ON A SPECIMEN OF THE RARE FIN WHALE, BALAENOPTERA EDENI ANDERSON, STRANDED ON PULI SUGI NEAR SINGAPORE

by

Dr. G. C. A. JUNGE
(Rijksmuseum van Natuurlijke Historie, Leiden)

A Fin Whale was cast ashore on the coast of Pulu Sugi, one of the smaller islands of the Rhio Archipelago between Singapore and the Sumatran coast in July 1936. Thanks to the generosity of Dr. K. W. Dammerman, former Director of 's Lands Plantentuin at Buitenzorg, and the unvaluable help of the late Mr. F. N. Chasen, Director of the Raffles Museum, Singapore, the specimen was saved and after cleaning sent to the Rijksmuseum van Natuurlijke Historie, Leiden. It was received in June 1939.

The length of the skeleton was slightly over 12 m and it must have belonged to an adult specimen, for in all vertebrae the epiphyses are coalesced completely with the rest of the vertebral body (Wheeler, 1930). It was clear that the specimen belonged to a *Balaenoptera*. It was too large for a *B. acutorostrata* and too small for a *B. physalus* and nearly related to *B. borealis*, but there were some important characters in which it differed from this species. The preliminary examination showed that especially the flat rostrum, the form of the part of the skull between the palatine bones and the occipital condyles were markedly different and also that the form of the atlas and the backward direction of the spinous processes of the dorsal and lumbar vertebrae did not agree with *borealis*. All these characters pointed to *B. edeni*, a species from the Indian region still insufficiently known, and also to *B. brydei*, though the latter was only known from South African waters. The stranding of the Pulu Sugi Whale offered a good opportunity to make a close comparison of *edeni* and *brydei* and if possible to clear up the relation between these two species. *B. edeni* was described by Anderson (1878), who gave a description of the skeleton from a specimen stranded in Thyabu Choung off the Gulf of Martaban. *B. brydei* was described by Olsen in a Norwegian newspaper Tidens Tegn in 1912. A full description of the external characters and biology of this species was given in the Proceedings of the Zoological Society by the same author in 1913.

It was not until 1931 that a careful description of the skeleton by Lönnberg appeared. Andrews in his monograph of *B. borealis* (1916) mentioned both species, which he regarded as nearly related to *borealis,* though probably distinct. In 1918 Andrews examined rather hastily the skeletons of *edeni* in the Calcutta Museum and came to the conclusion that it was difficult to believe that the differences between the skeletons of *edeni* and *borealis* were individual and he mentioned the possibility that *edeni* was identical with *brydei,* but at that time only the external characters of *brydei* were known. As far as I am aware nothing more has been added since to our knowledge about *edeni* and we are still waiting for particulars about the external anatomy of this whale.

During a visit to the British Museum I was able to examine a skeleton of *B. brydei* from Saldanha Bay, South Africa and an incomplete skeleton of *B. edeni* (without skull), presented by Mr. Anderson. I am much indebted to Dr. F. C. Fraser, who gave me all the help I needed and to whom I am indebted for the splendid photographs of the *B. brydei* specimen. In the South African Museum a specimen of *B. brydei,* also from Saldanha Bay, is found and in the Calcutta Museum two specimens of *B. edeni* are preserved, one of them being the type specimen. My sincere thanks are due to Dr. K. H. Barnard and Dr. L. D. Boonstra of the South African Museum and to Dr. M. L. Roonwal of the Zoological Survey of India, who gave me much important information about the specimens under their care.

Skull
(Pl. I, II, III fig. 1, IV, V, VI fig. 1)

When examining the skull of the Pulu Sugi specimen there is one feature, which strikes one immediately, the flat and straight forward pointing shape of the rostrum. The praemaxillaries, especially their posterior ends, are sunk in between the maxillaries, which together with the little downward curving of the maxillaries cause the flat appearance, when the skull is viewed laterally.

This is a difference from the skulls of *B. borealis* I saw. In these the praemaxillaries are strongly convex above and rise a good deal above the surface of the maxillaries. Moreover, in *borealis* the maxillaries are more strongly curved downward.

In these characters the specimen from Pulu Sugi is identical with Anderson's specimen of *edeni.* Anderson (1878, p. 554) calls the little downward shelving of the maxillaries one of the leading features of the skull of *edeni.* It is very clearly to be seen in Anderson's plate (l.c., plate XLIV fig. 2) and also in the photograph Dr. Roonwal kindly sent me from the skull of the type specimen of *edeni.*

TABLE I

Measurements

	brydei		*edeni*		
	Specimen		Specimen		
	British Museum	South African Museum	Pulu Sugi	Thyabu Choung Type	Arakan
Length of skull from tip praemaxillaries — back of condyles (straight). . . .	330	277	316	291	293
Greatest breadth of skull (squamosal). .	158	145	141	137	150
Breadth rostrum basally (straight) . . .	107	126	84	62	77.5
Breadth rostrum at its middle (straight).	68	60	62	61	70
Distance front of nasals to tip of praemaxillaries	224	225	225	–	–
Length nasal groove	± 69	43	± 65	–	–
Length praemaxillaries	± 242	212	245	–	–
Length maxillaries along upper surface.	237	170	233	–	185
Length of nasals mesially	18	11	18	–	–
Length of nasals laterally	22	30.5	23	–	–
Breadth of nasals in front.	15	24	14	–	–
Breadth of exposed parts of nasals behind	7	18	11	–	–
Breadth of frontal plane posterior to praemaxillaries	25	23.5	16	–	60?
Breadth of frontal wing laterally above orbits.	41	29	40	–	68.5?
Length of supraoccipital bone from foramen magnum	79	69	75	–	65
Breadth of occiput between squamosal sutures	107	97	95	–	–
Breadth across occipital condyles . . .	29	27	25	–	–
Length of mandible (straight)	314	264	303	287	290
Height of mandible at middle of its length.	24	20	19.5	–	21.5
Height of mandible at coronoid	41	37	37.5	32	36
Height of mandible at proc. articularis.	27	24	28.5	25	29
Greatest length of scapula	–	84	90–93	–	–
Greatest height of scapula	–	54	52–53	–	–
Length of humerus	37	35	34	–	–
Length of radius	65	–	65.5	–	–
Greatest length of ulna from olecranon.	62	–	67	–	–
Length of ulna between articulating surfaces	58	–	62–63	–	–
Breadth of sternum	–	27	19	–	–
Length of sternum.	–	16.5	31	–	–

In *brydei* there is some variation. Lönnberg (1931, p. 2) points to the fact that the rostrum of Bryde's Whale is flat and straight as compared with skulls of *borealis*. This feature is well shown in the side view of this skull (l.c., plate I fig. 1). In the specimen in the British Museum, however,

the rostrum is more curved to the rostral side. Here the praemaxillaries rise slightly above the surface of the maxillaries. In this specimen and in Lönnberg's the maxillaries are also slightly more curved to the lateral side.

Another difference between the specimen under consideration and specimens of *borealis* before me is that the ventral side of the maxillaries is much more concave in *borealis*. In the Pulu Sugi specimen the ventral side of the outer edge of the maxillaries is slightly bent down posteriorly and practically horizontal anteriorly. In *borealis* the outer edges are strongly curved down. The inner edges curve down in the Pulu Sugi specimen, but not so strongly as in *borealis*. The anterior part of the inner side of the maxillaries is concave in *borealis*, nearly straight in our specimen of *edeni*. In the specimen of *brydei*, which I saw in the British Museum the underside of the maxillaries is rather straight anteriorly, more curved posteriorly, but to a lesser degree than in a specimen of *borealis* from Portskewett, Monmouth, which I used for comparison.

In describing *edeni* Anderson (l.c., p. 555) points to its long and slender beak, a character which is also clearly to be seen in the drawing (l.c., plate XLIV figs. 1 and 3), and according to Anderson *edeni* differs in this character materially from *B. schlegeli* (= *borealis*). Andrews (1918, p. 106), who re-examined the specimens of *edeni* in the Calcutta Museum says that "the beaks of all three skulls are narrower at the base in proportion to the length and the breadth at the middle than those of *B. borealis* and consequently the beak has a somewhat different shape". Andrews thinks these characters of considerable importance.

In his description of the skull of *brydei* Lönnberg (l.c., p. 2) remarks on the other hand that the rostrum of Bryde's Whale compared with that of a Sei Whale is comparatively shorter and broader and gives some proportional measurements to show the difference. I give the same measurements of the material of *borealis* in the Leiden Museum, of the specimens mentioned by Lönnberg (1931), Andrews (1916) and Miller (1926). From the two latter the proportional measurements are taken from the plates. The measurements of *brydei* are given from the specimens in the British, Stockholm and South African Museums; and of *edeni* from two skulls in the Calcutta Museum and the specimen from Pulu Sugi (table II).

The table shows that the individual variation is large, but it can be said that the range of rostrum length is longer in *brydei* and *edeni* than in *borealis*, though there is overlapping. In *brydei* the rostrum basally is broader, in *edeni* it is generally more slender than in *borealis*. The rostrum at its middle is broader in *edeni* as well as in *brydei* than in *borealis*, which means the rostrum of *borealis* is more tapering distally. It is also straighter in outline in *borealis* than in *brydei* or *edeni*.

TABLE II

	borealis						*brydei*			*edeni*			
	Netherlands R.M.N.H.	Norway R.M.N.H.	Java R.M.N.H.	S. Georgia after Lönnberg	Florida after Miller	Japan after Andrews	S. Africa after Lönnberg	S. Africa after B. Museum specimen	S. Africa S. African Museum specimen	Pulu Sugi specimen R.M.N.H.	Thyabu Choung specimen Calcutta	Arakan specimen Calcutta	
Length of skull	208	327	302	390	348	339	291.5	330	277	316	292	293	
Proportional distance from nasals to tip of praemaxillaries	66.3 %	72.0 %	—	69.6 %	67.1 % [1]	62.2 % [1]	65.6 %	67.8 %	81 %	71.2 %	± 75 %	—	of the length of the skull
Proportional breadth of rostrum basally	30.7 %	28.5 %	29.8 %	26.5 %	28.9 % [1]	29 % [1]	32.5 %	32 %	45 %	26.5 %	28.1 %	26.2 %	of the length of the skull
Proportional breadth of rostrum at its middle .	18.7 %	16.7 %	17.2 %	16.6 %	17.1 %	18,6 %	21.2 %	20 %	21 %	19,6 %	27.8 %	23.8 %	of the length of the skull
Variation range of													
Proportional distance from nasals to tip of praemaxillaries	62.2-72.0 %						65.6-81 %			71.2-75 %			
Proportional breadth of rostrum basally	26.5-30.7 %						32-45 %			26.2-28.1 %			
Proportional breadth of rostrum at its middle .	16.6-18.7 %						20-21.5 %			19.6-27.8 %			

[1]) Measured from the plate.

Lönnberg (l.c., p. 2) mentions that there should be a difference in the length of the nasal groove between *brydei* and *borealis*. In his specimen of *brydei* the length of the nasal groove is about 33 % of the length of the praemaxillaries measured from the front end of the nasals, in *borealis* the nasal groove is about 25 % of this length. In the London specimen of *brydei* this length is 30 %, in our specimen of *edeni* about 28 %. In two specimens of *borealis* (from the Netherlands and Norway) about 32 and 29 % respectively. The overlapping is too great to be of any use for the separation of the species.

In the Pulu Sugi specimen of *edeni* the nasal processes of the maxillaries are narrower than in *borealis*. The breadth at the anterior border of the nasals is less than $^1/_5$ of their length. The same is found in the specimen of *edeni* from Thyabu Choung and in the specimen of *brydei* described by Lönnberg. It is also true in the London specimen of *brydei* in which the breadth at the anterior border of the nasals is even about $^1/_7$ of its length. In the three specimens of *borealis* I measured, the breadth is about $^1/_3$ of its length or less. The photographs of Andrews (1916) and Miller (1926) also show clearly the relative breadth of these nasal processes in *borealis*.

In the Pulu Sugi specimen the nasals are slightly tapering backwards, and posteriorly they are separated by a forwardly directed process of the frontals. It is smaller, however, than the process described by Lönnberg (l.c., p. 3) for his specimen of *brydei*, but agrees more with that of the specimen of *brydei* in the British Museum.

The front margin of the nasals is nearly straight in our specimen and bent forward on the outer side. The same is found in the specimen of *edeni* pictured by Anderson, in the London specimen of *brydei* and the one described by Lönnberg. In the specimens of *borealis* I saw, the front margin is straight.

The front margin of the nasals in our specimen is situated about 20 cm behind the anterior border of the posterior maxillary concavity. In Anderson's plate of *edeni* also the nasals fall conspicuously behind this concavity. The same (though judging from the plate to a less degree) is said by Lönnberg to be the case for his *brydei* specimen (l.c., p. 3). In the London specimen this distance too is about 20 cm. In *borealis* the nasals reach almost to the posterior maxillary concavity. In the specimen from Norway preserved in the Leiden Museum it falls about 5 cm behind.

Lönnberg stresses the point that the flat area formed by the nasals and the hind part of the maxillaries is longer than broad in *brydei*, whereas in the Sei Whale it is square or broader than long. In the London specimen of *brydei*, however, this area is also broader than long (breadth 33 cm, length

28 cm) the same therefore as in Lönnberg's specimen of the Sei Whale. The same is true in our *edeni* skull (breadth 27 cm, length 24 cm). In the specimen of *edeni* described by Anderson this area is about square judging from his plate. This character is too variable therefore to be of any use.

Andrews (l.c., p. 353) points to the fact that the proportional breadth across the squamosals in the skulls of the genus *Balaenoptera* varies considerably. In *borealis* he found that the squamosal breadth varies between 43.0 — 50.6 % of the length of the skull. In the three specimens of *brydei* it is 47.4, 50.9, 52.3 %; in the three *edeni* specimens 44.6, 47.4, 51.2 % respectively. Lönnberg is not quite correct therefore, when he says that in *brydei* this proportional breadth is 50 % or more, in *borealis, physalus* and *musculus* less than 50 %. There is too much overlapping in this character to be of taxonomic value.

The length of the supraoccipital measured from foramen magnum to the frontal suture is 24.5 % of the length of the skull in Lönnberg's specimen of *brydei*. In the specimen in the British Museum it is 23.9 %; in the specimen in the South African Museum 24.9 %. In our specimen of *edeni* it is 23.8 %, in the Arakan specimen 22.2 %, in the Thyabu Choung specimen, according to the measurements given by Anderson, 22.3 %. The variation found by Andrews (l.c., p. 352) for *borealis* is 22.0—26.6 %. I find the range for *brydei* to be 23.9—24.9 %, and for *edeni* 22.2—23.8 %. The supraoccipital is longer therefore in *brydei* than in *edeni*, though the variation range in one species (*borealis*) can be larger than it is for *brydei* and *edeni* together.

The breadth of the occiput between the squamosal sutures too shows a good deal of variation in *borealis*. According to Andrews it is 30.7—35.3 % of the length of the skull. Lönnberg gives 35 % for his specimen of *brydei*, in the London specimen it is 32.4 %, in the Cape Town specimen 35.0 %. In *edeni* I found it to be 30.6 % for the Pulu Sugi specimen and for the specimens in the Calcutta Museum 28.3 and 31.3 % respectively. It is thus shown that the measured skulls of *brydei* (32.4—35 %) and *edeni* (28.3—31.3 %) are separable in this respect. The measurements of *borealis* on the other hand indicate that the variability in one species can be larger than that of the measured *brydei* and *edeni* skulls.

The breadth of the frontal wing above the orbit is 12.3 % of the length of the skull in Lönnberg's specimen of *brydei*, 12.4 % in the London and 10.4 % in the Cape Town specimen. In the Pulu Sugi specimen of *edeni* it is 12.6 %, in the skulls mentioned by Anderson 14.9 and 15.1 %.

Again *brydei* and *edeni* are separable in this character, but the proportional measurements of *borealis* nearly match the variability of *brydei* and *edeni* together.

Miller (1926, p. 5) considers the deep and narrow sulcus between the articular and squamosal parts of the squamosal in *borealis* as a specific character of the Sei Whale. This sulcus is present in all three specimens of this species in the Leiden Museum, but is more feebly developed in the *borealis* specimen from Portskewett, Monmouth in the British Museum. In three skulls of *physalus* in the Leiden Museum it is absent in one and feebly developed in the other two. Lönnberg expresses some doubt to the importance of this sulcus and mentions that it is also developed in the skull of *brydei* before him. In the London specimen there is a well developed, but not very deep sulcus between these parts of the squamosal. In the specimen of *brydei* in the South African Museum Dr. Boonstra found it moderate, but not deep. In both the skulls of *edeni* in the Calcutta Museum a feebly developed sulcus is found, in the Pulu Sugi specimen it is absent. It can be said that though variable in development this sulcus is narrower and deeper in most specimens of *borealis* than it is in *physalus, brydei* or *edeni,* but it is of no use for separating *brydei* and *edeni.*

Lönnberg remarks that the palatines do not reach so far backwards in *brydei* as in *borealis.* In this character there is a good deal of variation too, but in general it can be said that it is true. If we measure the distance between the posterior ends of the palatines in the mesial line and the occipital condyles it is found that in the following specimens of *borealis* this distance is: Japan [1]) 8.5 %; Florida [2]) 9.3 %; Norway 9.7 %, Java 10.5 %; Netherlands 12.9 % of the length of the skull. It may be that the rather large distance between occipital condyles and the posterior parts of the palatines in the specimen from the Netherlands is caused by the fact that it is a juvenile specimen.

In *brydei* the same measurement is: London specimen 14.5 %; Cape Town specimen 14.8 %; Lönnberg's specimen 11.8 %. In *edeni*: Thyabu Choung specimen [3]) 11.9 %; Pulu Sugi specimen 15.1 % of the length of the skull.

In *borealis* the form of the basicranial part of the skull exposed behind the palatines is about squarish in outline, if viewed from below according to Miller (l.c., p. 4). This is also true for both adult specimens of *borealis* in the Leiden Museum; it is longer in the juvenile specimen from the Netherlands. In these specimens the distance of the median ends of the sutures between the palatines and the pterygoids is 87 % (Norway), 84 % (Java) and 53 % (Netherlands juv. specimen) of the distance from the

1) Measured from Andrew's plate.
2) Measured from Miller's plate.
3) Measured from the photograph kindly sent by Dr. Roonwal.

hind edge of the palatines to the occipital condyles. In the *brydei* specimens the distance between the palatines is 51 % (South African Museum specimen), 53 % (Lönnberg's specimen) and 58 % (London specimen) of the distance from the edge of the palatines to the occipital condyles. In *edeni* the same distance is 40 % (Pulu Sugi specimen) and 61 % (Thyabu Choung specimen). In *brydei* as well as in *edeni* the basicranial part of the skull is much longer than broad though to a varying degree. Neither species can be told apart by this character, but are separable from the adult specimens of *borealis*.

Lönnberg mentions that a difference between *brydei* and *borealis* is that the horns at the posterior ends of the pterygoids are longer and more slender in *brydei* than in *borealis*. The same holds good in the comparison of these horns in the Pulu Sugi specimen, which measure ± 7.5 cm, with those of *borealis*. In the London specimen the horns are unfortunately lost.

The bulla of the Pulu Sugi specimen resembles in general form the bulla of *brydei* on Lönnberg's plate (figs. 1 and 2), although it is smaller. In our specimen it measures: length 10.5 cm, greatest breadth ± 6 cm, against 12.3 and 8.3 cm respectively in Lönnberg's specimen of *brydei*.

MANDIBLE

(Pl. III figs. 2 and 3, VI fig. 2)

The mandibles are curved, but to a less degree than in the specimen of *brydei*, pictured by Lönnberg and than in the *brydei* specimen in the British Museum. Judging from the photographs kindly sent me by Dr. Roonwal the mandibles of the specimen of *edeni* from the Arakan coast are again less curved, the distal parts especially are straighter than in the specimens of *brydei*.

According to Miller (l.c., p. 5) *borealis* is distinguished from the other *Balaenoptera* species by the deeper groove on the inner side of the mandible between the angular and articular parts. This groove in our specimen of *edeni* is much less developed than in the specimens of *borealis* I saw. In the *brydei* specimen in the British Museum it is also much less developed, thus agreeing with Lönnberg's remarks about his specimen of *brydei*.

There is still another difference between *borealis* on the one hand and *brydei* and *edeni* on the other. In *borealis* the angular portion ends before the hind edge of the articular portion, in *brydei* and *edeni* the angular portion is at equal level or projects behind the articular part. Moreover in *borealis* the angular portion is found much more on the medial side of

the mandible than in our specimen of *edeni* or in the London specimen of *brydei,* where they are much more in a vertical line above each other.

HYOID BONE
(Pl. VIII fig. 2)

The hyoid bone of our specimen of *edeni* is more slender than in the specimens of *borealis* used for comparison. It resembles closely the drawing of the same bone of *edeni* given by Anderson (fig. 28, p. 561) and also the specimen of *edeni* in the British Museum. The photograph given by Lönnberg of *brydei* is also very similar to it (l.c., pl. 5 fig. 5). In the latter the distance between the forward projecting processes is perhaps slightly larger and the processes behind are a trifle more pronounced. The lateral breadth is 65 cm, the length 25 cm and the length mesially between the processes on the rostral side 12 cm in our specimen of *edeni.* In the British Museum specimen of *edeni* these measurements are 69, 23.5 and 10 cm respectively.

In our specimen the length of the stylohyal is 40 cm, its breadth 13.5 cm. The form is the same as in Lönnberg's photograph (pl. 5 fig. 6) of the stylohyal of *brydei.* It is more slender again than the same bone in *borealis.*

VERTEBRAL COLUMN
(Pl. VII, VIII figs. 1 and 2)

The cervical vertebrae in our specimen of *edeni* are all free, except the third and fourth where a small part of the parapophyses on the left side are ankylosed by a bony bridge of about 7 cm breadth.

The atlas mainly differs from the same vertebra in *borealis* I saw, in the smaller and more pointed transverse processes, which are higher and more wing-like in *borealis.* Some individual variation, however, is shown. In Anderson's specimen of *edeni* from Sittang (1878, pl. 44 fig. 5) the transverse processes are very long, in the specimen of *edeni* from Sidhi Island (Andrews 1918, pl. 15 fig. 1 and 2) they are shorter again and nearly agree with those of the specimen of *brydei* in the British Museum. In Lönnberg's plate (pl. 2 fig. 1) the transverse processes are the most robust of all, higher than in the former but still more pointed than in *borealis.*

The posterior process pointing to the axis on the lower edge of the vertebral body is short and obtuse in our specimen of *edeni* and in *brydei.* In *borealis* it is longer and more pointed. In our specimen of *edeni* the

tubercles on the upper side of the transverse processes are more strongly developed than in any of the other pictured specimens of *edeni* or *brydei*. The form of the spinal canal shows a good deal of individual variation, it is most contracted below in our *edeni* specimen.

The canal for the first spinal nerve is open in both pictured specimens of *edeni* as it is in our specimen. It is closed in Lönnberg's specimen of *brydei* and in the specimen of *brydei* in the British Museum. That there can be individual variation, however, in this character is shown in one of our specimens of *borealis*, in which this canal is open on one side, closed on the other.

The articular facets for the occipital condyles are confluent in the Pulu Sugi specimen; in the other figured specimens, as well as in the London and Cape Town specimens, they are separated. In the *edeni* and *brydei* specimens they are placed obliquely; in *borealis* they are placed slightly more vertically as far as I have seen.

The measurements of the atlas of the Pulu Sugi specimen are: greatest breadth 47 cm, being 14.8 % of the length of the skull (16.9 % in *brydei*, according to Lönnberg). The height is 25.5 cm. In the London specimen the greatest breadth is 53 cm or 16.0 % of the length of the skull. The greatest height is 33 cm.

The axis does not show many characters of special value, though it may be that the distal ends of the wing-like processes are in general rounded in *borealis*. In the axis of *edeni* figured by Anderson (l.c., p. 558, fig. 21 A) as well as in the *edeni* specimen in the British Museum the distal edges are remarkably straight. The same, though to a lesser degree can be said about the axis wings of our *edeni* specimen and of Lönnbergs *brydei* specimen. In the London specimen of *brydei* the axis possesses a tapering point latero-ventrally.

In the third cervical vertebra of the Pulu Sugi specimen the ring round the vertebrarterial canal formed by dia- and parapophyses is closed on the right, open on the left side, though the dia- and parapophyses are ankylosed at their ends. The parapophysis, however, has no communication with the vertebral body. In the fourth cervical vertebra the rings are closed on both sides, though there is a ridge between dia- and parapophysis on the left side. In the fifth vertebra the rings are open on their distal ends. In the sixth the parapophyses are very short, in the seventh they are found as small tubercles on the vertebral body. The diapophyses are well developed in the sixth as well as in the seventh vertebra. In the fifth and seventh, cartilage is found on dia- and parapophyses. Approximately the same condition is found in the specimen of *edeni* described by Anderson, though

here the ring on one side of the fifth cervical vertebra is closed. In the London specimen of *edeni* the rings in the fifth and the sixth vertebrae are open as in our specimen.

In the specimen of *brydei* described by Lönnberg the rings are closed in all cervical vertebrae, except in the seventh where the parapophyses are also reduced to a small notch on the vertebral body. The same is found in the London *brydei* specimen. In the specimen of *brydei* preserved in the South African Museum all rings are closed, except in the sixth and seventh vertebrae.

Andrews pointed to the great variability in *borealis* (l.c., p. 361) and he considers the transverse processes of the cervical vertebrae of doubtful value as a diagnostic character of this species. As shown above there is a good deal of variation in *edeni* and *brydei* also.

Lönnberg points to the fact that in the specimen of *brydei* described by him the parapophyses of the fourth, fifth and sixth cervical vertebrae show a flattened backwards turned portion. The same is found in the Cape Town specimen. In the London specimen of *brydei* this portion is hardly visible in the fourth, but is found in the fifth and sixth vertebrae. In the London *edeni* specimen it is just the same. In our specimen of *edeni* it is only present on the right side of the fourth cervical vertebra. In the type specimen of *edeni* it is only found in the fifth cervical vertebra. In *borealis* this character is variable in different specimens as Lönnberg already states. So it is in *brydei* and *edeni*.

A difference between *edeni* and *brydei* on the one hand and *borealis* on the other may be that the ends of the diapophyses are broader and thicker in the former, therefore the broadest parts of the closed rings are found latero-dorsally. In *borealis* the rings are mostly smaller or the broadest parts are found latero-ventrally as in our specimens from Java and Norway.

The dorsal and lumbar vertebrae of *brydei* and *edeni* differ in the same way from *borealis* in the strong backward inclination of the spinous processes. They agree in this character more with *acutorostrata* and *physalus*. Anderson (l.c., p. 559) already remarked that the backward direction confers on the vertebrae of *edeni* a very different character from those of the specimen of *borealis* from Java.

The backward direction of the spinous process begins in the seventh dorsal vertebra in the Pulu Sugi specimen and increases till it reaches its maximum in the seventh lumbar. In Anderson's specimen of *edeni* it begins in the sixth dorsal vertebra and becomes more and more pronounced until the eighth lumbar. In the London specimen of *edeni* the spinous processes from the fifth lumbar vertebra on are damaged, but here too the backward

inclination of the complete spinous processes is very pronounced. Lönnberg gives an impression of the degree of this backward inclination in the dorsal vertebrae in his specimen of *brydei* by measuring the distance at which the vertical plane along the posterior surface of the vertebral body reaches the upper margin of the spinous process reckoned from the anterior and posterior upper angle of the process. I measured the same in our specimen (*edeni*) and in the London specimen of *brydei*. These measurements are more or less approximate for it is difficult to take exact measurements.

TABLE III

No. of vertebra	Distance of anterior angle of processus spinosus			Distance of posterior angle of processus spinosus		
	edeni	*brydei*		*edeni*	*brydei*	
	Puli Sugi specimen	London specimen	Lönnberg's specimen	Pulu Sugi specimen	London specimen	Lönnberg's specimen
6	12	20	13	4.5	2	5
7	10	19	11.4	8	5	7
8	12	23	11.4	9	6	7
9	8	23	11.4	11	3	7.5
10	5	22	9	12	2	10
11	4.5	18	4.5	13	-1	13.5
12	5	15	5	14	-5	13
13	0	10	5	18	-13	13
14	1	3.5	-	20	-17	-
15	-3	0	-	20	-17	-
16	-3	-4	-	20.5	-23	-
17	-6	-6	-	23	-25	-
18	-11	-6	-	26	-26	-

These measurements compared with those of Lönnberg and his remarks on this point (l.c., pp. 10 and 11) show that the backward inclination of the spinous processes in our specimen of *edeni* is about the same, perhaps slightly larger. In our specimen the above mentioned vertical strikes the anterior angle of the spinous process of the thirteenth dorsal vertebra. In Lönnberg's specimen of *brydei* this vertical falls behind the anterior angle of the spinous process in the first lumbar, in the second lumbar (fifteenth vertebra) it falls before the anterior angle. In the London specimen of *brydei* the upper ridge of the spinous processes is longer antero-posteriorly than in either of the former specimens, but here too the vertical strikes the

anterior angle of the spinous process of the fifteenth vertebra (third lumbar). See plate IX fig. 2.

In the Pulu Sugi specimen the spinous processes in the first and second dorsal vertebra are rather low and blunt pointed. From the third on they show a square top and an increase in height. The height of the process of the thirteen dorsal vertebrae measured from the inside of the neural canal are:

11-13.5-17.5-20.5-23.5-27-±28 (damaged)-30-34-36-36.5-37-39 cm respectively.

The height is influenced by the fact that the spinous processes from the sixth dorsal on are bent to the right side.

Their height is slightly less than in Lönnberg's specimen of *brydei,* but in the London specimen of *brydei* these processes are a good deal higher. In this specimen the height from the first to the twelfth dorsal is: 14-14-18-21-27-31-35-40-44-45-45.5-5-49 cm respectively.

This large variation shows that this character is useless for taxonomic purposes.

The height of the vertebral centrum of the dorsal vertebrae is about the same in our specimen of *edeni* and Lönnberg's specimen of *brydei.* About 15 cm for the first to the ninth dorsal vertebrae, 15.5 cm for the tenth and 16 cm for the eleventh to the thirteenth. In the London *brydei* specimen the measurements were 15 cm for the first to fifth, 15.5 for the sixth, 16.5 for the tenth and 17 cm for the twelfth dorsal vertebra.

The transverse processes in the Pulu Sugi specimen are short and forwardly directed in the first to the sixth cervical vertebra; in the seventh they are outwardly directed; from the tenth onwards the direction is backwards. The thirteenth dorsal vertebra has the longest processus transversus of the whole vertebral column, measuring 40 cm along the anterior border. At the distal edge of the transverse processes the first two lumbar vertebrae show a small broad bony plate, which is ankylosed with the ends of the transverse processes. In both the transverse processes are directed backwards, in the third lumbar the direction is outwards again, from the fourth to the tenth they are forwardly directed, in the eleventh lumbar outwards again and from there on backwards. The length decreases caudally from the first lumbar; in the thirteenth lumbar the length is only 20 cm measured along the anterior border.

In the London specimen of *brydei* the transverse processes are directed backwards from the tenth dorsal on, in the first and second lumbar the processes are directed outwards, in the next three slightly forwards, in the seventh outwards again.

Anderson (l.c., p. 560) points to the fact that in the lumbar vertebrae of his specimen of *edeni* there is an increase of the breadth of the transverse processes from the first on, associated with a basal constriction. This is not very striking in our specimen, nor as far as I can judge from the photographs in Lönnberg's specimen of *brydei*. In the London specimen of this species it is is found more or less, but certainly this can be largely individual.

The spinous processes of the lumbar vertebrae increase in height to the fifth or sixth in our specimen of *edeni*. Unfortunately from the fifth on the tops of these processes are all more or less damaged. The height of the processus spinosus in the fifth lumbar is about 40 cm. The backward inclination in the spinous processes also increases in the first lumbar vertebrae (table III). The greatest inclination is found in the seventh lumbar (27th vertebra). From there on the tops of the processes are more bent forward. The height of the vertebral body increases from 16 cm in the first to 23 cm in the thirteenth vertebra. In Anderson's specimen of *edeni* the backward inclination of the spinous process is found to in the eighth lumbar (25th vertebra) from there on they curve more forwards. In Lönnberg's specimen of *brydei* the backward inclination is found to the thirtieth vertebra. The form of the praezygapophyses in our specimen of *edeni* agrees in general with Lönnberg's remarks about the praezygapophyses of *brydei*. The upper margin is square up to the eleventh; from there on slightly blunt pointed and the upper margin is more or less rounded. From the twenty-fifth to the thirtieth vertebra the direction is obliquely upward; from there backwards the upper outline is horizontal again. The form of the praezygapophyses in the London specimen of *brydei* corresponds in general with Lönnberg's specimen, though the praezygapophyses are heavier in the former.

It is difficult to give the exact boundary between lumbar and caudal vertebrae in our specimen of *edeni*. There are eleven chevron bones, the first is found between the thirty-sixth and thirty-seventh vertebra. As, however, there are two small facets for the articulation of the chevron bones on the posterior lower edge of the thirty-fourth vertebra and large ones on the thirty-fifth, I consider the thirty-fourth to be the first caudal. Probably two chevron bones have been lost. Thus there are thirteen lumbar and eighteen caudal vertebrae, but certainly one, perhaps two of the last caudals have been lost. This makes a total of nineteen or twenty caudals. The total number of vertebrae in our specimen of *edeni* is therefore 52 or perhaps 53 with a total length of 9 m. In Anderson's specimen of *edeni* the total number of vertebrae is given as 52. In the London specimen of *edeni*

there are 7 cervical, 12 dorsal, 12 lumbar and 16 caudal vertebrae present, but four or five of the hindmost vertebrae are lost, which makes the total 52 or 53 vertebrae. In Lönnberg's specimen of *brydei* the total number — 52 vertebrae — is given. In the London specimen of *brydei* 7 cervical, 12 dorsal, 14 lumbar and 19 caudals (perhaps the last one lost) are found, which makes a total of 52, perhaps 53 vertebrae. This is a very close agreement in all specimens of *edeni* and *brydei*. The total number of vertebrae in the different species of the genus *Balaenoptera* is different and rather constant for each species. According to Lönnberg (l.c., p. 14) the total number is 56-57 in *borealis*, 61-63 in *physalus*, 48-50 in *acutorostrata*, 63-65 in *musculus*.

In the caudal vertebrae of our specimen of *edeni* the height of the spinous processes diminishes rapidly and has disappeared by the ninth (damaged in the eighth) as in Anderson's specimen of *edeni* and in the London specimen of *brydei*. In Lönnberg's specimen it disappears in the eighth. The neural canal in our specimen is closed to the eleventh as in Lönnberg's specimen, in the London specimen of *brydei* it is closed up to the ninth. Also the length of the transverse processes decreases rapidly and in the eighth and ninth there are only transverse ridges. In the London *brydei* specimen this is the case in the eighth caudal vertebra. In Lönnberg's specimen of *brydei* there are distinct transverse processes on the first six caudal vertebrae and reduced processes on the seventh and eighth. In the Pulu Sugi Whale the transverse process in the third caudal is perforated on the left side only, in the fourth on both sides and from there on the perforation is visible to the eleventh caudal. In Anderson's specimen of *edeni* the third caudal is the first to be perforated, in Lönnberg's *brydei* specimen it is the fourth, which is perforated on both sides. In the London *brydei* specimen we find a perforation from the third to the ninth caudal vertebrae. Lönnberg (l.c., p. 13) demonstrates that in *borealis* the perforation can occur in the third or in the fourth caudal. This is a matter of individual variation.

CHEVRON BONES

As already stated above eleven chevron bones have been secured and probably the first two have been lost. The chevron bones were fastened on the vertebrae and the first one was tied to the thirty-seventh vertebra. If there has been made no mistake this chevron bone was placed between the thirty-sixth and the thirty-seventh vertebrae. It must be added, however, that the series of *brydei* in Lönnberg's plate (l.c., pl. 4 fig. 6), which shows nine chevron bones resembles closely the series in our *edeni* specimen and in the former the first chevron was found attached to the thirty-fourth

vertebra. The two last are lacking in Lönnberg's *brydei* specimen. The tenth chevron bone in our series is composed of two small bones, the eleventh is only one small bone.

No pelvic bones have been saved.

RIBS

The Pulu Sugi specimen has thirteen pairs of ribs. The first rib has the well known form, deeply bifurcated at the head, broadly expanded at the distal end. In the first rib of our specimen the heads for the last cervical and the first thoracic vertebrae are about equal in height; in Lönnberg's specimen (l.c., plate 4 fig 7) the head of the first thoracic rib is shorter, judging from the plate. Anderson remarks in his description of *edeni* (l.c., pp. 560-561) that the first rib is single headed, but in the specimen from Sidhi Island the first rib is bifurcated (Andrews, 1918, p. 107, plate 15).

In Lönnberg's specimen of *brydei* there is a rudiment of a capitulum and collum in the second and third ribs. In our specimen of *edeni* it is found in the second, third and fourth ribs. Comparing these ribs with those in Lönnberg's plate there are some differences. The heads of the ribs are heavier in our *edeni* specimen, the collum is longer and bent posteriorly. The collum in the fourth rib is short.

The presence or absence of a collum in the second to the fourth rib is a feature, which according to Miller may be of specific value and Lönnberg too stresses this character. He points to the fact that the Northern Fin Whale has a collum in the second, third and fourth ribs, the Antarctic Fin Whale in the second and third only and Lönnberg remarks that if Miller is right, it strengthens his supposition that there is a racial difference between the Northern and Southern Fin Whale. True (1904, pp. 137-138) on the other hand mentions a rather large individual variation in this character for the Finback Whale (*physalus*) from the northern regions. For this species he mentions capitular processes in the following ribs: first and second; first, second and third; second and third; second, third and fourth. In *borealis* also individual variation is found in this character. Lönnberg (l.c., p. 15) mentions a fairly well developed collum in the second, third and fourth ribs in a specimen from the Norwegian coast. In the Leiden Museum a specimen from the same locality has a well developed collum on the second and third ribs, a rudimentary one on the fourth. The specimen from the Netherlands has well developed processes on the same ribs. In the specimen from Java the collum is well developed on the third, rudimentary on the second and fourth. The same is found in the specimen from Florida

mentioned by Miller. In Andrews' specimen from Japan a neck is only mentioned for the second and third ribs. In my opinion all above mentioned facts show that the presence or absence of a collum on the fourth rib is of no special value, but largely due to individual variation.

The measurements of the ribs on either side in our *edeni* specimen are:

No. of rib	Length in straight line	
	Right	Left
1	85	84
2	114	113
3	125	126
4	133	130
5	137	136
6	141	141
7	141	139
8	135.5	136
9	130	133
10	127	127
11	113.5	123
12	118	118
13	120	damaged

The eleventh rib on the left side is strongly twisted. From the thirteenth rib on this side the upper part only is saved.

STERNUM

(Pl. VIII fig. 2)

The sternum in our specimen of *edeni* is cross shaped and differs slightly in form from the one of *brydei*, pictured by Lönnberg (l.c., plate 5 fig. 4). The transverse processes are somewhat broader in our specimen of *edeni* and the posterior process is less pointed. The length is 19 cm, the breadth across the transverse arms 31 cm. The proportional length is 61.2 % of the breadth, which is very near to what is found in Lönnberg's specimen of *brydei* (60.2 %). In the specimen of *brydei* in the South African Museum it is 61 %. The posterior plate in our *edeni* specimen is only 1 cm thick. The sternum is smaller and thinner than in the *brydei* specimen described by Lönnberg. Of a different form is the sternum of *brydei* pictured by Péringuey (1921, plate I). Here the anterior process is much reduced and the transverse processes are very little pronounced.

SCAPULA

(Pl. VIII fig. 3)

The scapula has the form generally found in the Balaenopteridae. The greatest length measured from angle to angle is 93 and 90 cm for the right and left scapulae respectively. The height is 53 and 52 cm. The length of the

acromion is 26 and 25 cm respectively. Length of the coracoid is 9 cm. Lönnberg mentions for his specimen of *brydei* that the height is 59.2 % of its length. In our *edeni* specimen for the right and left scapula it is 57 and 57.7 % respectively. In the specimen of *brydei* in the South African Museum it is even 70.2 %.

The acromion in the scapula of the Pulu Sugi Whale is well developed, not broadening towards the ends, the coracoid is less downwardly directed than in Lönnberg's specimen.

HUMERUS, RADIUS, AND ULNA

(Pl. VIII fig. 3)

There is nothing particular to remark about the form of these bones in our specimen. The humerus has about the same form and length as in Lönnberg's *brydei* specimen. The radius and ulna, however, are much longer. The length of the humerus is 52.6 % on the right side and 51.9 % on the left side of the length of the radius. In Anderson's specimen of *edeni* the humerus is 56.2 % of this length, in the London *edeni* specimen it is 54.2 %. In the London *brydei* specimen it is 56.9 %. In Lönnberg's *brydei* specimen 63.3 %. This shows that the proportional length of the humerus in the *edeni* specimens is 51.9-54.2 %, in the *brydei* specimens 56.9-63.3 % of the length of the radius. I do not think, however, that this difference is an essential one, for it is shown by my measurements that this proportional length of the humerus can vary to a large extent in specimens of *borealis*.

Lönnberg gives (l.c., p. 18) 50-52.9 % of the length of the radius for the proportional length of the humerus in *borealis* and he is inclined to think that the difference he found between the proportional length of the humerus of a Sei Whale from the northern Atlantic (± 50 %) and one from S. Georgia (52.9 %), points to a racial difference. In our specimens from *borealis* I find for the same relation the following percentages for the right and left side respectively:

	right	left
Netherlands (juv.)	53.6	53.7 %
Norway	52.2	51.3 %
Java	60.2	62.7 %
Florida (after Miller)	49.2 %	
Japan (after Andrews [1])	58.5 %	

1) Measured from the plate.

This shows that the variation range in this character is much larger than it was supposed to be by Lönnberg and that if we want to use it for racial characters, there is more reason to separate the Atlantic and Pacific Sei Whales than the North and South Atlantic populations. Considering, however, the enormous variability found in whales, splitting them up into races, if it is possible, can only be done with very large numbers of specimens.

It is also shown that the variation range of this character is about the same in *borealis* on the one hand and *brydei* and *edeni* on the other. For *borealis* it is ± 50-62.7 %, for *edeni* and *brydei* 51.9-63.3 %.

The right humerus in our specimen of *edeni* is 10.9 % of the length of the skull, the right radius 20.7 %. In Anderson's specimen of *edeni* the humerus is 10.1 %, the radius 18 % of the skull length. In Lönnberg's *brydei* specimen the humerus is 11.8 %, the radius 18.6 %; in the London specimen the same proportional measurements are 11.2 % and 19.6 % of the length of the skull.

The length of the forearm in the *edeni* specimens is therefore 28.1-31.6 %, in the *brydei* specimens 30.4-30.8 % of the length of the skull.

The radius of our specimen of *edeni* is at the middle of the diaphyse 16 %, in Anderson's *edeni* specimen 12.4 %, in Lönnberg's *brydei* 15 % of its length. In the ulna the same relation is 8.7 %, 10.4 % and 8 % respectively.

The carpus and manus in the Pulu Sugi Whale are unfortunately very incomplete. Only one carpus is saved, and it is composed of five bones, loosely united by bony bridges. The manus shows three phalanges on the ulnar side. All the other fingers have only two phalanges, the others are lost. From the other hand only some digits are saved.

CONCLUSIONS

As shown above there are many characters in the skeleton, which separate both *Balaenoptera edeni* and *Balaenoptera brydei* from *Balaenoptera borealis*. These differences are:

1. The dorsal surface of the rostrum is mostly more straight and flat in *edeni-brydei*.
2. The ventral surface of the maxillaries is less concave in *edeni-brydei*.
3. The range of the rostrum length is larger in *edeni-brydei*.
4. The rostrum at its middle is broader in *edeni-brydei*.
5. The nasal processes of the maxillaries are narrowed in *edeni-brydei*.
6. The front margin of the nasals is bent forward on the outer side in *edeni-brydei*, straight in *borealis*.

7. The front margin of the nasals falls strikingly behind the anterior border of the posterior maxillary concavity in *edeni-brydei,* at about the same level in *borealis.*
8. The sulcus between articular and squamosal parts of the squamosal is not so deep and narrow in *edeni-brydei.*
9. The palatines do not extend so far back in *edeni-brydei.*
10. The basicranial part of the skull exposed behind the palatines is much longer than broad in *edeni-brydei.*
11. The posterior horns of the pterygoids are longer and more slender in *edeni-brydei.*
12. The groove on the inner side of the mandible between articular and angular parts is shallower in *edeni-brydei.*
13. The angular portion of the mandible ends at level of, or behind, the articular part in *edeni-brydei,* in front of it in *borealis.*
14. The angular and articular parts are more vertical above each other in *edeni-brydei.*
15. The transverse processes of the atlas are smaller and more pointed in *edeni-brydei,* the process pointing to the axis is shorter and more obtuse.
16. The distal ends of the wing-like processes of the axis are squarer in *edeni-brydei.*
17. The spinous processes of the dorsal and first lumbar vertebrae show a strong backward inclination in *edeni-brydei.*
18. The total number of the vertebrae is 52-53 in *edeni-brydei,* against 56-57 in *borealis.*

All these differences of which especially nos. 1, 2, 5, 6, 7, 13, 17, and 18 seem to be important, show that *borealis* is a different species, which can be easily separated from *edeni* and *brydei* skeletons.

The skeletons of *brydei* and *edeni* agree in all essential points, the only differences found are the following:

1. The rostrum basally is broader in *brydei,* more slender in *edeni* than in *borealis.*
2. The proportional length of the supraoccipital is greater in *brydei.*
3. The proportional breadth of the occiput between the squamosal sutures is greater in *brydei.*
4. The proportional breadth of the frontal wing above the orbits is less in *brydei.*
5. The proportional length of the humerus is greater in *brydei.*

As far as the differences pointed out in nos. 2, 3, and 4 are concerned, it is shown that the variability in one species (*borealis*) nearly or entirely matches the variability found in *edeni* and *brydei* together, so I do not

think that these differences are of essential value. The differences left are the breadth of the rostrum basally and the proportional length of the humerus. Certainly we cannot base a specific distinction on these characters in such a highly variable group as whales are. It may be that, if much more material is available, it will be shown that they are sexual differences, of which as yet nothing is known, or perhaps racial differences at the utmost. As I have already said I do not think this very probable. More material will probably show that the individual variation is still greater than displayed in the specimens discussed above. The conclusion therefore is that we can consider *edeni* and *brydei* conspecific, which makes the name *Balaenoptera brydei* Olsen a synonym of *Balaenoptera edeni* Anderson. The species occurs in South African waters as well as in the waters of South-eastern Asia.

LITERATURE

ANDERSON, J., 1878. Anatomical and Zoological Researches: comprising an Account of the Zoological Results of the two Expeditions to Western Yunnan in 1868 and 1875. London, pp. 551-564, plate XLIV.

ANDREWS, ROY CHAPMAN, 1916. Monographs of the Pacific Cetacea. II. The Sei Whale (Balaenoptera borealis Lesson). Mem. American Museum Nat. Hist., n.s., vol. 1, pt. 6.

——, 1918. A Note on the Skeletons of Balaenoptera edeni Anderson, in the Indian Museum, Calcutta. Records Indian Museum, vol. 15.

BLANFORD, W. T., 1888-1891. The Fauna of British India, including Ceylon and Burma. Mammalia. London.

LÖNNBERG, EINAR, 1931. The Skeleton of Balaenoptera brydei Ö. Olsen. Arkiv f. Zoologi, vol. 23 A, no. 1.

MILLER, GERRIT S., 1926. A Pollack Whale from Florida presented to the National Museum by the Miami Aquarium Association. Proc. U.S. Nat. Mus., vol. 66, art. 9.

OLSEN, ØRJAN, 1913. On the external Characters and Biology of Bryde's Whale (Balaenoptera brydei), a new Rorqual from the Coast of South Africa. Proc. Zool. Soc. London.

PÉRINGUEY, L. 1921. A Note on the Whales frequenting South African Waters. Trans. Roy. Soc. of South Africa, vol. 9, pt. 1.

SCLATER, W. L., 1891. Catalogue of Mammalia in the Indian Museum. Calcutta.

TRUE, FREDERICK W., 1904. The Whalebone Whales of the Western North Atlantic compared with those occuring in European Waters; with some Observations on the Species of the North Pacific. Smiths. Contr. to Knowledge, vol. 33.

WHEELER, J. F. G., 1930. The Age of Fin Whales at physical Maturity with a Note on multiple Ovulations. Discovery Reports, vol. 2.

EXPLANATION OF THE PLATES

Plate I

Balaenoptera edeni Anderson, dorsal view of the skull from Pulu Sugi.

Plate II

Balaenoptera edeni Anderson, ventral view of the skull from Pulu Sugi.

Plate III

Balaenoptera edeni Anderson.

Fig. 1. Lateral view of the skull from Pulu Sugi.
Fig. 2. Dorsal view of the left mandible of the specimen from Pulu Sugi.
Fig. 3. Lateral view of the left mandible of the specimen from Pulu Sugi.

Plate IV

Balaenoptera brydei Olsen, dorsal view of the skull from Saldanha Bay in the British Museum.

Plate V

Balaenoptera brydei Olsen, ventral view of the skull from Saldanha Bay in the British Museum.

Plate VI

Balaenoptera brydei Olsen.

Fig. 1. Lateral view of the skull from Saldanha Bay in the British Museum.
Fig. 2. Dorsal view of the left mandible of the same specimen.

Plate VII

Balaenoptera edeni Anderson.

Fig. 1. Cervical and dorsal vertebrae of the specimen from Pulu Sugi.
Fig. 2. Lumbar vertebrae of the same specimen.
Fig. 3. Caudal vertebrae of the same specimen.

Plate VIII

Balaenoptera edeni Anderson.

Fig. 1. Atlas, axis, third and fourth cervical vertebrae of the specimen from Pulu Sugi, seen from the rostral side.

Fig. 2. Hyoid bone, sternum, fifth, sixth and seventh cervical vertebrae of the same specimen.

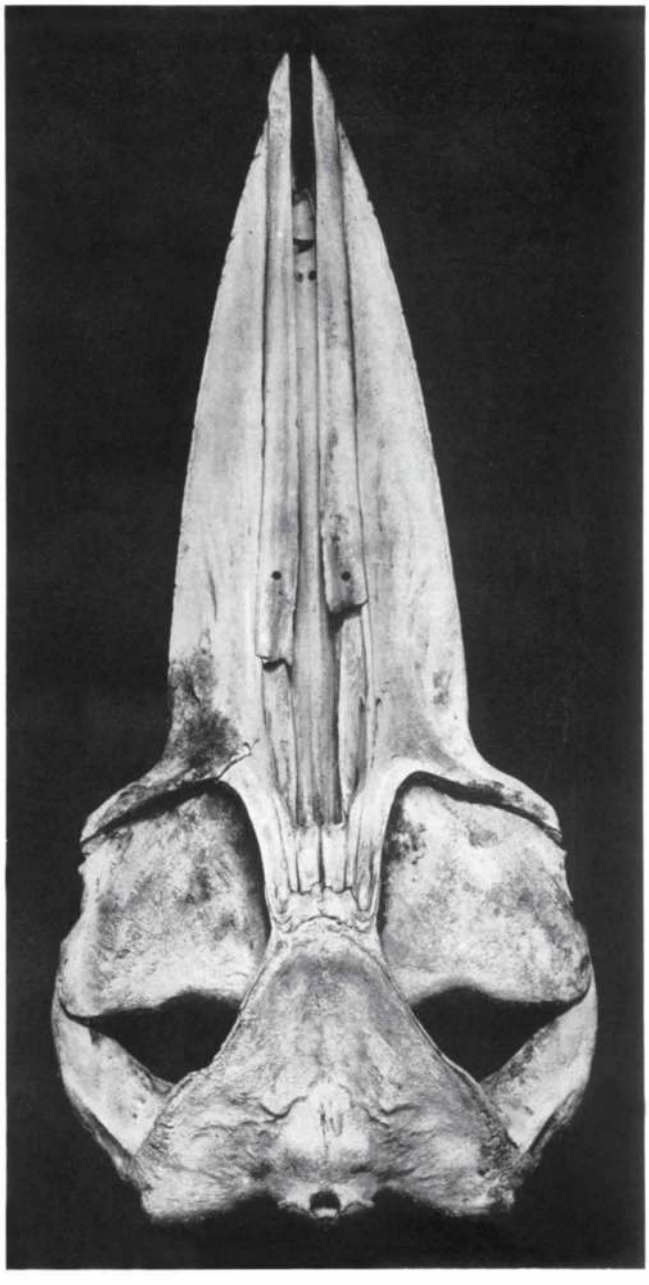
Fig. 3. Left and right scapula, left humerus, radius and ulna of the same specimen.

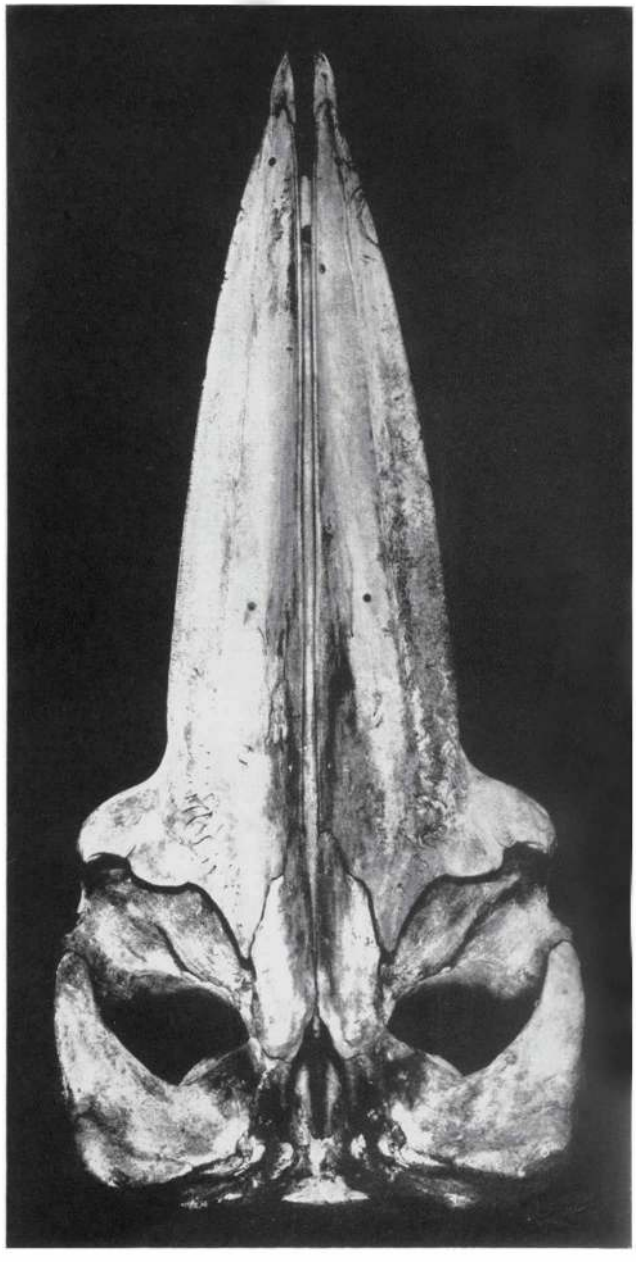
Plate IX

Balaenoptera brydei Olsen.

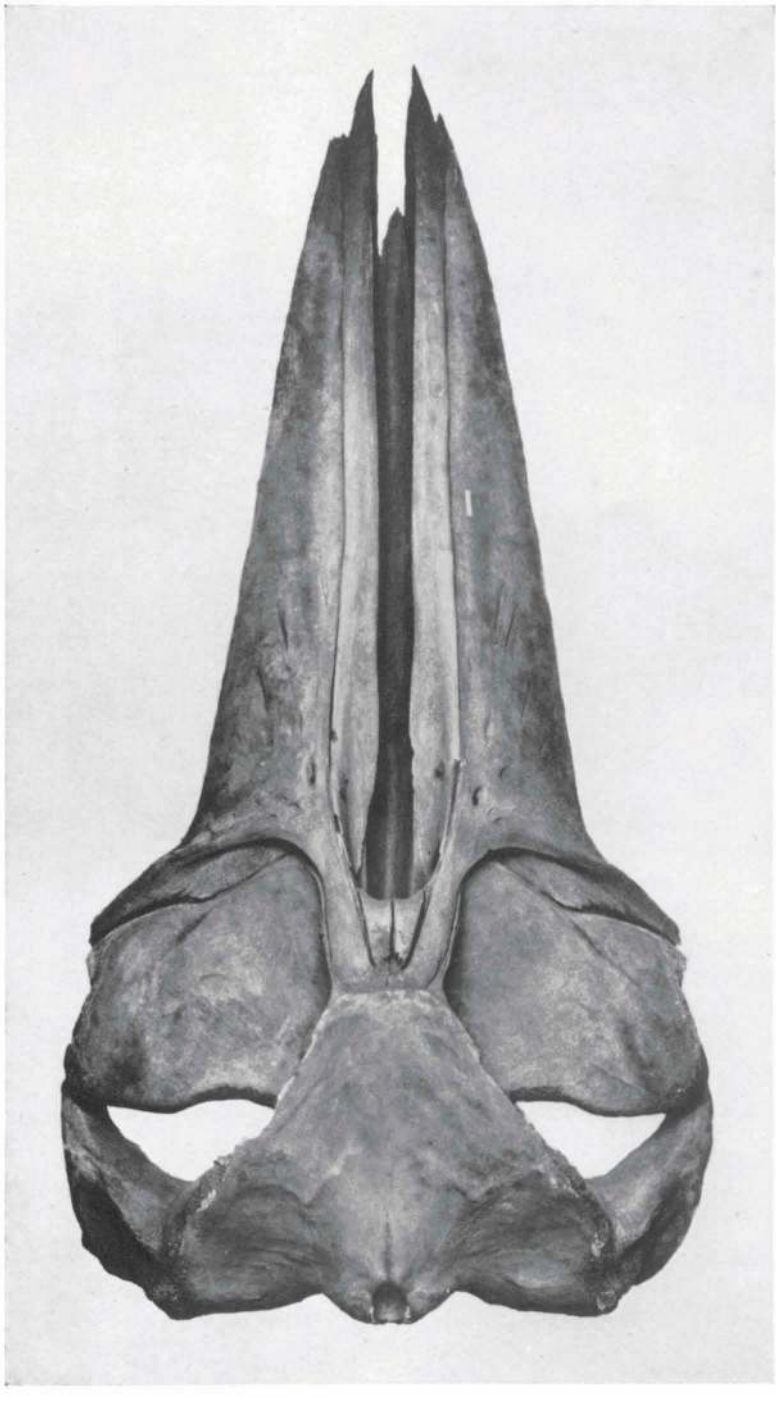
Fig. 1. Atlas of the specimen from Saldanha Bay in the British Museum.

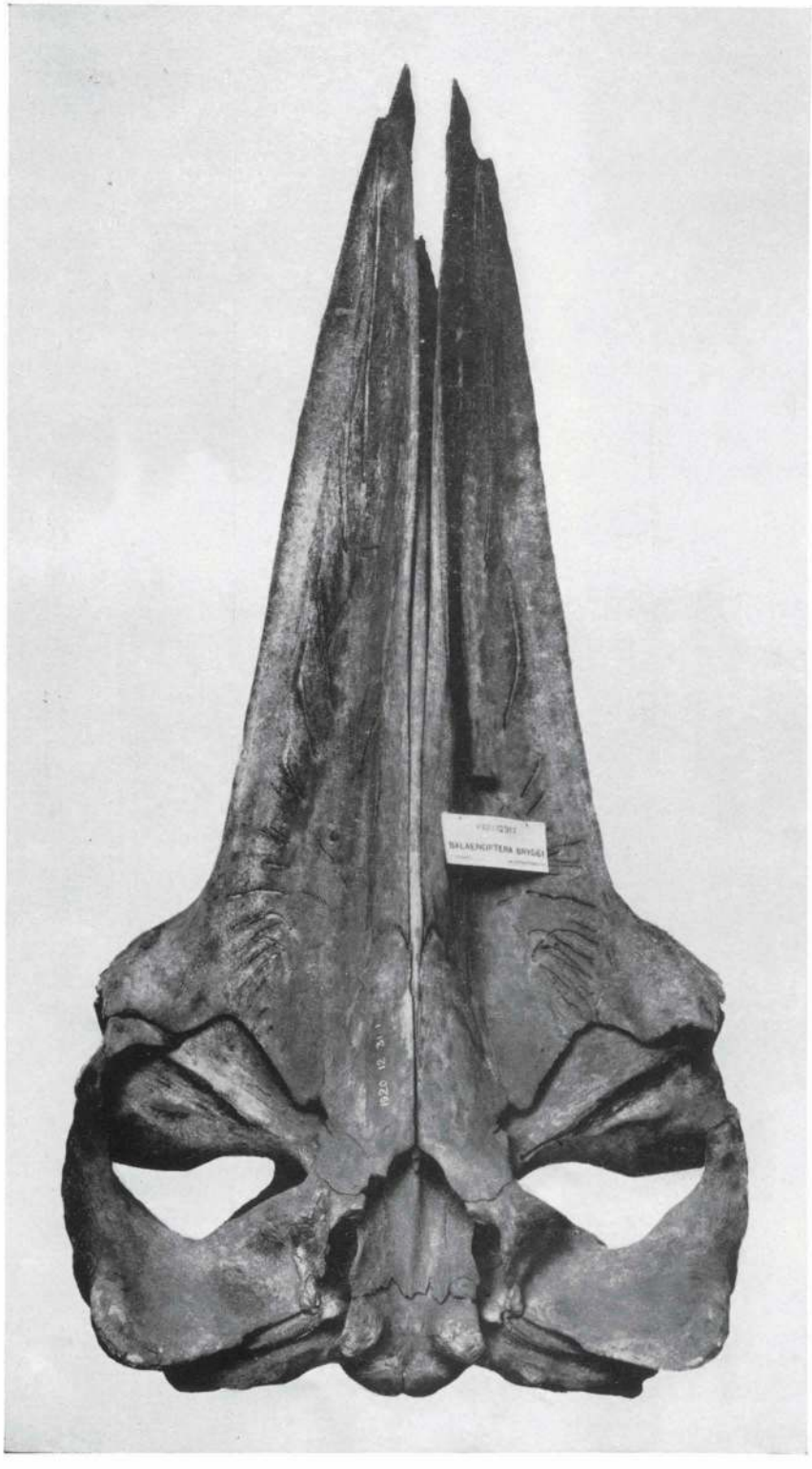
Fig. 2. First seven lumbar vertebrae of the same specimen.



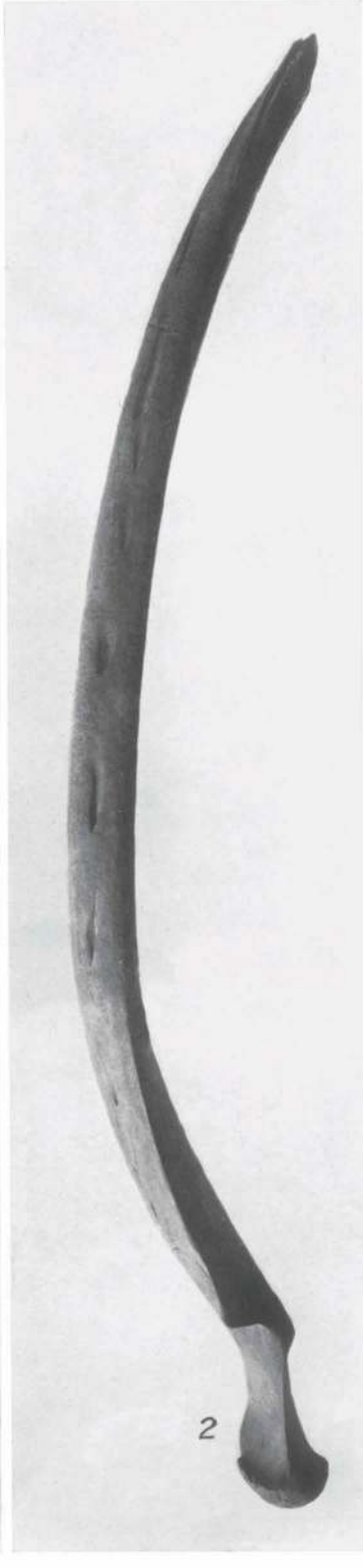


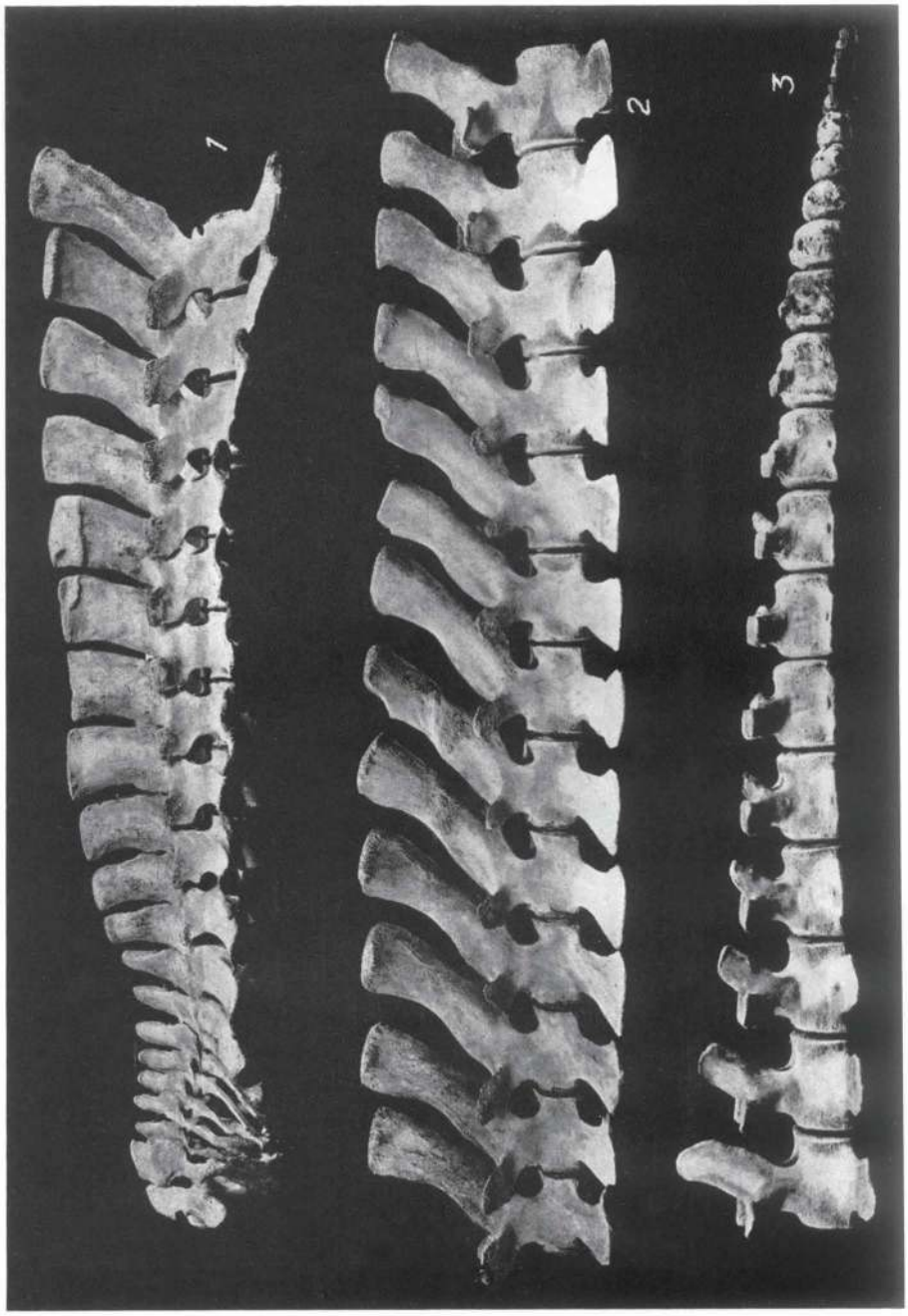

1
2
3

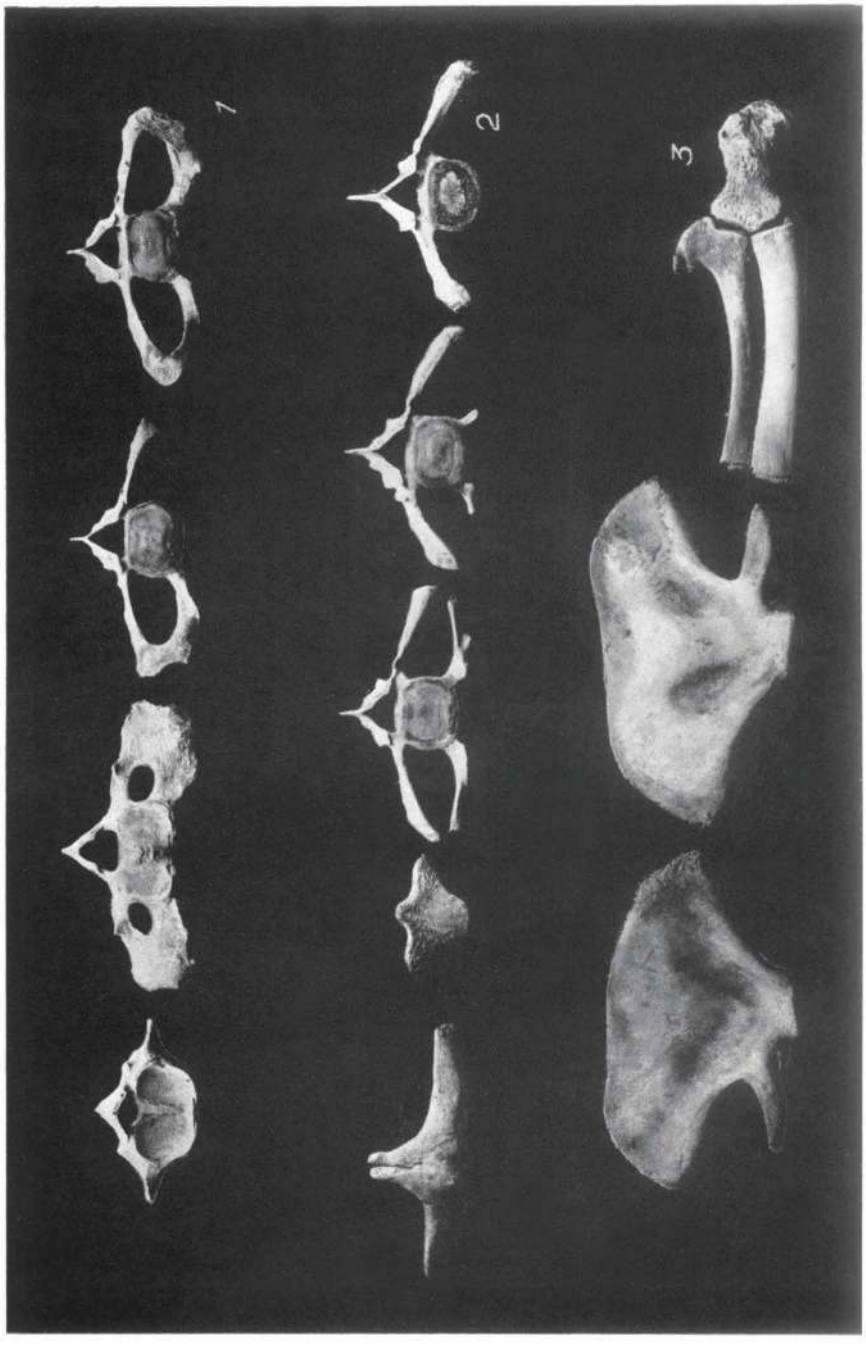


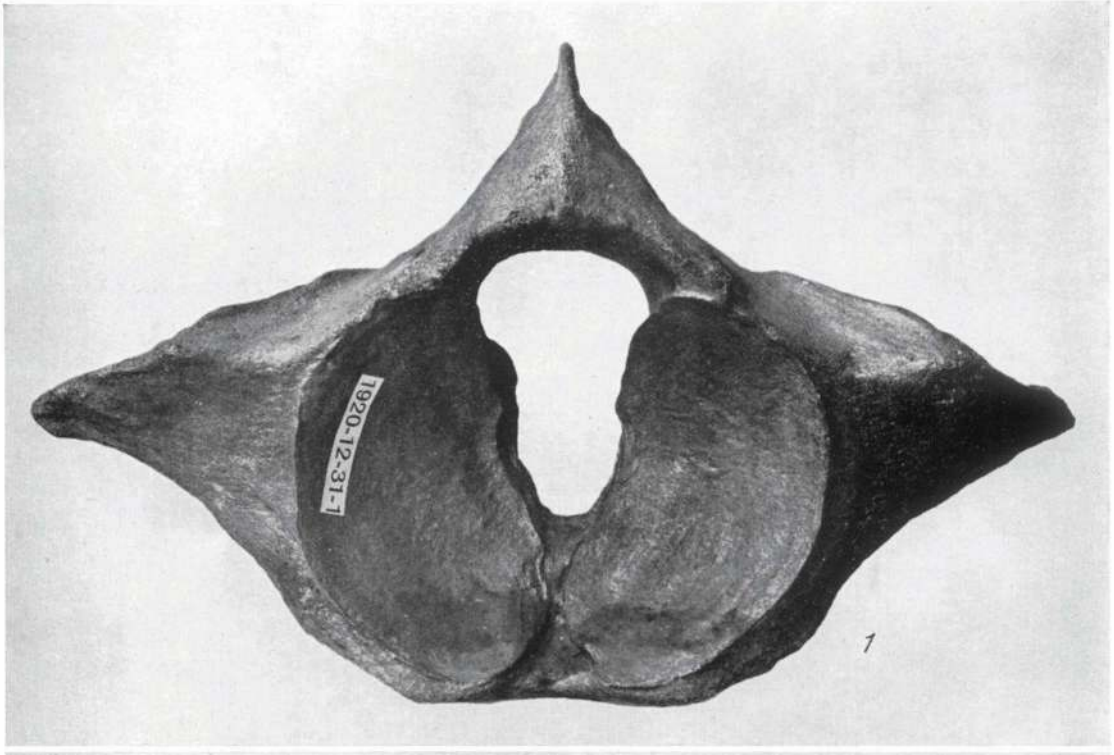

BALAENOPTERA BRYDEI

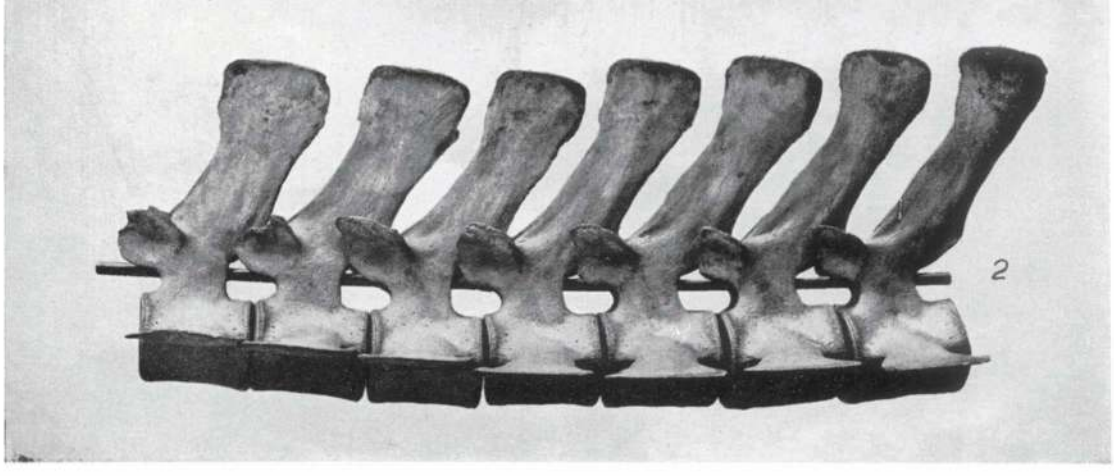

1


2


1
2
3


1
2
3


1920-12-31-1
1


2