, several blades of baleen, and two ribs from Chatham Light, Mass., 1910.

ILLUSTRATIONS.

PLATES.

Plate XXIX.

Fig. 1. Side view of a spout; full height.
Fig. 2. Posterior view of a spout; full height.
Fig. 3. Low spout.
Fig. 4. Spout of a Sei Whale fast to a ship.
Fig. 5. " " " Finback Whale.
Fig. 6. " " " Sei Whale fast to a ship.
Fig. 7. " " " " " " " " "
Fig. 8. " " " " " " " " "

Plate XXX.

Fig. 1. Spout of a Sei Whale fast to the ship.
Fig. 2. Sei Whale fast to ship; spout dissolving.
Fig. 3. Sei Whale which has just spouted.
Fig. 4. Sei Whale's nostrils dilated during inspiration.
Fig. 5. A Sei Whale pursuing a school of sardines.
Fig. 6. A Sei Whale which had charged the ship; the blubber of the snout and right lip, which was torn by the propeller, is shown.

Plate XXXI.

Fig. 1. Sei Whale struck by a harpoon.
Fig. 2. Side view of a Sei Whale diving.
Fig. 3. Oblique posterior view of a Sei Whale diving.
Fig. 4. Finback Whale sounding.
Fig. 5. Sei Whale which has just spouted.

Plate XXXII.

Fig. 1. Oblique ventral view of Sei Whale No. 41.
Fig. 2. " " " " " " " 34, showing tongue.
Fig. 3. Front view of Sei Whale No. 38.
Fig. 4. " " " " " " 35.
Fig. 5. " " " " " " 43.
Fig. 6. Oblique ventral view of Sei Whale.

Plate XXXIII.

Fig. 1. Sei Whale No. 34, partly in the water.
Fig. 2. Sei Whale No. 38, partly in the water.
Fig. 3. Ventral view of Sei Whale No. 26.
Fig. 4. Sei Whale No. 43, partly in the water.
Fig. 5. Oblique posterior view of Sei Whale No. 26.
Fig. 6. Young Sei Whale being flensed.

Plate XXXIV.

Fig. 1. Throat and breast of Sei Whale No. 36.
Fig. 2. " " " " " " " 26.
Fig. 3. " " " " " " " 43.
Fig. 4. Breast of Sei Whale No. 34.
Fig. 5. " " " " " 35.
Fig. 6. Side view of throat of Sei Whale No. 63.

Plate XXXV.

Fig. 1. Ends of furrows of Sei Whale No. 35, showing the 'anchor-like' white marking.
Fig. 2. Umbilicus of Sei Whale No. 35.
Fig. 3. Breast of Sei Whale No. 36, showing the 'anchor-like' white marking.
Fig. 4. Posterior portion of Sei Whale showing 'patch-like' markings.
Fig. 5. Umbilicus of Sei Whale No. 35; cut by the right edge of the photograph.
Fig. 6. " " " " " " under the rope crossing the body.

Plate XXXVI.

Fig. 1. Ventral view of female Sei Whale, showing genitalia and mammæ.
Fig. 2. Mammæ slits and vulva partially dilated, showing clitoris of female Sei Whale No. 35.
Fig. 3. Male genitalia of Sei Whale No. 36, showing rudimentary mammæ, concealed in the two short oblique slits just posterior to the penis slit.
Fig. 4. Posterior side view of Sei Whale No. 36.
Fig. 5. Female genitalia of Sei Whale.
Fig. 6. Male genitalia of Sei Whale No. 34.

Plate XXXVII.

Fig. 1. Anterior back and head of Sei Whale No. 38.
Fig. 2. Peduncle of Sei Whale.
Fig. 3. Gray markings on the peduncle of Sei Whale No. 41.
Fig. 4. Back and pectoral fin of Sei Whale No. 26.
Fig. 5. Breast of Sei Whale No. 63 — very dark.
Fig. 6. Gray markings on peduncle of a Sei Whale. The white scars have been produced by the parasite *Penella antarctica*.

Plate XXXVIII.

Fig. 1. View of dorsal portion of head of a Sei Whale. The elongated depression in the left side of the rostrum is probably a harpoon-scar.
Fig. 2. Eye of Sei Whale No. 35.
Fig. 3. View of inner edges (bristles) of baleen rows of Sei Whale No. 26.
Fig. 4. Blowholes of Sei Whale No. 34.
Fig. 5. " " " " " "
Fig. 6. Inner view of a single baleen row after removal from Sei Whale No. 2.

Plate XXXIX.

Fig. 1. View of the anterior edge of the flukes of a Sei Whale.
Fig. 2. Right pectoral fin of Sei Whale No. 34.
Fig. 3. " " " " " " " 43.
Fig. 4. Inferior surface of flukes of a Sei Whale.
Fig. 5. " " " " " " " " No. 26.
Fig. 6. Outer surface of pectoral fin of Whale No. 19.
Fig. 7. Inner " " " " " " " "

Plate XL.

Fig. 1. Lateral view of a Sei Whale showing the most usual type of coloration.
Fig. 2. Ventral view of a Sei Whale showing the most usual type of coloration.
(Drawings by J. Henry Blake, under the direction of Roy Chapman Andrews.)

Plate XLI.

Fig. 1. Dorsal view of the skull of the specimen from Japan, No. 34871, in the Am. Mus. Nat. Hist.
Fig. 2. Ventral view of the same skull.

Plate XLII.

Fig. 1. Lateral view of skull of the specimen from Japan, No. 34871, in the Am. Mus. Nat. Hist.
Fig. 2. Outer view of the right ramus of the mandible of the same skull.
Fig. 3. Inner view of the right ramus of the mandible.

TEXT FIGURES.

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