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ON THE TEETH AND SOME OTHER PARTICULARS OF THE SPERM WHALE (PHYSETER MACROCEPHALUS L.)

BY

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I. INTRODUCTION AND REMARKS ON VARIOUS DETAILS

In the morning of February 24, 1937, two male sperm whales stranded on the Middenplaat, a shoal in the estuary Westerschelde in the extreme southern part of the Netherlands. As soon as the news of this stranding reached us at Leiden, Dr. G. C. A. Junge and Dr. L. D. Brongersma went to Terneuzen to obtain the carcasses for the Rijksmuseum van Natuurlijke Historie. Upon their arrival at Terneuzen they found the smaller of the two specimens at the beach of this place, the other had been towed to the beach at Breskens. The negotiations met with success, but the two carcasses were in rather out of the way and difficultly accessible places. It would have been an extremely costly process to have the flensing and disjunction of the skeleton done at Terneuzen and Breskens, moreover the transport of the skeletal parts to Leiden would have met with extreme difficulties.

Provisionally the sperm whales remained where they were now, whilst we attempted to find a solution for the problem to reduce the cost of the enterprise. In this we succeeded by the coöperation with the "Gekro" at Rotterdam (Overschie), a company for the destruction of the carcasses of domesticated animals, and the production of material of commercial value from these carcasses. We decided to transport the two sperm whales to Rotterdam so that the museum officials who had to dissect the bodies could come to their work every day without great loss of time and money, and the soft parts of the animals could be easily and quickly removed to the "Gekro" Company in the immediate neighbourhood of the town.

In the meantime each of the two carcasses remained under the care of a museum official. The bodies stayed in good condition with the exception of a large burst on the dorsal side of the larger specimen, which compelled

us to pay a second visit to Breskens. Investigation of the damaged portion proved that development of gasses of decomposition in the muscles had caused the body covering to burst and these gasses had found thereby an outlet. The condition of the specimen, however, in all other respects was excellent so that we determined to proceed with the transport of the animals.

For each carcass a tug was hired which towed the specimen to Rotterdam. Fortunately the water was not too rough so that the two specimens safely arrived, the smaller of the two on March 1, the larger on March 2, within a week after their death. We had the good fortune that in the town an excellent locality could be found for the two specimens, viz., the place where the tunnel under the Maas (the river Meuse) now is in construction. Here the two sperm whales could be deposited on the quay which gave us an ideal opportunity for the dissection. Soon after the arrival at Rotterdam each of the two sperm whales was taken out of the water by means of three floating cranes each with a capacity for lifting 20,000 kg. Strong steel wires were slung around the bodies, the cutting in of these wires was avoided by heavy timbers. Hanging in the wires the animals now were taken out of the water and put down on the quay (Pl. X). The weight of the bodies could be roughly determined now: one had a weight of about 53,000 kg, the other of about 40,000 kg.

There are previous records of the weight of large cetaceans, but in these cases the weight has been determined by adding the weights of the different parts which had been detached from the body. Andrews (1916, p. 140) remarks that Lucas weighed in sections a blue whale (*Balaenoptera musculus* (L.)) at Newfoundland, and found a total weight of 63 tons. Zenkovič (1934) gives as weights of two female *Balaenoptera physalus* (L.) 53,801 and 48,600 kg, whilst the weight of a female *Megaptera longimana* (Rud.) determined in the same manner was 32,374 kg. Fraser (1937, p. 220) mentions as weights of two blue whales of 89 and 66 feet, over 119 and 51 tons.

Already when the two sperm whales were lying on the beach at Terneuzen and Breskens they attracted large crowds of visitors. As soon as they arrived at Rotterdam and were put down at a locality in the town easily accessible by all means of conveyance the interest of the public became enormous: in the month of March over 48,000 visitors came to see the sperm whales and the process of flensing and further disjunction of the remains. Gradually the parts of the skeleton, still covered with remains of the tissues, were transported to Leiden. On March 19 the last part, the skull of the smaller specimen, arrived there.

When the carcasses of the two sperm whales arrived at Rotterdam they had been dead already for some days. The thick outside layer of fat had kept them well warm inside so that decay of the tissues had gone on for a considerable time. Therefore they were not altogether free of smell, which especially was apparent in the first days when the viscera were taken from the abdomen. Fortunately the weather was cold, so that soon after the removal of the most strongly odorous parts the smell was not too pungent. There were some complaints about the bad odour by inhabitants of the town in the neighbourhood of the locality where the carcasses were dissected, but, as the newspapers truthfully stated that the stench was decidedly decreasing during the progress of dissection and removal of the offensive parts, no serious inconvenience was caused.

In previous records of stranded sperm whales often mention is made of the bad odour. Concerning a specimen stranded on the south coast of England Hunter (1829) remarks: "The stench arising from the dead body was almost intolerable, and was smelt at three miles' distance from the sea." Woods (1829) says of the same animal that five days after its death the internal parts had become insufferably putrid. Heckel (1853) refers to Rondelet's (1554) description of a stuffed sperm whale which was set up before the palace of the Duke of Florence in the middle of the sixteenth century, but had to be removed very soon on account of "grauissimum foetorum". Iovius (1561) relates a similar history, undoubtedly with reference to the same specimen. Moreover Heckel mentions the stranding of a large sperm whale near Alexandria in 1838 which had to be returned to the sea because of "pestilenzialischem Geruch". Southwell (1881, p. 94) quotes Sir Thomas Browne, who writes of a sperm whale which came on shore at Wells, in 1646: "In vain was it to rake for ambergriese in the paunch of this leviathan, insufferable foetor denying that inquiry;..." Concerning a specimen washed ashore at Ceylon there is a remark by Fernando (1913) about the unbearable stench, which was carried by the wind for a long distance. Finally the following may be quoted from Bennett (1931, p. 69): "Sperm Whales, if not cut up very soon after death, are liable to explode, and when they do, the noise is like that of a boiler explosion. The whole of the stomach and its contents go sky high with a roar, and should you be in the line of 'fire'—well, you are decidedly unlucky. The stench of a stale Rorqual is enough for most people, but that of the Sperm is far worse; and if ambergris is present, it fairly beggars description!"

Near Dunkirk in the North of France two male sperm whales stranded in July 1937. Pictures of these animals appeared in the newspapers, which

proved the identity of the animals. These specimens too were rather smelly, as according to the newspapers the workmen who had to dissect the carcasses wanted gas-masks as a protection against the stench. But then these specimens arrived in the hot season whilst during the dissection of our specimens the cold more or less formed an impediment to the progress of the work.

For anatomical and microscopical studies during the process of dissection some parts of the animals were taken off for Dr. E. J. Slijper, who, together with Dr. Junge, made some measurements (in cm) of parts of the animals, which, by their permission, are given below.

	Smaller specimen	Larger specimen
Total length (approximately)	1600	1800
Anus to posterior border of penis	122	150
Diameter of basal part of penis	35	43
Anterior border of penis to navel	70	90
Length of penis	190	140
Anus to notch in flukes	460	490
Larger diameter of flukes	405	440
Notch in flukes to posterior border of dorsal fin	490	530
Length of dorsal fin	110	150
Height of dorsal fin	46	40
Length of blowhole	46	50
Breadth of blowhole	15	20
Angle of mouth to extremity of lower jaw	335	350
Length of anterior border of right flipper	115	160
Transverse diameter of right flipper	70	
Anterior border of right flipper to anterior part of upper jaw	425	

On Plate X the smaller of the two sperm whales is represented in ventral view. On the enormous head the lower jaw and the palate with the pits caused by the mandibular teeth are visible. The foremost part of the head projects for a considerable distance beyond the tip of the lower jaw, the ventral region of this part shows a distinct ridge. Moreover the two flippers, the penis, the anus, and the tail with the flukes are visible in the picture.

The head of the larger specimen is shown on Pl. XI fig. 1. It is seen here in front view, the long narrow lower jaw and the open mouth are visible, as is the median ridge in front of the foremost part of the mouth. Moreover the picture shows that at each side of the head there is a broad shallow groove in the dorsal part of the anterior half of the head; this groove runs in a longitudinal direction. When this picture was taken the thin

skin of the animal already had loosened in large patches causing an untidy appearance of the originally smooth, shining black skin of the head.

In the smaller specimen no teeth were visible in the upper jaw, later, after dissection of the palate, they were found to be present, but completely hidden in the tissues. In the larger specimen a number of maxillary teeth were distinctly visible, as they penetrated through the tissues for a short distance (Pl. XI fig. 2). An account of these teeth is given in a following

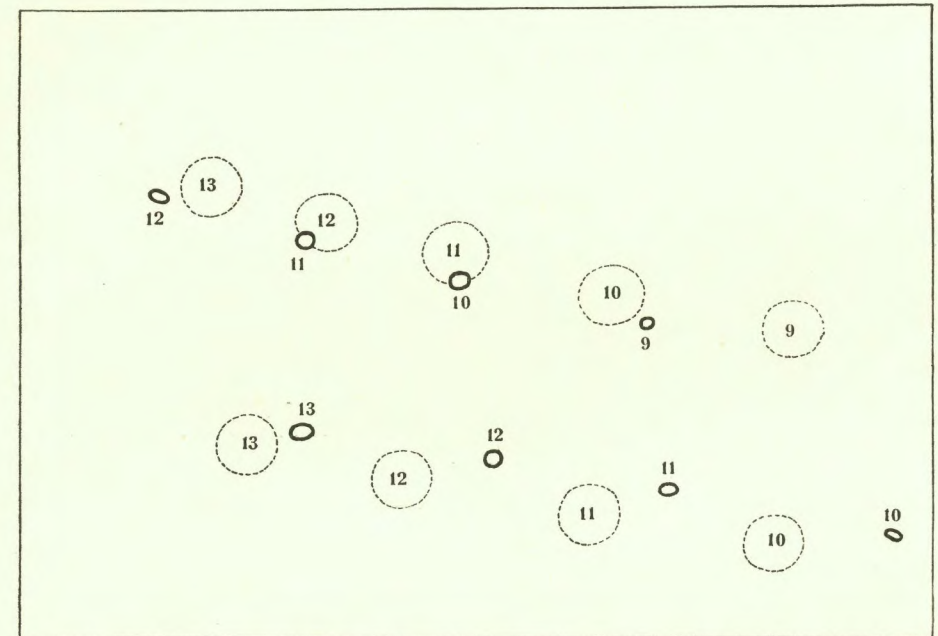


Fig. 1. Diagram of the part of the palate of the larger specimen represented on Pl. XI fig. 2. The dotted lines are the approximate contours of pits caused by mandibular teeth, the drawn lines represent maxillary teeth. Upper part of the figure, right side; lower part of the figure, left side (cf. fig. 14).

chapter, here a short description of the figure may be given. The figure shows the middle third part of the palate of the larger specimen, with the maxillary teeth just extending beyond the gum and the pits caused by the mandibular teeth when the mouth is shut. Some of the teeth are shown distinctly enough, the pits in the gum are not apparent at once. The part of the palate represented on Pl. XI fig. 2 is reproduced more or less diagrammatically in fig. 1, so that a comparison of the two figures shows at once the chief particulars. In fig. 1 the maxillary teeth are given as drawn lines, the pits caused by the mandibular teeth as dotted lines. The upper row

shows the pits of the mandibular teeth 9 to 13 and the contours of the maxillary teeth 9 to 12 of the right side. The lower row shows the pits of the mandibular teeth 10 to 13 and the contours of the maxillary teeth 10 to 13 of the left side. Moreover the diagram of fig. 1 may be compared to that of fig. 14 in which the whole dentition of this specimen is given.

The dorsal fin of the sperm whale hardly deserves this name as it is nothing else but a slight elevation of the dorsal part of the body, rather compressed laterally, but not as fully developed to warrant the name "fin". It was known as the "hump" by the old sperm whalers. Between this hump and the flukes there is a series of smaller humps which may be more or less conspicuous. In the two specimens of February 1937 four or five of these smaller ridges were visible, the figure (Pl. XII fig. 1) shows two of these distinctly enough.

This series of humps has been known for a long time, descriptions or drawings of them are found already in the older literature. In Paré's figure (1604) an undulating line is found between the dorsal fin and the flukes, which may represent seven small elevations. The figures of Aldrovandus (1613) and of Jonston (1657, 1660), which are copies of the one of Paré, show the same undulating line (cf. fig. 2 a, b).

In Köhne's figure (1724) besides the dorsal hump, which is very little elevated, there is a distinct swelling of the hindmost part of the tail, just in front of the flukes, described by Köhne as a smaller hump in the shape of a fin (cf. fig. 2 e).

Anderson (1747) published some data of the account of a sperm whale captured by a Hamburger captain of a whaling ship, among which we read: "Das sonderlichste, was er hinzusetzte, war, dass der Fisch hinten auf dem Rücken gegen den Schwanz drey Höcker, davon der erste andert-halb Fuss, der zweyte ein halben und der dritte und hinterste nur ein viertel Fusses hoch gewesen" (l.c., p. 235). Anon. (1784), and de Jong, Kobel and Salieth (1792) cite Köhne's and Anderson's data.

In the figure of Quoy and Gaimard (1824, cf. fig. 3 e) not only at least four distinct small excrescences are found between the large dorsal hump and the flukes, but also the region between the head and the hump shows a number of small elevations. Consequently Gentil (1833—1834) could remark that in this sperm whale there is a continuous range of humps from the neck to the tail.

Beale (1835) remarks that there are several humps and ridges on the back of the sperm whale, and Bennett (1840, p. 156) says, after describing the dorsal hump: "From this embossed appendage, an undulating series

of six or eight similar but smaller elevations occupy the upper margin, or ridge of the tail, to the commencement of the caudal fin." In his illustration (cf. fig. 3 k) these smaller humps are drawn as regularly decreasing in size towards the posterior region.

Gray (1866) mentions two or three quite small finlets as occurring between the dorsal fin and caudal. In Scammon's figure, which was copied by Goode (1884) and several other authors, the sperm whale has an irregular row of rather indistinct elevations behind the dorsal hump (cf. fig. 3 g). Howell (1930, cf. fig. 3 h) represents the sperm whale with one smaller hump behind the dorsal elevation, and Fraser (1937, cf. fig. 4 h) gives a figure in which the dorsal hump and the three or four following elevations form a continuous series of protuberances gradually decreasing in size towards the flukes.

In the illustration showing the dorsal elevations (Pl. XII fig. 1) another peculiarity is visible, viz., a number of parallel stripes, commencing in the region of the dorsal hump, and continuing for some distance towards the posterior region of the body. These stripes are scars of a bite of another specimen of sperm whale. Each scar has the breadth of the blunt top of a mandibular tooth, and the distance between the scars is approximately that between two of these teeth. When the other specimen was biting the tail slipped along the series of teeth so that a long scar remained on the skin. Accounts of fighting between sperm whales are found in many publications on whaling, the only record of scars corresponding with those described here, I found in a paper by Shaler (1873, p. 2): "Captain Pease had seen males struggling with each other and often found their bodies scarred with imprints of the rival's teeth; the scars showing their origin very distinctly by their form—the distance apart of the wounds answering to the intervals of the teeth." Scars on the skins of smaller cetaceans, brought about by fighting of these animals among each other, have been repeatedly described.

The sperm whales of February 1937 showed numerous grooves on the throat in the region where the two posterior parts of the lower jaw diverge. In each specimen two of these grooves were strongly pronounced; besides these a number of somewhat shallower grooves were present. In the figure this system of grooves (Pl. XII fig. 2, in the central part) is clearly visible. Perhaps the function of these grooves is to allow the expansion of the posterior part of the lower jaw, when swallowing large squids as remarked by Stead (1930). In the two specimens stranded in February 1937 the two

larger grooves were found in corresponding places, the system of smaller grooves was different in the two specimens.

Repeatedly the occurrence of these grooves has been mentioned in literature, and they have been figured in numerous illustrations. In Matham's and van der Gouwen's engravings several longitudinal grooves were represented on the throat (cf. fig. 3 1), the same applies to the figure given by Robertson (1771), and a number of figures derived from this (cf. fig. 3 a, c). De Sanctis (1881) describes the two pronounced longitudinal grooves of the throat, and remarks that they may have a function in the distention of the skin during the movements of the jaw. Moreover the two grooves are mentioned by Pouchet and Chaves (1890) and by Millais (1906).

Hentschel (1910) gives a description of the system of grooves found in the specimen examined by him in Newfoundland, the measurements and distances of these grooves are given in a semidiagrammatic figure.

These grooves, which seem to occur without exception in adult animals, were not yet visible in the embryo studied by Kükenthal (1914).

A few remarks on the skeletons of the two specimens may be added, as the condition of the bones shows that both animals still were comparatively young. In full grown sperm whales the epiphysal plates are ankylosed to the bodies of the vertebrae, radius and ulna are ankylosed together, and the subdivisions of the sternum are united into one bone (Turner, 1872).

Flower (1885) gives as the number of vertebrae of the sperm whale: 7 cervical, 11 thoracic, 8 lumbar, and 24 caudal, a total number of 50. Elliot (1901) too states that the sperm whale has 50 vertebrae. Slijper (1936) gives the number of vertebrae of a specimen in the London Gallery as follows: 7 cervical, 11 thoracic, 9 lumbar, and 20 caudal, resulting in a total number of 47 vertebrae. In both of our specimens there are 7 cervical, 11 thoracic, and 8 lumbar vertebrae. The smaller specimen has 25 caudal vertebrae, so that the total number is 51. The larger specimen has 22 caudal vertebrae, so that the total number is 48. Of these the 20th and 21st vertebrae are united into a single bone, but the original parts remain sufficiently distinct.

In both our specimens not yet all the epiphyses had united completely with the main bodies of the vertebrae which proves that the animals still were comparatively young.

In the cervical vertebrae of the smaller specimen the epiphyses have united with the corpora, the same holds for the first three thoracic vertebrae. From the fourth to the seventh thoracic the posterior epiphysis is loose, from the eighth to the eleventh thoracic the posterior epiphysis is loose and

the anterior epiphysis but slightly connected. On the first till the fourth lumbar vertebrae the epiphyses are connected in their central part, but loose in the margin. The fifth lumbar and following vertebrae, including the caudal, have epiphyses which have grown on to the corpora.

In the larger specimen the fusion of the epiphyses to the corpora of the vertebrae is less advanced than in the smaller specimen. Here too the cervical vertebrae have epiphyses which are completely connected with the corpora, the same holds for the two first thoracic. In the third to the sixth thoracic the epiphyses are still loose, partially or wholly, at least on one side. The epiphyses of the seventh to the ninth thoracic vertebrae are loose, the posterior as well as the anterior. Those of the tenth and eleventh thoracic, and those of the first and second lumbar vertebrae are slightly connected in the central part only, at least one of the two on each vertebrae. The epiphyses of the third to the eighth lumbar are more strongly united with their corpora, although they are loose at the margins. The first till the fourth caudal have epiphyses which have fused with their corpora for the greater part of their extent, the fifth to the seventh have nearly completely grown on, and in the remainder of the tail vertebrae no separate epiphyses are found.

The sternum of the sperm whale is composed of the presternum and two mesosternal segments, altogether originally six pieces of bone. In young specimens these bones are separate; when growing older they gradually unite into one compound. This development of the sternum from six separate centres was already commented upon by Wall (1887, original edition in 1851). Flower (1885) describes and figures a sternum of a sperm whale which still is composed of three parts: the united presternum and first metasternal segment of the left side, the same combination of the right side, and the united pair of second mesosternal segments. This figure was made after that in a previous publication (Flower, 1869, pl. 60 fig. 3), where the two anterior portions of the sternum are represented in immediate contact, but, as is stated in the text (l.c., p. 355) these two portions are completely separate. The sternum of the sperm whale described and figured by Turner (1912) consists of a single piece of bone. Here the first mesosternal segments are fully ankylosed to the presternum. On the ventral surface there is a distinct groove separating the second mesosternal segments (united in the median plane) from the preceding. This groove is no more visible on the dorsal surface of the sternum.

In the larger of our two specimens the sternum forms a single bone, in the smaller the presternum is united with the two bones of the first mesosternal segment. The two bones forming the second mesosternal

segments are separate and were united to each other and to the larger part of the sternum by cartilage only.

Cuvier (1823, pl. XXIV fig. 14) gives a figure of the humerus, radius, and ulna of the sperm whale, which shows that the two latter bones are ankylosed. Between this compound and the humerus there is at least a distinct groove. The same figure is found on a larger scale in Pander and d'Alton (1827, pl. V fig. e). In later years van Deinse (1916) has drawn attention to the fact that in sperm whales with advancing age the humerus, radius, and ulna show a tendency to unite into a single bone. It is interesting that this process in our smaller specimen is in a far more advanced state than in our larger specimen. In the larger specimen the radius and ulna are largely united in their proximal region, but this compound in the left flipper is still completely separated from the humerus, whilst in the right flipper, where radius and ulna are united in the same manner as in the left, the ulna in one small spot only is united with the humerus.

On the other hand in both flippers of the smaller specimen humerus, radius, and ulna are united into one compound. There is still a distinct groove between the humerus and the united radius and ulna, but this groove only occurs in the centre, the rostral and the caudal side of the compound have a smooth surface in the region where the different bones have united.

The occurrence of maxillary teeth in our two specimens gave reason to a survey of the literature on the subject. During this work I came across so many different opinions on these teeth and on other particulars of sperm whales that it seemed worth while to study the literature in more detail.

Numerous books have appeared dealing wholly or partially with the sperm whale, moreover in periodicals a multitude of papers have been published dealing with the sperm whale or containing notes on this animal. It is nearly impossible to collect the whole of the literature on this subject. As far as concerns the literature up to 1873 the works of Bosgoed (1873) and of Allen (1881) are invaluable, though many papers which appeared in the periods covered by these authors have escaped their notice. Moreover numerous papers on Cetacea are cited in the bibliographies of Engelmann (1846), Carus and Engelmann (1861), and Taschenberg (1899). For the literature of later years the Zoological Record is invaluable, and the works of Jenkins (1921) and of Hohman (1928) may be mentioned as containing important lists of the literature on whales and whaling. Unfortunately many of the works cited in these bibliographies were not available to me though I consulted all the important libraries in this country.

II. THE SPECIFIC NAME OF THE SPERM WHALE

As soon as sufficient evidence was given for the fact that there is but one recent species of sperm whale this animal generally was indicated with one of the two names *Physeter macrocephalus* L. and *Physeter catodon* L. In the later half of the nineteenth century and in the beginning of the present century the name *Physeter macrocephalus* was most commonly used; in later years zoologists are inclined to regard *Physeter catodon* as the valid name of the sperm whale. In the following pages an attempt is given to show that this is incorrect so that the animal must be named *Physeter macrocephalus* L.

The nomenclature of the different "species" of sperm whales which were recognized in the older literature is largely based on Sibbald's *Phalainologia nova*¹⁾. Later authors, among whom especially Ray (1713) is often cited in the literature of the eighteenth century, copied the diagnoses as given by Sibbald. Ray (l.c., p. 15, 16) distinguishes a number of "Pisces Cetacei seu Belluae marinae", among these the following have been regarded as representing species of sperm whales:

I. ²⁾ *Balaena minor*, in inferiore maxilla tantum dentata, sine pinna aut spina in dorso.

II. *Balaena major*, in inferiore tantum maxilla dentata macrocephala, bipinnis.

III. *Balaena major*, in inferiore tantum maxilla dentata, dentibus arcuatis falciformibus, pinnam seu spinam in dorso habens.

IV. *Balaena macrocephala tripinnis*, Quae in mandibula inferiore dentes habet minus inflexos, & in planum desinentes³⁾.

Among later authors before 1758 especially Brisson (1756) may be mentioned, who recorded seven species of sperm whales:

1. Le Cachalot = *Cetus*. In the synonymy species II of Ray is cited.
2. Le Cachalot blanc = *Cetus albicans*.
3. Le Cachalot de la Nouvelle Angleterre = *Cetus Novae Angliae*.
4. Le Petit Cachalot = *Cetus minor*. In the synonymy species I of Ray is cited.

1) Not seen; first edition, Edinburgh, 1692; second edition, London, 1773. A detailed account of the contents of the latter edition is given by Allen (1881, p. 464).

2) Roman numerals arbitrarily added.

3) Allen (1881) identifies Ray's species in the following manner: I, *Beluga catodon* (= *Delphinapterus leucas*, the white whale); II, *Physeter macrocephalus*; III, *Physeter tursio*; IV, *Physeter tursio*. The name for species III probably is given by mistake, as it corresponds with Linné's species *Physeter microps*.

5. Le Cachalot à dents pointuës.

6. Le Cachalot à dents en faucilles. In the synonymy species III of Ray is cited.

7. Le Cachalot à dents plates. In the synonymy species IV of Ray is cited.

Species 2 undoubtedly is the white whale, *Delphinapterus leucas* (Pall.), in the older literature often named *Beluga catodon*. The length, 15—16 feet, as given by Brisson, is in accordance with the size of the white whale (cf. Fraser, 1937: 12 to 14 feet, upper limit 18 feet). Another species of small size is no. 4, for which Brisson gives 24 feet as measurement. This is too long for the white whale, but a rather short size for a sperm whale. If really species 4 is the white whale, as presumed by many later authors, then this animal is mentioned twice, under different names (*Cetus albicans* and *C. minor*). There is another possibility, viz., that Brisson's species 4 is the pilot whale, which reaches a size of 28 feet (Fraser, l.c.). De Lacepède (1804) regards Brisson's species 4 as a synonym of his *Catodon svineval* which possibly is the pilot whale. The measurements of the other species of Brisson are from 52 to 100 or more feet, though exaggerated as far as concerns the maximum size these lengths may apply to the sperm whale.

In the tenth edition of his *Systema Naturae* Linné (1758) enumerates four species of the genus *Physeter*, in the synonymy of each of these species Ray is cited as the oldest author. The four species are given in the same order as in Ray's work, they are named by Linné: *Catodon*, *macrocephalus*, *microps*, and *Tursio*. In his list of synonyms Linné moreover cites Artedi (1738), who characterizes his species by the diagnoses given by Sibbald and Ray.

In the twelfth edition of Linné's *Systema Naturae*, edited by Gmelin (1789) the sperm whales are given in the following order:

1. *Catodon*, synonyms: Ray's species I, Brisson's species 4.
2. *macrocephalus*, divided into three forms:
 - α, synonyms: Ray's species II, Brisson's species 1.
 - β, synonym: Brisson's species 2.
 - γ, synonym: Brisson's species 3.
3. *microps*, divided into two forms:
 - α, synonyms: Ray's species III, Brisson's species 6.
 - β, synonym: Brisson's species 5.
4. *Tursio*, synonyms: Ray's species IV, Brisson's species 7.

Brisson's species 2, the white whale, therefore is included in the species *macrocephalus*; Brisson's species 4, *catodon* of Gmelin, may represent a sperm whale of small size, but later authors often gave the name *catodon* to the white whale.

In 1758 Linné used the generic name *Physeter* for the sperm whales, in a later publication (Linné, 1761) the generic name *Catodon* is found. Previously Artedi (1738), who listed the four species of Sibbald and Ray, included two of these (III and IV) into the genus *Physeter*, the two other species (I and II) into the genus *Catodon*.

Borowski (1781 a) used the name *Physeter novae angliae* for the 3rd species of Brisson, already indicated by this name in Brisson's work. Borowski (l.c.) gave the new name *Physeter andersonii* to species 5 of Brisson, the "zweyte Sorte der Cachelotte" of Anderson (1747).

The generic name was spelled by Bonnaterre (1789) "*Phiseter*" instead of *Physeter*, he gave specific names to three forms previously described. One of these, *Phiseter Trumpo*, is the "blunt-headed Cachalot" of Robertson (1771), the second, *Phiseter Cylindricus*, is the "dritte Art der Cachelotten" of Anderson (1747, with figure of a specimen opp. p. 250), the third, *Phiseter Mular*, represents the first species of sperm whales of Anderson (the identity of this "species" with previously described animals is not clear).

A trinomial system of nomenclature for a number of species of whales was adopted by Kerr (1792). The sperm whales thus indicated are *Physeter macrocephalus niger*, *Physeter macrocephalus albicans*, *Physeter macrocephalus cinereus*, *Physeter microps falcidentatus*, and *Physeter microps rectidentatus*. The subspecies *albicans* undoubtedly represents the white whale, the other forms indicated trinominally certainly are sperm whales, as their size is given as sixty or more feet and the generic characters are: "Has teeth in the lower, and none in the upper jaw." (Kerr, 1792, p. 360).

According to Sherborn (1891) plates CCCXXXVIII and CCCXXXVIII B of von Schreber's *Säugethiere* appeared in 1792. In the explanation of these plates the name *Physeter gibbosus* is used for the first time. The plates represent Robertson's (1771) and Pennant's (1776) figures of the "blunt-headed cachalot".

One of the specimens figured by Bonnaterre (1789, pl. 7 fig. 2) was identified by him as *Phiseter Macrocephalus*. It is interesting that Cuvier, who in later years took a great deal of trouble to demonstrate that there is but one species of sperm whale, in 1798 gave the specific name *Physeter maximus* to this animal.

De Lacepède (1802) enumerates eight species of cachalots, distributed in three genera. The first genus, *Catodon*, contains the species *macrocephalus*, *trumpo*, *svineval*, and *albicans*. Of these the two former are real sperm whales whilst of the two remaining forms one (*svineval*) may represent the pilot whale (*Globicephala melaena*). According to de Lacepède (1804) his

svineval is a synonym of Gmelin's *Physeter catodon*. This may be correct, for Fraser (1937) gives as maximum length for the pilot whale 28 feet, and Gmelin states that his species is 24 feet long. The species *albicans* is the white whale (*Delphinapterus leucas*). The second genus, *Physalus*, is new; it is erected by de Lacepède for the species *cylindricus*. In the third genus, *Physeter*, the three species *microps*, *orthodon*, and *mular* are included. Of these *Physeter orthodon* is a new name. The synonyms given under this name all point to Anderson's second species of cachalot, to which in 1781 the name *Physeter andersonii* had been given by Borowski.

The generic name *Cetus*, already used by Brisson (1756) for the sperm whales, became a valid synonym of *Physeter* in 1816, when Oken published it as the name for the genus.

Physeterus sulcatus is a new "species" of sperm whale, described by de Lacepède (1818) after a coloured drawing of a specimen from Japanese waters. The figure has not been published. Inadvertently the author added two letters to the generic name, which, however, was not original, as Duméril (1806) already used the word *physeterus* to designate a genus of sperm whales.

The name *Physeter australasianus* was given by Desmoulins (1822) to the animal which was described and figured by Quoy and Gaimard (1824) as *physeter polycyphus*. In 1822, however, the plate of the specimen existed already, as it is cited by Desmoulins.

Fleming (1822) places two species of sperm whales, *macrocephalus* and *Catodon*, into the genus *Physeter*. For two other species a new genus is established: "*Tursio*. A high dorsal fin. *T. vulgaris* and *microps*, are recognised species" (l.c., p. 211). *Tursio vulgaris* cannot be meant as a synonym of the bottle-nosed dolphin (*Tursiops truncatus*, a synonym of which is *Delphinus tursio*), as *Delphinus truncatus* is mentioned on a previous page (l.c., p. 209). Moreover the sperm whales, including the two species of *Tursio*, are defined without a bony septum in the skull between the nostrils.

What Fleming (1828) meant with his species *Catodon Sibbaldi* is not easily understood. In the synonymy Sibbald's diagnosis is given which was copied by Ray for his species I, another synonym is *Physeter Catodon* L. As further particulars Fleming (l.c., p. 39) adds: "A herd of this species, upwards of 100 in number, are stated by Sibbald to have been found at Kairston, Orkney, the individuals of which were from 2 to 24 feet in length. Head round; gape small; and the teeth about half an inch above the gums. "In rostrum nares habebant", "et asperitatem quandam in dorso". The claims of this species, to rank as distinct from the preceding [*Physeter macroce-*

phalus], chiefly rest on the truncated teeth". This might indicate that Sibbald's species, afterwards named by Linné *Physeter Catodon*, in reality is the pilot whale (*Globicephala melaena*). Its occurrence in herds and the length (although newly born animals measure six feet) more or less fit in with the lines quoted above.

According to Allen (1881) the genus *Mular* with the species *M. Tursio* and *M. microps* is used by Leiblein (1839)¹⁾ next to *Physeter* with the species *macrocephalus*, *polycyphus*, *Trumpo*, and *cylindricus*.

The description of *Physeter pterodon* by Lesson²⁾ was not accessible to me.

The specific name "*australis*" first occurs in a paper by Gray (1844—1845) as a misprint for "*australasianus*", here the sperm whale described by Quoy and Gaimard was meant. In a later paper (Wall, 1887, first edition in 1851) the name *Catodon australis* is given to a new sperm whale in the Australian Museum. As the author of this species often MacLeay is cited, e.g., on the plate which is added to the second edition of Wall's publication. Moreover MacLeay is often cited as the author of the paper.

Leaving aside small differences in the spelling of the words six genera and nineteen species have been erected for the different forms of sperm whales which the older authors thought be able to recognize. Of some of these it could be proven that the names are synonyms of previously described "species", but still a fairly large number of "distinct species" remains.

In the *Recherches sur les Ossements fossiles* (1823, first edition 1812) G. Cuvier gave a critical review of the characters of the forms previously described as different species, and concluded that there is but one species of sperm whale. F. Cuvier (1836) was of the same opinion, and recognized but one species of sperm whale, *Physeter macrocephalus*. Gradually this opinion obtained more supporters, although some investigators, e.g., Gray, upheld the separation of the sperm whales into more than one genus and species.

Blyth (1863) named the sperm whale *Catodon macrocephalus*, and indicated as synonyms the names *Physeter trumpo*, *Ph. catodon* and *Ph. gibbus* (misprint for *gibbosus*). The species *macrocephalus* was already the type

1) Leiblein, V., 1839. Grundzüge eine methodischen Uebersicht des Thierreiches nach seinen Classen, Ordnungen, Familie'n und Gattungen, nebst Aufzählung ihrer Haupt-Repräsentanten. Würzburg. Not seen, title from Allen (l.c., p. 557).

2) Lesson, R. P., 1842, in: *Echo Monde Savant*, vol. IX. Not seen, title from Sherborn (1922—1933, p. 5206). Giebel (1855 a, note on p. 90) remarks that Lesson's description is based solely on a tooth from the South Sea, of cylindrical shape with conical crown, and with a sharp cutting edge at each side.

of the genus *Catodon* as this generic name was made valid for the first time by Linné (1761), who then mentioned *macrocephalus* as the only species, which thereby became the type of the genus *Catodon*. But as in 1758 the generic name of the sperm whale was given by Linné as *Physeter* the latter name has priority against the former.

In the book on the geographical distribution of mammals by Murray (1866) there is an appendix: "Synonymic List of Species of Mammals and their Localities". In this list we find under the genus *Physeter* (l.c., p. 340): "*macrocephalus* Linn. — (*Catodon*, *microps*, and *tursio*, Linn. *trumpo* Robertson. *gibbosus* Schreb. *cylindricus*, *orthodon*, and *sulcatus* Lacep. *polycyphus* Quoy and Gaim. *pterodon* Less.)". Consequently here the name *Physeter macrocephalus* is chosen as the valid name of the sperm whale, so that an end was made to the uncertainty. Trouessart (1898—1899) too regarded the name *Physeter macrocephalus* as the valid name, and placed *catodon*, *microps*, *tursio*, *trumpo*, *gibbosus*, *cylindricus*, *orthodon*, *sulcatus*, *polycyphus*, *pterodon*, *Kreffti*, and *macrocephalus* foss. into the synonymy of the species. Partially this was incorrect, as *Kreffti* is a synonym of *Kogia breviceps*, but the important result is that from now the name *Physeter catodon* is nothing else but a synonym of *Physeter macrocephalus*, a fact which cannot be undone by a later choice of a name among the four (*Catodon*, *macrocephalus*, *microps*, and *Trumpo*) used by Linné (1758).

As type of the genus *Physeter* was fixed the species *macrocephalus* by Slater (1901). Palmer (1904), who enumerates the four species of Linné, too indicates *macrocephalus* as the type of the genus.

According to Thomas (1911) the sperm whale should bear the name of *Physeter catodon* L. of which the name *macrocephalus* would be a synonym. This opinion, however, cannot be upheld, as previously (Murray, 1866) the name *catodon* was made one of the synonyms of *Physeter macrocephalus*. Next to the fact that *macrocephalus* is the valid name according to the Rules of Zoological Nomenclature the important circumstance remains that the name *macrocephalus* never has been in use for any other animal than the sperm whale, whereas the identity of Linné's species *catodon* is highly uncertain. Thomas (1911, p. 157) writes: "The absence of teeth in the upper jaw is a definite character, to which much weight should be attached; while the fact that females of the Sperm Whale go together in schools would account for the large number (105) stranded at Kairston, and their comparatively small size (24 feet)." The absence of maxillary teeth indeed points to the identity of *Physeter catodon* with the sperm whale; the other facts quoted by Thomas, however, decidedly indicate that *catodon* was not a sperm whale. The measurement, 24 feet, is the maximum size of the animals

stranded at Kairston as is stated by Ray (1713, p. 15), who writes: "Hoc genus ad portum Orcadensem Kairston dictum nuper appulit. Ex his maximæ 4 orgyas hoc est 24 pedes longæ erant. Caput iis rotundum, rictus parvus. Fistulæ carebant, sed in rostro nares habebant." This maximum length of 24 feet is very small even for female sperm whales, which in adult state are 10 to 13 meters long. Newly born animals already have more than half this size (cf. Wheeler, 1933, a specimen of 13 feet 3 inches). In the literature repeatedly the opinion is given that the specimens stranded at Kairston were white whales (Cuvier, 1812, 1823; Jenyns, 1835; de Sanctis, 1881).

Moreover female sperm whales are not known to occur as far north as the Orkney Islands. The two specimens recorded for the Scottish waters in the 30th Annual Report of the Fishery Board for Scotland (cf. Anon., 1911—1913) in reality were males (cf. Thompson, 1928 b). The occurrence of a very young specimen (a sucker) on the west coast of Ireland, in 1916, however, proved that sometimes females may wander as far north (Harmer, 1917). According to Anderson (1747) the herd of sperm whales stranded in the mouth of the Elbe in 1723 consisted of approximately as many females as males. Better known is the stranding of 31 sperm whales at Audierne in 1784, most of which were females. But these two cases together with the record of the young specimen of 1916 are the only facts proving that female sperm whales may occur in high latitudes.

Iredale and Troughton (1934) give a list of synonyms of the genus *Physeter* and of the species *P. australasianus*. In this list a few synonyms of *Kogia breviceps* are included. They regard *Physeter catodon* as the type species of the genus.

As a result of the paper by Thomas (1911) in the recent literature on sperm whales this animal generally is named *Physeter catodon*. Concerning this name Oliver (1922, p. 566) writes: "It has been the fashion recently to use the name *Physeter catodon* for this species, its only claim being priority of place on the page. On the other hand, its identity appears doubtful. Gray, Cope, and others applied it to the Arctic White Whale, whereas the identity of *P. macrocephalus* is clear, and the name has been in general use since its publication."

The following list is an attempt to give the synonymy of the species *Physeter macrocephalus*. Some of the synonyms are merely misspellings, others are doubtful synonyms (e.g., *Catodon*). To this list a few more synonyms perhaps could be added. An example is the name *Physeter polyclystus* Couch, cited by Lillie (1910), the original publication of which I

was unable to trace ¹⁾. Names as *albicans* which undoubtedly refer to other species of whales are omitted.

Physeter macrocephalus L.

- Physeter Catodon* Linné, Syst. Nat., ed. 10, 1758, p. 76.
Physeter macrocephalus Linné, Syst. Nat., ed. 10, 1758, p. 76.
Physeter microps Linné, Syst. Nat., ed. 10, 1758, p. 76.
Physeter Tursio Linné, Syst. Nat., ed. 10, 1758, p. 77.
Catodon macrocephalus Linné, Fauna Svec., ed. 2, 1761, p. 18.
Physeter Katodon Müller, Linné vollst. Natursyst., I, 1773, p. 497.
Physeter novae angliae Borowski, Gem. Nat. Thierr., II, 1781, p. 32.
Physeter andersonii Borowski, Gem. Nat. Thierr., II, 1781, p. 33.
Physeter Macrocephalus Bonnaterre, Tabl. Enc. Méth., Cétol., 1789, p. 12.
Physeter Catodon Bonnaterre, Tabl. Enc. Méth., Cétol., 1789, p. 14.
Physeter Trumpo Bonnaterre, Tabl. Enc. Méth., Cétol., 1789, p. 14.
Physeter Cylindricus Bonnaterre, Tabl. Enc. Méth., Cétol., 1789, p. 16.
Physeter Microps Bonnaterre, Tabl. Enc. Méth., Cétol., 1789, p. 16.
Physeter Mular Bonnaterre, Tabl. Enc. Méth., Cétol., 1789, p. 17.
Physeter macrocephalus niger Kerr, Anim. Kingd., 1792, p. 360.
Physeter macrocephalus cinereus Kerr, Anim. Kingd., 1792, p. 361.
Physeter microps falcidentatus Kerr, Anim. Kingd., 1792, p. 361.
Physeter microps rectidentatus Kerr, Anim. Kingd., 1792, p. 362.
Physeter gibbosus von Schreber, Säugthiere, 1792, pl. CCCXXXVIII.
Physeter maximus Cuvier, Tabl. Elém. Hist. Nat. Anim., 1798, p. 176.
Catodon trumpo de Lacepède, Tabl. Mamm., 1802, p. 60.
Physalus cylindricus de Lacepède, Tabl. Mamm., 1802, p. 60.
Physeter orthodon de Lacepède, Tabl. Mamm., 1802, p. 61.
Physeter mular de Lacepède, Tabl. Mamm., 1802, p. 61.
Physeter trumpo Virey, Nouv. Dict. Hist. Nat., IV, 1803, p. 44.
Physeter cylindricus Virey, Nouv. Dict. Hist. Nat., IV, 1803, p. 45.
physalus (genus) Duméril, Zool. Anal., 1806, p. 28.
physeterus (genus) Duméril, Zool. Anal., 1806, p. 28.
Cetus macrocephalus Oken, Lehrb. Nat. III (2), 1816, p. 675.
Cetus microps Oken, Lehrb. Nat. III (2), 1816, p. 677.
Cetus tursio Oken, Lehrb. Nat. III (2), 1816, p. 678.
Cetus orthodon Oken, Lehrb. Nat. III (2), 1816, p. 678.
Physeter mycrops Gérardin, Dict. Sc. Nat., VI, 1817, p. 61.
Physeter ortodon Gérardin, Dict. Sc. Nat., VI, 1817, p. 61.
Physeterus sulcatus de Lacepède, Mém. Mus. Hist. Nat., Paris, IV, 1818, p. 474.
Physeter australasianus Desmoulins, Dict. class. Hist. Nat., II, 1822, p. 614.
Tursio vulgaris Fleming, Philos. Zool., II, 1822, p. 211.
Tursio microps Fleming, Philos. Zool., II, 1822, p. 211.
physeter polycyphus Quoy and Gaimard, Voyage l'Uranie et la Physicienne, Zool., 1824, p. 77.

¹⁾ Couch (1878) records *Physeter macrocephalus* (sperm whale) and *Physeter polycyphus* (humped blower) as representatives of the Cornish fauna. A specimen of *P. polycyphus* stranded in Couch's time; he remarks that it probably is identical with the *Balaena monstrosa* of Ruysch (1718).

- Cetus cylindricus* G. J. Billberg, Syn. Faunae Scand., I (1), 1827, p. 38¹⁾.
Catodon polycyphus Lesson, Man. Mamm., 1827, p. 422.
Physeter sulcatus Lesson, Man. Mamm., 1827, p. 424.
Catodon Sibbaldi Fleming, Hist. Brit. Anim., 1828, p. 39.
Physeter cetadon Dewhurst, Nat. Hist. Order Cetac., 1834, p. 158.
Physeter gibbosa Dewhurst, Nat. Hist. Order Cetac., 1834, p. 168.
Mular Tursio Leiblein, Grundz. meth. Uebers. Thierr., I, 1839, p. 170¹⁾.
Mular microps Leiblein, Grundz. meth. Uebers. Thierr., I, 1839, p. 170¹⁾.
Physeter pterodon R. P. Lesson, Echo Monde Savant, IX, 18 Aug. 1842, p. 299¹⁾.
Physeter australis Gray, Zool. Erebus and Terror, 1844—1845, p. 22.
Catodon australis Wall, Skeleton new Sperm Whale, 1851, p. 1.
Physetes tursio Knauer, Handw. Zool., 1887, p. 551.

III. FIGURES OF SPERM WHALES

In the course of time a great number of different figures of sperm whales have been published. As this animal is so characteristically different from all other Cetaceans it usually gives no trouble to recognize a figure as an image of a sperm whale, although the proportions often are far from correct. In the following pages an attempt is given for a review of the figures of sperm whales which have been published in books and periodicals. No attention is given here to engravings or paintings which have not appeared in the literature (especially the zoological literature). The figures which appeared from 1860 onwards as a rule have not been dealt with separately, as the origin of these figures cannot easily be traced. No claim can be made for completeness of the list of figures, as especially numerous works which appeared in the last 100 years must have escaped my notice. The data on the figures mentioned below have been arranged in the chronological order of the occurrence of the sperm whales after which they were made.

1. The oldest figures of sperm whales.

In the middle of the sixteenth century several figures of sea monsters were published which undoubtedly were based on the at that time imperfect knowledge of sperm whales. Among the oldest figures are those of Olaus Magnus (1567, first edition 1555, cf. Allen, 1881). Especially the figure on p. 776, representing a sea monster in the act of destroying a vessel, is interesting. The figure shows a sea monster of large size with a wide blowhole at the top of the head (in the figure on p. 781 two blowholes are drawn, each at the extremity of a short tube). In the lower jaw two immense tusks are drawn and a nostril at the end of the snout. There is a gill cleft as in true fishes on which a number of rays are placed.

¹⁾ Not seen; cited after Allen (1881) and Sherborn (1922—1933).

The figures of Gesner (1558, earlier edition in 1555, cf. Neuville, 1932) undoubtedly are from the same source. The figure showing the destruction of a vessel by a sea monster (l.c., p. 138, upper figure) is easily recognizable as that of Olaus Magnus. In other figures the gill cleft is modified into a kind of collar. In most figures there are two blowholes, each at the top of a distinct tube, in one figure bristly eyebrows are drawn. Nearly all figures show two or three large tusks in the lower jaw, in one illustration (l.c., p. 138, lower figure) besides the two tusks there are a number of smaller teeth in the upper jaw as well as in the lower. In this figure the creature has a large forepaw like that of a land animal.

Some of the figures of Olaus Magnus and of Gesner are reproduced by Ashton (1890) and by Neuville (1932). Besides the authors cited above, Charlton (1668) mentions that these sea monsters have the habit of destroying ships by flooding them with water from their blowholes.

Killermann (1919, fig. 1) gives a picture from a work of Petrus Candidus, which shows similar sea monsters as those referred to above. In this picture four animals are represented, all of different shape: one has a single large blowhole, another two separate blowholes on the tops of tubes, the two other specimens do not possess blowholes. In one of these there is a crest of excrescences on the neck behind the head, the other has a smooth surface.

One of the figures of Herold (1557, plate on p. XXVI and XXVII fig. A) was made after an illustration of Gesner; the work contains a description of "Pfyser, sunst Physter gnannt", its manner of destroying ships, and how this may be avoided.

Another figure from the sixteenth century representing an animal called "Physeter" is the one found, e. g., in Rondelet (1554, p. 485). Probably this figure was made after dolphins, as both jaws show teeth of the same size and number. The blowhole is found in the posterior half of the head, the flukes and the flippers are similar to fins of fishes, they show numerous rays (cf. fig. 3 q). This figure remained for a long time in the literature on Cetacea, it is found, in a slightly different form, in Duhamel du Monceau (1782, pl. IX fig. 6), representing here the "mulard ou senedette", the explanation of the figure reads: "Fig. 6, Mulard de Rondelet, qu'il dit être le Souffleur des François; il a quelques ressemblances avec ce que plusieurs Auteurs disent du Cachalot." This confusion of the sperm whale with dolphins is found in other papers too, e. g., in Mann (1780), who mentions as rare visitors of the North Sea "*Cete* — le Cachalot" and "*Physeter* — la Sédenette". Stein's (1826) figure of the sperm whale represents an animal which shows some resemblance to the killer whale, this mistake probably is due to the same confusion.

2. The sperm whale of 1555.

In the Addenda to the Nomenclator of Gesner (1560), on page 367, there is a figure of a sperm whale which is more natural than any of the previous figures (cf. fig. 4 g). It was made after an animal stranded in the Adriatic in the year 1555. The head is squarely truncated in front, the upper part of the head appreciably longer than the lower jaw. In the lower jaw teeth are drawn of a quite natural shape, in the text the number of these is indicated as 44. Gesner states that there were no teeth in the upper jaw. In the middle of the head a hole is represented out of which water is ejected, in the foremost part of the head moreover a nostril is drawn. The flipper has a straight edge with pointed angles. The dorsal fin is shown as a well developed hump of quite natural appearance, it is found in its appropriate place. The shape of the flukes is very accurately represented, they are separated by a distinct notch. At their extremities, however, a number of fin rays are extending beyond the margin. The flukes are represented in a vertical plane instead of horizontally.

3. The sperm whale of 1566.

In the Royal Library at The Hague there is a manuscript by Adriaen Coenensoon entitled "Vis-boock", which contains descriptions and figures of fishes and other marine animals. Nyenhuis (1836) already published some remarks on these figures, more particulars about them are given by van Deinse (1918, 1931). One of the figures from the above-mentioned manuscript is published on a reduced scale by van Deinse (1931, vignette on cover). It represents the sperm whale stranded at Zandvoort on the Dutch coast in 1566. The figure shows sufficiently that the animal represented is a sperm whale. Especially the palate with the pits with which the tips of the mandibular teeth are corresponding gives evidence for the identity of the animal as a sperm whale. The head is rounded in front, there is a large blowhole. The dorsal fin is represented as a thin excrescence with a posterior, pointed tip, the flukes are very large whilst the flipper is small.

The manuscript referred to above is from 1578, it contains two more figures of sperm whales (cf. van Deinse, 1931), but the one mentioned above is the only figure which was published.

4. The sperm whale of July 1577.

An old engraving by an unknown artist of a sperm whale stranded at Hastings in den Doel, at about five miles from Antwerp, on July 2, 1577, is reproduced by van Deinse (1918, pls. II and III). The somewhat

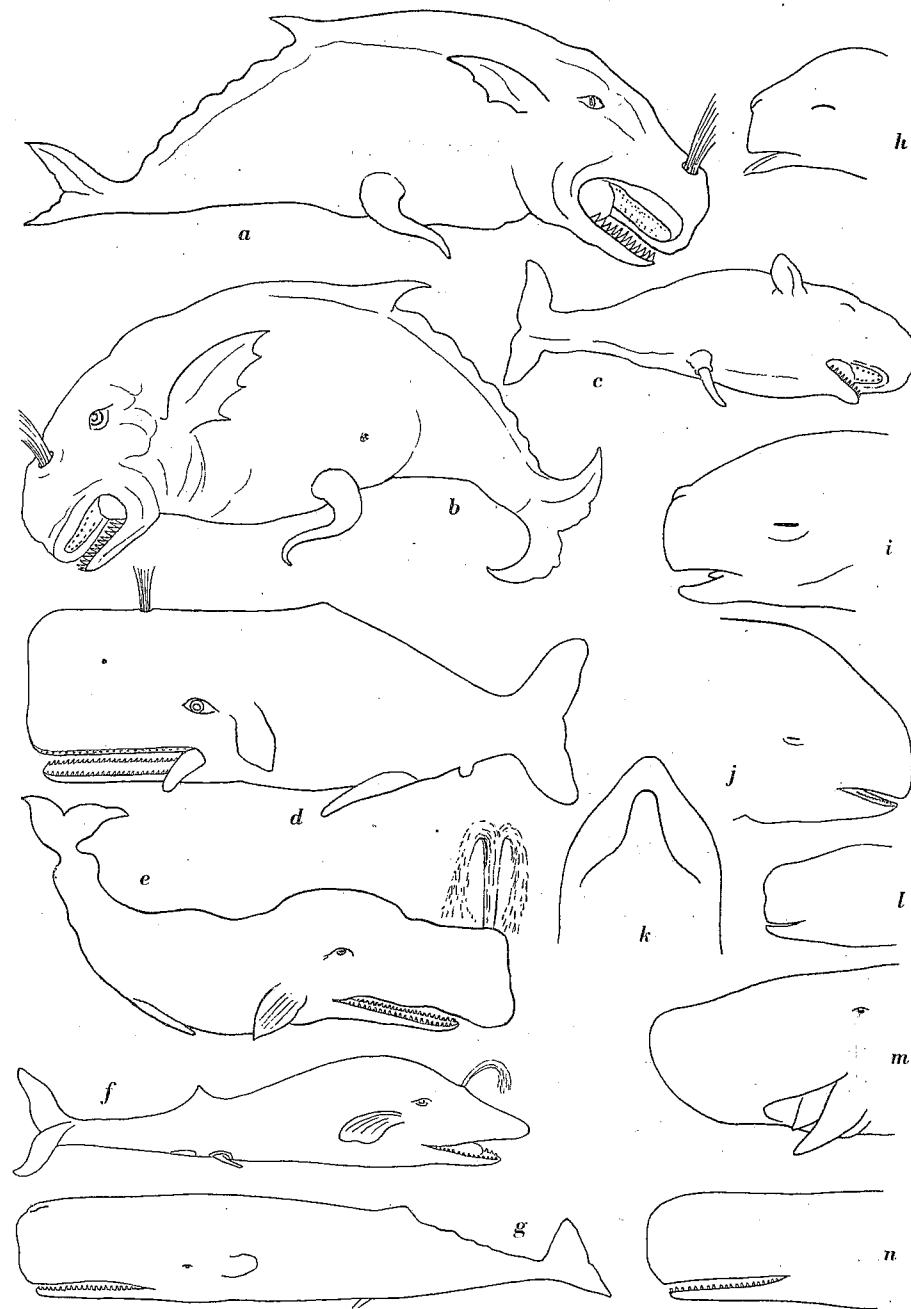


Fig. 2. Outline drawings after figures from different authors. a, Paré (1604, p. 827); b, Aldrovandus (1613, p. 682); c, Clusius (1605, p. 131); d, Anderson (1747, pl. opp. p. 250); e, Köhne (1724, pl. opp. p. 16); f, Sibbald's figure, from Bechstein (1801, pl. XX fig. 2); g, de Sanctis (1881, pl. VII fig. XXI); h, Beddard (1919, text-fig. 2); i, Beddard (1919, text-fig. 5); j, Kükenthal (1914, pl. 3 b fig. 34); k, Kükenthal (1914, pl. 3 b fig. 35); l, Beddard (1915, pl. VIII fig. 1); m, Wheeler (1933, pl. I fig. 1); n, Lillie (1910, text-fig. 78).

disfigured head is rather truncated, the foremost part projects very little beyond the mouth opening.

Van Beneden (1888) too refers to some old prints of sperm whales. The oldest drawing from the collection in the Royal Library at Brussels is after a sperm whale stranded at Hastings. Possibly this drawing is the same as the one reproduced by van Deinse (1918), it certainly is different from Paré's figure dealt with below, as van Beneden (1885, 1888) mentions the latter figure too.

The same animal is figured differently in the works of Paré (1604, p. 827). The sperm whale is represented here in side view (cf. fig. 2a), twelve broad, pointed teeth are drawn in the right half of the lower jaw, the impressions of these teeth in the palate are indicated. The snout does not project beyond the mouth, the blowhole is represented on the right side of the truncated head. The dorsal fin ends in a sharp point, between this and the tail there are seven small humps. Three persons, one of which on the steps of a ladder, are measuring the animal. The figure gives a fairly good idea of the chief particulars of a sperm whale, although in many points it is somewhat phantastical. Repeatedly this figure is cited as the oldest image of a sperm whale (de Selys-Longchamps, 1842; de Quatrefages, 1844).

As already pointed out by van Beneden (1888), the figure of Paré has been copied by Aldrovandus and by Jonston. In the figure of Aldrovandus (1613, p. 682) the sperm whale is seen from the left side, and the blowhole therefore now is found approximately at the right place (cf. fig. 2b). The figure differs slightly from that of Paré: the animal is thicker in comparison to its length, the tail is more symmetrical. The dorsal fin and the small humps between this fin and the tail are similar in the two figures.

The figure of the "*Balaena Monstrosa*" in Jonston (1657 and 1660, pl. XLI, third figure) is a copy of that of Aldrovandus with alterations. The left side of the animal is represented, it is thinner than in Aldrovandus' figure, but the tail corresponds in every detail. Ruysch (1718), who used Jonston's plates, shows the same figure.

5. The sperm whales of November 1577.

In Brussels there is an engraving by J. Wierics, representing three male sperm whales stranded on the Dutch coast near Ter Heide, on November 22 and 23, 1577. Moreover the print shows ten sperm whales in the sea, in the immediate neighbourhood of the shore. Van Deinse (1931, frontispiece) gives an excellent reproduction of this print, which is found too in a paper by Mohr (1935). The sperm whales are represented with rather squarely

truncated head, which projects very little beyond the lower jaw. With the exception of those in the background the animals show a blowhole at the right side of the head. In one of the stranded specimens two spouts of water are being ejected from the two blowholes, in one of the animals in the sea also two separate spouts of water are visible. The flippers are represented as having a straight distal border, the dorsal fin is drawn as a thin excrescence with a sharp point directed backwards. The slender lower jaw and the narrow palate are represented in their characteristic shape in the specimen in the foreground of the figure.

6. The figures of Matham and van der Gouwen of the sperm whale of 1598.

In the beginning of February, 1598, a large male sperm whale stranded at Berkheide, a no more existing village on the Dutch coast between Katwijk and Scheveningen (cf. van Deinse, 1931, p. 179). An India ink drawing of this whale is in the collection of Teyler's Museum at Haarlem. It is signed at the bottom with the monogram of the painter H. Goltzius, but, according to Scholten (1904), probably J. Matham, a pupil and son in law of Goltzius, was the draughtsman. This drawing served as a model for engravings by Matham and by G. van der Gouwen, corresponding in almost every minute detail except the signatures at the bottom. The sperm whale is lying on its left side, the mouth is open, so that the teeth of the lower jaw and the cavities in the gum of the upper jaw are visible. The left half of the flukes is partly buried in the sand, the penis is fully extended. The head is rather short and truncated, it extends very little in front of the mouth opening. Numerous persons are pictured around the whale, visitors on horseback, in carriages, and on foot, and people engaged in collecting oil or in the beginning of flensing.

Matham's engraving is represented on a reduced scale in Nielsen (1935, opposite page 9), the engraving signed by van der Gouwen is reproduced in Bor (1684, between page 432 and 433) and in Leti (1690, opposite page 113). A reduced figure of Matham's or van der Gouwen's print is found in Robin (1923, page 281). An outline of the head, after the engraving in Bor (l.c.) is given in fig. 31.

Turner (1878) describes in some detail a print by Turpin, representing a sperm whale stranded at Ancona (Italy) in 1601. With the exception of the partially retracted penis the print corresponds in every detail with those of Matham and van der Gouwen. It is, therefore, safe to assume that the artist took the existing print as his model and added a new explanation, including "drawn from nature" (cf. Turner, 1878).

A similar though less obvious case is the print by Schönemann, represented on a reduced scale by Mohr (1935, fig. 5). According to the explanation of the figure it represents a sperm whale stranded at Ritzbüttel (near the mouth of the Elbe) in 1723. The figure undoubtedly is made after Matham's or van der Gouwen's print, although there are some differences: the head does not project beyond the mouth opening, the eye and the flipper are different. In comparison to the original just a few persons are represented, but each of these nearly exactly corresponds with one in the original picture and occupies approximately the same place. Even an anchor, a few pieces of wood and a hatchet are represented in a corresponding manner.

Hirth (1885, fig. 1533) represents a figure taken from Gottfried's *Historische Chronica*, 1674. The figure shows the sperm whale of 1598 as figured by Matham and van der Gouwen, with the greater part of the people and other surroundings as given by these engravers. Though differing in many details, the figure taken as a whole unmistakably represents the same scene. It is stated to represent the "Walfisch von Antorf, 1603" (the sperm whale of Antwerp of 1603). The same figure is found in the work of de Vries (1702), which is a Dutch version of and a sequel to Gottfried's work. In the text (de Vries, 1702, column 556/557) the sperm whale of Berkheide, 1598, and that of Antwerp, 1603, are briefly mentioned.

In this connection mention may be made of a short account of strandings of sperm whales on the Dutch coast (Anon., 1870), accompanied by a figure after Matham or van der Gouwen. The sperm whale is indicated as the specimen of 1598, the figure of the animal bears a strong likeness to that of its contemporary engravers, though its eye and tail are different, and the penis is omitted. The people surrounding the sperm whale are quite different, their costumes too are entirely different, and are from a much later period.

The "aliud Cete admirabile" of Clusius (1605, p. 131) was described after the sperm whale stranded in 1598 at Berkheide. The figure undoubtedly was made after Matham or van der Gouwen, as results from the shape of the head, the flipper and the penis. The left fluke has been added to the tail (cf. fig. 2 c).

The same figure is given by Nieremberg (1635, copied from Clusius), and the sperm whale after which this figure was made became known in literature as "Cete Clusii" or "Cetus dentatus à Carolo Clusio descriptus" (e. g., Charlton, 1677; Willoughby, 1686; Klein, 1741; Linné, 1758; Gmelin, 1789).

Jonston's two figures of "Balaena" (upper part of Tab. XLI in Jonston, 1657 and 1660) represent animals of similar shape, easily recognizable as

sperm whales. At least the second figure undoubtedly was made after Matham's or van der Gouwen's print, as is indicated by the shape of the head, the penis, and the tail, the part of which that was buried in the sand is omitted here. Ruysch (1718) gives the same figures, as his plates are those of Jonston.

Willoughby (1686, Tab. A 1 fig. 3, Balaena) gives a figure of a sperm whale corresponding in almost every detail with the animal figured by Matham and van der Gouwen.

The figure in Pontoppidan (1754, wallfisch, plate opposite page 209) undoubtedly too is after the same original, although it is a bad copy. The position of the eye, the shape of the tail, the palate and the badly drawn lower jaw, the flipper bear an unmistakable similarity to the original.

Borowski (1781 b, Cet: III A) gives a figure in which Matham's or van der Gouwen's print easily can be recognized. The same holds for the figures given by von Schreber (1792, cf. Sherborn, 1891) and Strack (1820?).

Pasteur (1800) published a coloured plate of a stranded sperm whale which is easily recognizable as having been made after Matham's or van der Gouwen's original.

The figure of Shaw (1801, pl. 228, lower figure) without any doubt too was based upon Matham's or van der Gouwen's print. The draughtsman, however, concealed the conspicuous penis behind a stone in the foreground and provided the lower jaw with broad sharp teeth like those of a shark. The tongue is very badly drawn. The figures of Pöppig (1851, fig. 1085) and Giebel (1859, fig. 915) probably are drawn after that of Shaw mentioned above. They show the same row of sharp broad teeth in the lower jaw and the entirely misunderstood tongue. The penis is drawn here at full length. Instead of the pits in the palate as visible in Shaw's figure, those of Pöppig and Giebel show a row of distinct teeth in one half of the upper jaw. This probably is a mistake made by the draughtsman, as Pöppig and Giebel describe the teeth of the upper jaw as rudimentary.

In a pamphlet on the sperm whale of Berkheide (Anon., 1598?) there is a small figure, probably made independently from those of Matham and van der Gouwen.

In the literature after 1758 the figures of sperm whales which are derived from Matham's or van der Gouwen's originals, are indicated with the specific name *macrocephalus*.

7. Saenredam's figure of the sperm whale of 1601.

One of the very best figures of sperm whales is the engraving by Saenredam of the animal stranded in 1601 at Wijk aan Zee at the Dutch coast.

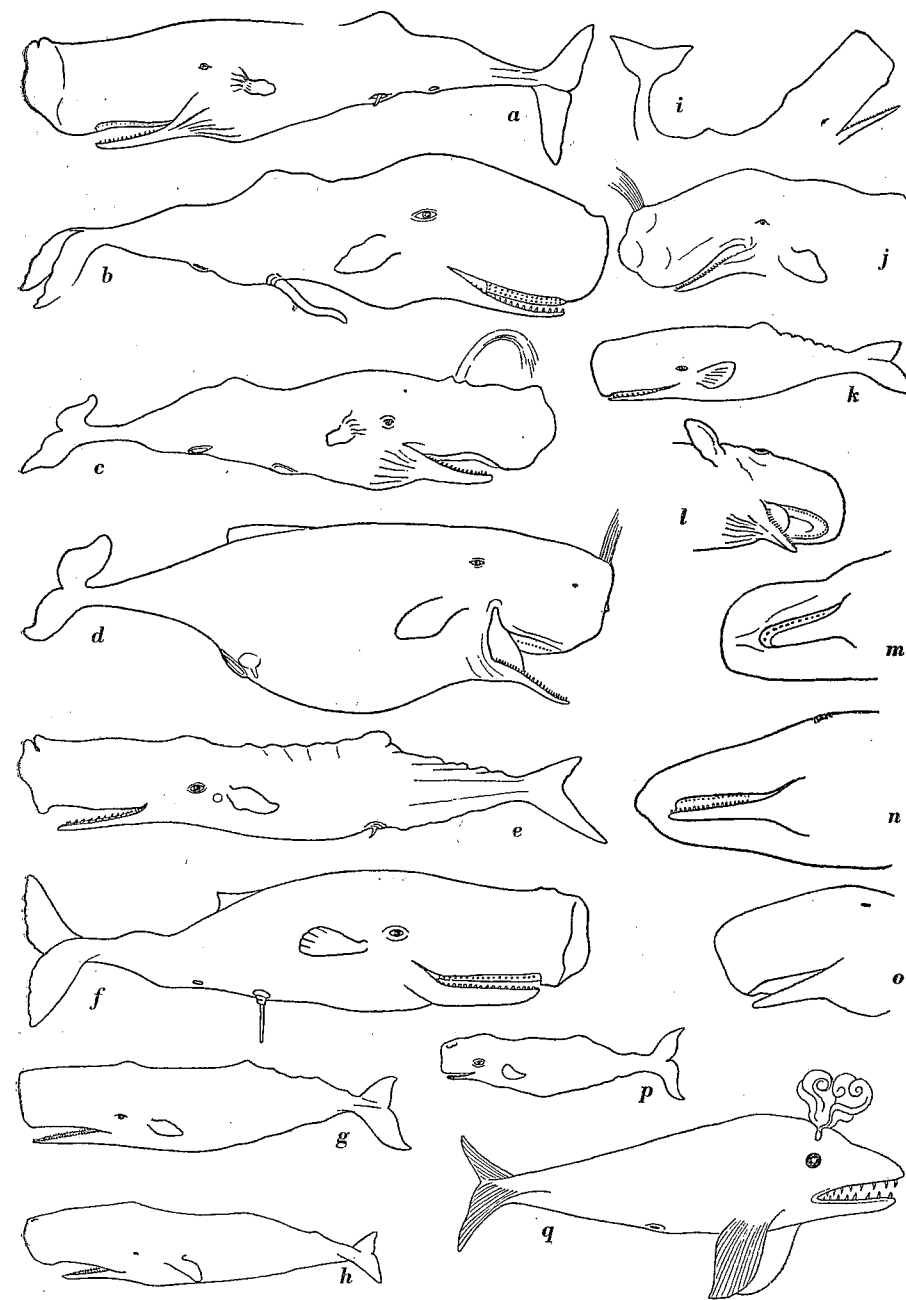


Fig. 3. Outline drawings after figures from different authors. a, Robertson (1771, pl. IX); b, Pennant (1776, pl. VI); c, Dewhurst (1834, pl. opp. p. 148 fig. 2); d, Bonnaterre (1789, pl. 7 fig. 2); e, Quoy and Gaimard (1824, pl. 12); f, Cuvier (1836, pl. 19 fig. 1); g, Scammon's figure, from Bailey (1936, pl. 49 fig. A); h, Howell (1930, fig. 9 a); i, Beale (1839, frontispiece); j, Jardine (1837, pl. 9); k, Bennett (1840, p. 153); l, van der Gouwen's engraving, from Bor (1684, between pp. 432 and 433); m, Jonston (1660, pl. XLII); n, Pouchet and Beauregard (1889 a, pl. I fig. 2); o, Pouchet and Beauregard (1892, pl. I fig. 1); p, Colnett's figure, from Jardine (1837, p. 174); q, Rondelet (1554, p. 485).

The animal is lying on its right side, the ventral surface is represented. The head extends distinctly beyond the end of the lower jaw, the keel at the underside is clearly visible. The depressions in the palate caused by the mandibular teeth are accurately drawn. A gradually accumulated mass of spermaceti extends from the sand of the shore to the corner of the mouth. Count Ernest of Nassau and other prominent people are depicted in the foreground, here too the artist himself is seen drawing the animal. Numerous other people are represented on the scene. In the upper part of the plate the head of the sperm whale is represented in front view and in dorsal view. The former shows the teeth of the lower jaw and the blowhole, the dorsal view shows the somewhat tapering foremost part and the slitlike blowhole.

A reduced figure after Saenredam's print is found in a paper by Kilterman (1919).

In Jonston (1657 and 1660, pl. XLII) a reproduction of Saenredam's engraving is found, but of much less artistic value. The sperm whale corresponds in approximately every detail with that of the original figure, the people surrounding the animal are quite different. The same figure is contained in Ruysch (1718), it is reproduced on a smaller scale in de Pauw and Willemsen (1905). Fig. 3 m is an outline of the head, after Jonston's figure.

Bonnaterre's figure (1789, pl. 6 fig. 1) represents the sperm whale after Saenredam or Jonston. Blumenbach (1796—1810) has a similar figure, which, according to the author, was made after Saenredam's engraving; a figure of the lower jaw with the teeth was added. Brandt and Ratzeburg (1829) copied the animal from Jonston's figure. A description of the original print by Saenredam is found in a paper by Turner (1878).

Saenredam's sperm whale forms the center-piece of a figure in Nieuhof (1665, p. 159). The landscape and the people are Chinese, and in the foreground there are numerous tropical fishes of different kinds.

In the publications by Bonnaterre, Blumenbach, and Brandt and Ratzeburg the sperm whale dealt with above is identified with the specific name *macrocephalus*.

8. The sperm whale of 1606.

In the Rijksmuseum van Natuurlijke Historie there is a painting by an unknown artist representing the sperm whale which stranded in January 1606 on the Springersplaat near Brouwershaven on the Dutch coast. The picture measures 160 by 260 cm, a reproduction is given by van Oort (1919, opposite p. 7). The sperm whale has a large head which is rather

squarely truncated in front, the lower jaw with its pointed teeth is distinctly shorter than the head. On the palate the depressions caused by the mandibular teeth are faintly indicated. The eye and the flipper are not visible, the flukes are of large size. More particulars about the picture are given by van Deinse (1918, p. 40/41).

9. Sibbald's figures.

Allen (1881, p. 464) remarks about a book by Sibbald (Robert Sibbald, *Phalainologia nova*, 1st ed., Edinburgh, 1692; 2nd ed., London, 1773¹⁾: "Plate i, upper figure, is a very faulty representation of *Physeter macrocephalus*, the blowhole being at the posterior part of the head and the upper jaw rather small and pointed." This animal was named by Sibbald "*Balaena Macrocephala*".

Brandt and Ratzeburg (1829) state that plate CCCXXXIX in Schreber (1792, cf. Sherborn, 1891) is a copy of Sibbald's figure. Here it bears the name *Physeter microps*, the same figure and name occur in Bechstein (1801, pl. XX fig. 2). The figure represents an animal of slender shape with pointed jaws. The lower jaw is broad and but little shorter than the upper. The blowhole is found in the posterior half of the head. The dorsal fin is thin and sharply pointed (cf. fig. 2 f).

As Sibbald was regarded as a person of great authority (cf. Allen, 1881, p. 464) the figure could be used for long years as the image of a sperm whale. Later authors who used the same figure gave another explanation. The figure in Pöppig (1851, fig. 1061), which undoubtedly is made after Sibbald's original or after one of the books cited above, bears the legend "Delphin". Giebel (1859, fig. 901) uses a similar figure and names the animal "Gemeiner Delphin".

The name *microps* as used for the animal originally figured by Sibbald, is not a synonym of *Physeter microps* Linné 1758. In his synonyms Linné gives under the four species recognized by him the diagnoses of Ray, who copied them from Sibbald. In Linné's species *macrocephalus* and *Tursio* the word "macrocephala" occurs in these diagnoses, not in Linné's species *Catodon* and *microps*. Allen (1881, p. 464) states that the figure of the sperm whale on Plate I of Sibbald is indicated as "*Balaena Macrocephala*". Consequently Sibbald's figure cannot represent Linné's species *microps*.

Some interesting figures of whales are found in a paper by Walker (1871—1872, pl. II figs. 1—3). Two of these (figs. 2 and 3, representing the same animal in dorsal and lateral view) undoubtedly are made after a sperm

1) Not seen.

whale. Walter remarks that these figures on the original drawing are marked in Sir Robert Sibbald's hand "A Spermaceti Whale", and in another hand "Whale at Monyfeeth, Feb. 23, 1763", etc. In the same paper reference is made to a statement by Sibbald about materials for a second part of his "Phalainologia"¹⁾. Probably the drawings belonged to these materials. Especially the lateral view of the sperm whale (cf. fig. 5) is interesting, as it shows that the upper part of the head is prolonged beyond the tip of the lower jaw to a considerable degree. The lower jaw has distinct teeth, the upper jaw appears toothless. The head is somewhat deformed, the flippers are placed too far posteriorly, and the dorsal fin is hardly indicated, but the general shape of the body proves without any doubt that the figure was made after a sperm whale, which cannot be said of the figure dealt with above. In the dorsal view of the animal the blowhole is indicated as a longitudinal curved slit in the anterior part of the head, but by mistake on the right side. Moreover the eyes are placed too far dorsally, but these are mistakes of minor importance, as compared to those of numerous illustrations of later years.

10. The figures of Köhne (Hasaeus?).

In 1723, T. Hasaeus published a pamphlet (*De Leviathan Jobi en Ceto Jonae disquisitio, Bremae*)²⁾ intended to prove that the Leviathan in the book of Job and Jonah's whale could not have been anything else but sperm whales. A translation of this work with additions by the translator was published by Köhne (1724). The latter work contains a plate (l.c., opposite p. 16) on which two sperm whales (or one specimen seen from two sides), a lower jaw, and three mandibular teeth are represented. The head of the sperm whales is truncated in front, the blowhole is represented on the left side of the anterior part, the lower jaw is noticeably shorter than the rest of the head. In one of the figures the pits of the palate corresponding with the maxillary teeth are distinctly visible. In both figures the dorsal fin is indicated, and, moreover, a distinct swelling of the tail before the flukes.

The smaller of the two figures, an outline of which is given in fig. 2 e, was the model for the figure given by Zorgdrager (1728). The latter shows some differences with Köhne's figure, as the head is more obliquely truncated and the swelling of the tail is less pronounced. Moreover two spouts of

1) Sibbald (1708) makes some remarks on his plans for a second volume of his *Natural History of Scotland* which will contain especially Fishes and other Aquatiles; several plates for this work were ready and other in preparation.

2) Not seen.

water emerge from the head instead of the single one in Köhne's figure. The figure in Oken (1816, pl. XXXVII, *Cetus*) is a copy of the one in Zorgdrager.

There exists another figure of a sperm whale which probably is derived from the same original, viz., Anon., 1783, pl. 50. In this figure the blowhole is found at some distance from the anterior border of the head, and teeth are drawn in the upper jaw as well as in the lower. The shape of the tail and of the eye, and especially that of the flipper bear a striking resemblance to corresponding details of Zorgdrager's figure.

11. The sperm whale of Neuwerk (Ritzebüttel).

Near Neuwerk, at the mouth of the Elbe (in other publications the locality is given as Ritzebüttel) a herd of 17 sperm whales stranded in December, 1723. In the archives of Hamburg there is a manuscript containing a drawing of one of these animals, which is reproduced by Mohr (1935, fig. 4). The sperm whale shows a muzzle rounded in front, extending for a considerable distance beyond the lower jaw. In the latter sharp pointed teeth are drawn, and in the upper jaw there is a series of blunt knobs which might be meant as maxillary teeth. As the drawing, however, is rather primitive, the series of roundish appendices of the upper jaw might perhaps indicate the depressions of the palate caused by the tops of the teeth of the lower jaw. At the left side of the head there are two spouts of water, ejected from the single blowhole, and directed obliquely forward. The flipper is rather diagrammatically indicated, the dorsal fin is found at the right spot and has approximately the right dimensions. Between the dorsal fin and the flukes there are a number of minute excrescences, possibly representing the small humps which are commonly occurring here.

In the manuscript referred to above it is stated that the herd consisted of about as many males as females (cf. Mohr, 1935, p. 352). Anderson (1747) could dispose of the same information, in his book he largely puts forth the particulars about these sperm whales. Some of the teeth of specimens from the herd of 1723 came into Anderson's possession, and are described by him.

12. Baier's specimen.

A cetacean of about 14 meters length stranded near Nice, in the south of France, on November 10, 1726. A paper on this animal was amongst those which Vallisneri sent to Baier (1733). The paper is accompanied by a picture which shows that it was 5 fathoms long (Baier, 1733, pl. I fig. 1). Each side of the lower jaw contains 14 teeth, there are corresponding pits in the palate. The head extends slightly beyond the tip of the lower jaw, the

blowhole is found in the posterior half of the head. The tail has artistically curved flukes, the dorsal fin is thin and rather high, the flipper is small and seems to contain finrays. The eye is large, the spout of water from the blowhole forms a high fountain (only the lower part of this represented in fig. 4a). Baier compares this specimens with the sperm whales described by Nieremberg, Clusius, and Paré. Especially the shape of the head and the pits in the palate give evidence for regarding the cetacean as a sperm whale.

Risso (1826) describes the cetacean of Nice as *Delphinus Bayeri*. He possessed a figure of the animal (not published in the cited work), which proved that it was made after the same animal as Baier's figure. In the description of *Delphinus Bayeri* it is explicitly stated that teeth of similar size occur in the upper jaw as well as in the lower, 34 at each side. Risso regards the animal as a dolphin, through he admits that the head shows some similarity to that of a sperm whale, especially because it has about one third of the length of the body.

Cuvier (1836) too classifies *Delphinus Bayeri* Risso amongst the dolphins, although Cuvier admits its likeness to a sperm whale by its length and its comparatively large sized head.

13. Anderson's figure.

A figure of the sperm whale which stranded in 1738 near the river Eider (Schleswig-Holstein) is given by Anderson (1747). The figure shows an animal with squarely truncated head and a comparatively thick, short body. The lower jaw extends nearly to the end of the head. There is a blowhole at the top of the head, approximately in the middle of its length (cf. fig. 2d). The figure is reproduced on a smaller scale by Mohr (1935), and, with a Dutch explanation instead of the original German, in Anon. (1784) and de Jong, Kobel and Salieth (1792).

Repeatedly Anderson's figure has been used as a model for illustrations of sperm whales, by its ungainly shape it always is easily recognized, though later artists often made slight alterations from the original. Anderson's figure, unaltered or slightly modified, besides in the works mentioned above, is found in the following publications: Borowski (1781 b), Bonnaterre (1789), Sonnini (1804), Oken (1816), Strack (1820?), Brandt and Ratzeburg (1829), Dewhurst (1834), and Desmarest (1847).

The description of *Phiseter Cylindricus* by Bonnaterre (1789) is based on Anderson's figure and notes. Brandt and Ratzeburg (1829) and Dewhurst (1834) too indicate the figure with the specific name *cylindricus*. On the other hand Borowski (1781 b) and Strack (1820?) use the name

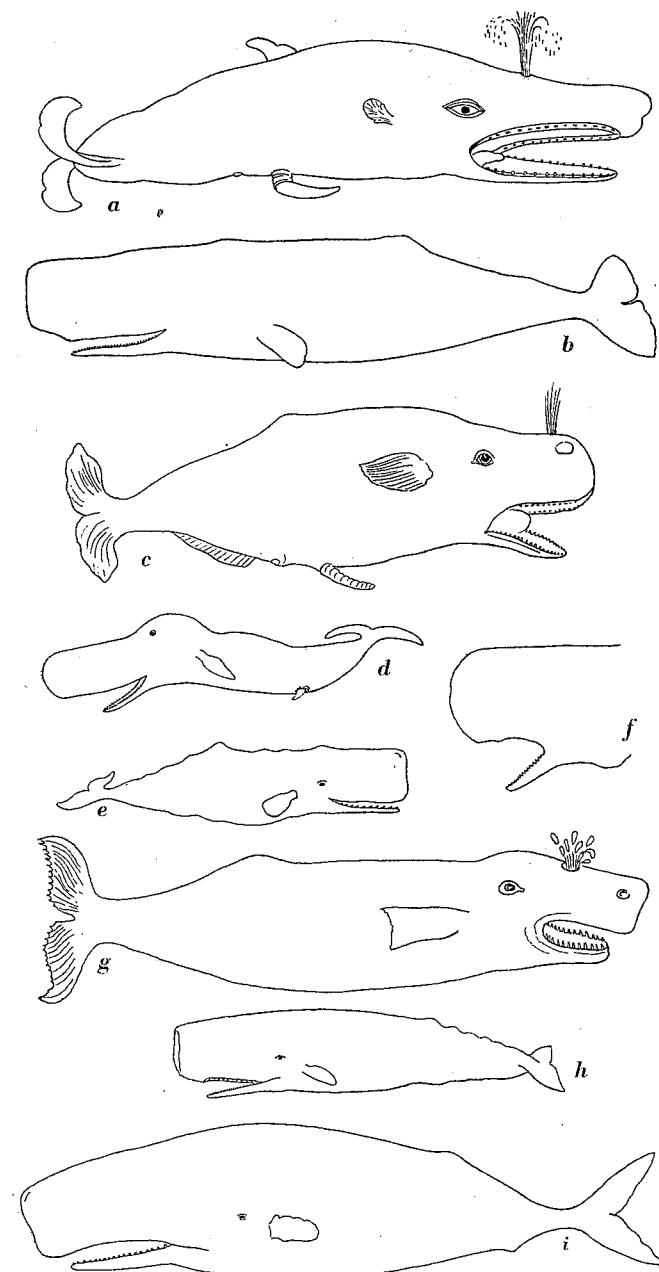


Fig. 4. Outline drawings after figures from different authors. a, Baier (1773, pl. I fig. 1); b, Peters (1930, p. 313); c, Duhamel du Monceau (1782, pl. XV fig. 3); d, Thompson (1829, fig. 114); e, Beale (1835, fig. 1); f, Monaco (1888, fig. 1); g, Gesner (1560, p. 267); h, Fraser (1937, fig. 67); i, Barceló (1879, p. 19).

Physeter microps in the explanations of the figures which undoubtedly are drawn after Anderson's original.

14. The sperm whale stranded in the Adour in 1741.

In 1741, on April 1, a sperm whale stranded in the river Adour, near Bayonne. The military surgeon Despelette sent some notes and a drawing of the animal to M. de la Peyronie, who forwarded these to the Royal Academy of Sciences at Paris (cf. Despelette, 1744). The animal was 49 feet long, it possessed 18 teeth in each half of the lower jaw.

Duhamel du Monceau (1782) gives some particulars about a sperm whale from Bayonne which in all probability is the same as Despelette's animal: its length is stated as 48 feet and the number of teeth in each half of the lower jaw as 18 or 20. The animal is represented on plate XV fig. 3 of the cited work (Despelette's figure?), it shows the teeth in the lower jaw and the depressions in the palate of the upper jaw caused by these teeth. The head does not project noticeably beyond the extremity of the lower jaw, it is evenly rounded in front. A spout of water seems to be ejected from a blowhole in the centre of the anterior dorsal region of the head, next to this a nostril is indicated. The dorsal fin is indicated as a slight hump. At the ventral side, between the anus and the flukes of the tail, a kind of anal fin is represented with distinct rays. In the flukes themselves too some lines are drawn which might mean an indication of rays, the same applies to the flipper (cf. fig. 4 c).

Quite another figure of the sperm whale of the river Adour is that given by Cuvier (1816—1829, pl. 99 fig. 2; 1836, pl. 19 fig. 1). In this figure the anterior part of the head is squarely truncated, the grooves at the dorsal region and the sharp keel at the ventral part are distinctly visible. The head extends beyond the extremity of the lower jaw; the latter fits into a groove of the lower part of the head. The blowhole is represented on the top of the head at some distance from the anterior border. The dorsal fin has a rather sharp top, it is thin like that of a fish (cf. fig. 3 f).

The figure of the sperm whale in Guérin-Ménéville (1829—1844) is drawn after that of Cuvier; here, however, the blowhole is found at the right side of the head. Another figure for which the one of Cuvier has served as a model is that of Pizzetta. The figure in the atlas of the Dictionnaire in which Gentil (1833—1834) wrote the article "Cachalot" is easily recognizable as having been made after the same original. Moreover Cuvier's figure is represented, slightly modified, in Beale (1839). The figures of the sperm whale in Pouchet (1841) and in Vogt (1851) too are made after that of Cuvier.

Duhamel du Monceau (1782) does not use a scientific name for the animal from the Adour; Cuvier (1816—1829, 1836) names it *Physeter macrocephalus*.

15. The figure in the Encyclopédie of 1768.

In the article "Cachalot" Daubenton (1751) gives a description of the sperm whale, largely based on Willoughby's account which the latter author copied from Clusius, and on Anderson's statements. No reference is made in this article to the figure which occurs on plate XXIV of the "Recueil de Planches" of the same work, which appeared in 1768. Here an illustration

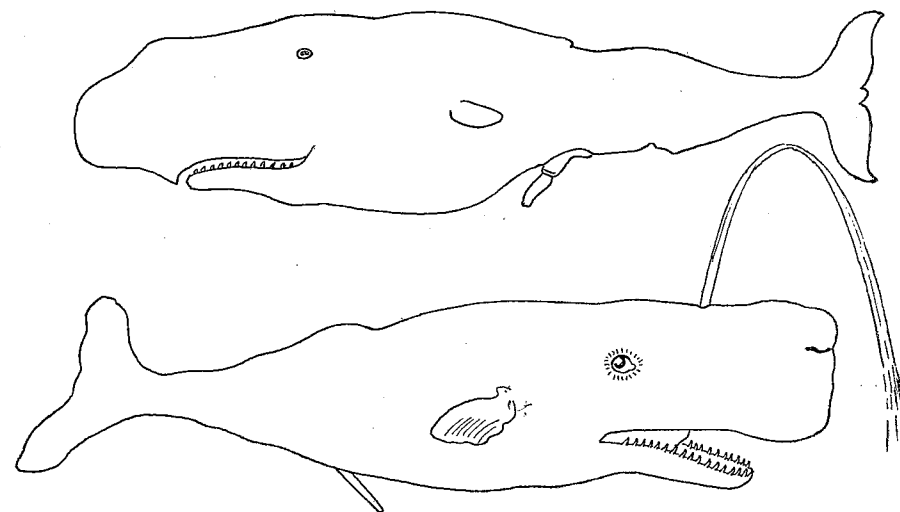


Fig. 5. Upper figure, outline drawing after Walker (1871—1872, pl. II fig. 3); lower figure, outline drawing after Daubenton (1768, pl. XXIV fig. 2).

of a sperm whale is given which has excellent qualities (cf. fig. 5). The proportions of the animal are much better than those of numerous later figures. The truncated head projects noticeably in front of the tip of the lower jaw. The flipper and the dorsal fin are drawn in the right place, both are represented in a quite natural manner. The eye is too large and placed too high. Besides the groove on the anterior part of the muzzle which undoubtedly represents the blowhole (although it is found on the right side) the figure shows a spout of water originating from the middle region of the head. Consequently in its general aspect the head is strikingly similar to the much later figure of Dewhurst (1834, cf. fig. 3 c), which, however, is a copy of the one by Robertson (1771). In the figure of 1768 no grooves are drawn at the throat and the rows of teeth of both sides of the lower jaw are clearly visible.

16. Robertson's sperm whale.

Robertson (1771) described a sperm whale stranded in the Firth of Forth in December, 1769. He remarks that the upper jaw projected five feet over the lower, and his drawings (l.c., pl. IX) are fairly accurate. The foremost part of the head is rather truncated, the blowhole occupies the centre of the anterior upper margin. The dorsal fin is rather large, the flipper is of comparatively small size. Several grooves are visible under the posterior part of the lower jaw. A transverse section of the anterior part of the snout shows the two shallow grooves at each side of the dorsal region, and the keel in the ventral part. The tail is slightly twisted, one of the flukes extends upwards, the other downwards (cf. fig. 3 a).

Bonnaterre (1789), von Schreber (1792), and Brandt and Ratzeburg (1829) give accurate reproductions of Robertson's figure.

There is a copy of Robertson's figure in de Lacepède (1804), which in some respects differs from the original: the blowhole is drawn on the top of a slight excrescence, and the flukes are smaller and bent in a different manner.

In Dewhurst (1834) there is a figure which in nearly every respect corresponds with that of Robertson; the blowhole, however, is drawn here in the posterior region of the head (cf. fig. 3 c).

One of Jardine's figures (1837, pl. 8) is drawn after Robertson's original. It is slightly different but the chief particulars are distinctly recognizable. Hamilton (1852, pl. 8) has the same figure, and the figure of Nicholson (1871) undoubtedly was made after that of Jardine.

Bell (1837) published a figure of a sperm whale which is easily recognizable as a copy of that of Robertson (1771) with slight alterations. The figure of Freund (1932, fig. 30) is made after Bell's illustration, as stated by the author. Trouessart (1884) gives a figure of a sperm whale which bears a strong resemblance to that of Bell.

Many different names have been attached to Robertson's sperm whale. Robertson (1771) named it *Physeter Catodon*, Bonnaterre created for this animal the new specific name *Phiseter Trumpo*, von Schreber used the new specific name *Physeter gibbosus* (indicating Pennant's figure, see below, with the same name), Nicholson (1871) placed the name *macrocephalus* under a figure made after Robertson's original. The name *trumpo* is moreover found under figures of the same animal in the publications of Brandt and Ratzeburg (1829), de Lacepède (1804), and Dewhurst (1834).

17. Pennant's figure.

A most ungainly figure of a sperm whale was published by Pennant

(1776, pl. VI; 1812, pl. VIII). If the author had not stated that the figure was borrowed from Robertson (1771), the original after which the figure was made would be difficultly traced. The head projects very little beyond the lower jaw, the foremost part is rounded instead of squarely truncated, the flipper is comparatively large, there are no grooves in the posterior part of the lower jaw, the penis is of large size in comparison to that in Robertson's figure, and both tailflukes are hanging downwards. The dorsal fin is similar to that of the original (cf. fig. 3 b).

The dissimilarity of the two figures is so apparent that it is not to be wondered that for some time the name *Physeter gibbosus* was in general use for the animal which Pennant's figure was intended to represent.

A number of later authors reproduced Pennant's figure: von Schreber (1792), Shaw (1801), Dewhurst (1834).

Pennant (1776) gave the specific name *microps* to the animal represented by his figure, von Schreber (1792) uses the name *gibbosus* in the legend of his copy of Pennant's figure, Dewhurst (1834) indicated his figure which was made after Pennant's original as *Physeter gibbosa*.

18. Bonnaterre's figure of one of the Audierne specimens.

On March 14, 1784, thirty-one sperm whales stranded near Audierne on the coast of Brittany. Nearly all of these were females, one specimen is figured by Bonnaterre (1789, pl. 7 fig. 2). The foremost part of the head extends somewhat beyond the extremity of the lower jaw. The mouth opening is wide and bent upwards in its posterior region, which gives the animal a rather queer appearance. The dorsal fin is drawn as a narrow ridge (cf. fig. 3 d).

Von Schreber (1792) and Brandt and Ratzeburg (1829) give accurate reproductions of Bonnaterre's figure; in the works of de Lacepède (1804), Sonnini (1804) and Dewhurst (1834) the figure is found in a slightly different shape, though easily recognizable as Bonnaterre's. Moreover the figure is reproduced more or less exactly or has served as a model for a drawing in the works of the following authors: Kaup (1835), Burmeister (1843, 1860), Schinz (1845 b), Desmarest (1847), Lubach and Logeman (1851), Pöppig (1851), Curtman and Walter (1854), Giebel (1859), Brehm (1865), Schmarda (1878), Acloque (1900), and Calkoen (1903). In one of these works (Desmarest, 1847) the animal is represented as stranded on the rocks in a quite unnatural position; in some of the others it is drawn in a swimming position (e.g., Brehm, 1865). The blowhole which in Bonnaterre's figure is found about in the middle of the anterior part of the head, is drawn at the right side in Brehm's figure. Pöppig (1851) even represents the

animal with two spouts of water from the blowholes, one at each side of the head.

The Audierne specimens were included by Bonnaterre (1789) into the species *Phiseter Macrocephalus*. Later authors almost invariably used the same specific name in the legend of figures made after Bonnaterre's original. Cuvier (1798), however, referring to Bonnaterre's description and figure dealt with above, gave the new specific name *Physeter maximus* to the Audierne specimens. This is interesting as afterwards Cuvier was the first to defend the opinion that all the described species of sperm whales in reality belong to one valid species only.

19. Colnett's figure.

As remarked by Allen (1881, p. 485) the figure by Colnett¹⁾ has been many times copied in works relating to whaling. The figure represents a sperm whale caught on the coast of Mexico, on the figure the manner of cutting in, etc., is indicated. The head is small in comparison to the rest of the body, it is squarely truncated in front and the lower jaw nearly reaches the anterior border of the head. The flipper is represented in a more or less diagrammatic manner, the blowhole is drawn very accurately as an elongated S.

Lesson (1828), Brandt and Ratzeburg (1829), Jardine (1837), and Hamilton (1852) have copied Colnett's figure. The figure by Lesson differs in some details from those given by the other authors cited above. The figure in the present paper (fig. 3 p) is after the one in Jardine.

20. The figure of Quoy and Gaimard.

The description of *physeter polycyphus*, the "cachalot bosselé", by Quoy and Gaimard (1824, pl. XII) was based on animals which the authors did not see. The description and the figure were made after a drawing by Captain Hammat, who was engaged in hunting these animals in the seas around Timor. The figure (cf. fig. 3 e) shows a rather attenuated sperm whale, it bears some resemblance to that of Robertson (1771). The head projects slightly in front of the extremity of the lower jaw. The dorsal fin is of fairly large size, four or five smaller humps are found between the dorsal fin and the flukes. Before the dorsal fin there are a number of irregular swellings on the back.

The figure is reproduced by Brandt and Ratzeburg (1829, pl. XIV fig. 1),

1) Not seen. The title is (after Allen, l.c.): Colnett, James. A Voyage to the South Atlantic and round Cape Horn into the Pacific Ocean, etc. London, 1798.

and by Schinz (1845 b, pl. 167). Moreover the figure is stated to be found in Reichenbach (1855, pl. 70 fig. 1)¹⁾.

Quoy and Gaimard (1824) gave the name *physeter polycyphus* to the animal represented by their figure. This specific name is a synonym of *australasianus*, a name published by Desmoulins (1822), two years before Quoy and Gaimard's work appeared. By mistake Gray (1844—1845) used the name *australis* to indicate the same animal. Wagler (1830) remarks that *polycyphus* is hardly different from *macrocephalus*, it may represent an animal in bad health.

21. Von Chamisso's figures.

In 1824 von Chamisso published a paper in which he described some carvings of whales by Aleutan aborigines, and even gave specific names to the animals which the images were supposed to represent. Allen (1881, p. 516) makes the following remark: "A more barbarous piece of work was doubtless never perpetrated in natural history than the burdening of Cetology by Chamisso with nine "species" of Cetaceans based on wooden images by the Aleuts". One of the carvings (von Chamisso, 1824, pl. IX fig. VII) is easily recognizable as a sperm whale. Its head has a length of at least one third of the body, it is squarely truncated in front. The lower jaw does not reach the anterior part of the head, the flukes of the tail are of extraordinary size, the dorsal fin has a rather sharp point. On the flat anterior surface of the muzzle two blowholes are represented.

22. The sperm whale of the Yorkshire coast of 1825.

A sperm whale which stranded on the Yorkshire coast on April 28, 1825, was described and figured by Alderson (1827, pl. 12). The figure shows that the lower jaw is much shorter than the muzzle, which in front is rather convex. The region of the neck is rather sunken and constricted, the dorsal fin (l.c., pl. 12 fig. 2) is drawn as a laterally flattened excrescence.

The same animal is figured in a note by Thompson (1829). The figure has much in common with Alderson's, but shows differences in minor details. Especially in Thompson's figure the convex muzzle is seen extending considerably beyond the tip of the lower jaw (cf. fig. 4 d).

The skeleton of this sperm whale was taken to Burton Constable in Yorkshire. Beale (1839) and Wall (1887) describe some particulars of this skeleton.

Thompson (1829) indicates the specimen with the name *Physeter catodon*.

1) Not seen; the text only was available to me.

23. Beale's figures.

In publications of Beale (1835, 1839) some excellent figures of sperm whales are to be found (cf. fig. 3 i). One of these (Beale, 1835, p. 45 no. 1) is a copy of an engraving by Mr. Huggins, marine painter to the King. It represents a sperm whale in its death struggle, lying on its back. The jaw is open, the head projects for some distance beyond the palate, it is truncated in front. In most of the other figures the shape of the sperm whales apparently is based on this figure, in one the blowhole is drawn at the right side. Beale gives an excellent transverse section of the foremost part of the head with the two grooves in the upper part and the distinctly keeled lower region. In the figure representing the method of flensing (cf. fig. 4 e) the head is drawn too short: the truncated front hardly extends beyond the tip of the lower jaw. Here again the blowhole is drawn at the right side of the head.

Jardine (1837, pls. 9 and 10) and Hamilton (1852, pls. 9 and 10) give two figures made after those of Beale. They differ rather strongly from the original ones. In plate 10 the lower jaw and the palate are drawn too broad, in both plates the foremost part of the head is not squarely truncated, but shows some irregular knobs. The plates of Cheever (1850) are made after those of Jardine, they are similar in composition and in the shape of the animals, but show slight differences. The figure in Pokorny (1868) bears a strong resemblance to that of Cheever. Frédo's (1865) figure was made after one of Jardine's plates.

Jardine's plate 9 (cf. fig. 3 j) served as a basis for the figure in De Kay (1842), which represents the complete animal without the scenery. The same figure is found in Schlegel (1857, 1862, 1872) and Oudemans (1892), somewhat modified in Chenu (1858?). One of the figures in Hohman (1928, upper figure of plate opposite p. 42) is a reproduction of Jardine's plate 9.

Gosse (1856, fig. 329) gives an outline of a sperm whale, this figure undoubtedly was made after Beale's illustration representing the method of flensing. In the lower jaw, however, just a few teeth are drawn.

One of Hohman's figures (1928, plate opposite p. 278) bears a very strong likeness to a figure of Beale (1835, fig. 1; 1839, p. 154). In both figures the animal is represented as lying on its back with open mouth, part of the head and the tail above the water. The lower jaw and the tail, and two boats with whale hunters are figured in corresponding shape and position. The ventral anterior part of the head is slightly different in the two figures. The cited figure of Hohman is found on a smaller scale in Sørensen (1912).

24. Bennett's figure.

Bennett (1840, p. 153) gives an interesting figure of a stranded sperm whale. The massive head is truncated in front, the lower jaw nearly reaches the foremost part of the head, the flipper is comparatively large, the tail is short and has broad flukes. On the back a dorsal fin of large size is to be seen, and between this and the flukes six small humps are visible (cf. fig. 3 k). In comparison to the persons in the foreground of Bennett's figure the animal is of enormous size.

25. The sperm whale described by de Sanctis.

On March 10, 1874, a large male sperm whale stranded at Porto S. Giorgio (Adriatic coast of Italy). De Sanctis (1881), who had the opportunity of studying this animal, gives two figures of the exterior. In the first (l.c., pl. I), a drawing after a photograph, the ventral surface of the animal is shown. The long narrow lower jaw and the palate with the pits caused by the teeth of the lower jaw are clearly visible, on the throat two pronounced grooves are present. The muzzle is slightly tapering in anterior direction, its foremost part is convex and projects noticeably beyond the extremity of the lower jaw. In another figure (l.c., pl. VII fig. XXI) the left side of the animal is represented. Here the tip of the lower jaw nearly reaches the foremost part of the head. The muzzle is rather truncated in front, the long blowhole is distinctly visible. Behind the dorsal fin there is a series of four smaller humps (cf. fig. 2 g).

26. The sperm whale of the Balearic islands of 1878.

A sperm whale of a length of 20 m was found dead in the Bay of Sóller in Majorca. Barceló (1879) gives a short description of the specimen, accompanied by one of the best drawings which have been published of the sperm whale (cf. fig. 4 i). The animal is represented from the left side so that the blowhole is visible. The head projects distinctly beyond the anterior end of the lower jaw. In the foremost part of the head the lateral shallow groove is accurately represented. The dorsal fin consists of one hump only, Barceló remarks that no other excrescences were present here, he cites Beale and Quoy as authors who have described smaller gibbosities between the hump and the flukes. On the ventral side there is a kind of excrescence just before the end of the tail. The flukes, which in the figure have been drawn in a slightly bent position, to show their shape and size, are rather pointed. In the figure the contour of the dorsal region is evenly convex, as is that of the ventral surface. The size of the eye is not exaggerated as in so many of the previous figures.

27. Scammon's and Flower's figures.

An outline of the figure of a sperm whale by Scammon¹⁾ was published by Starbuck (1878, pl. I) and by Goode (1884, pl. I). This figure shows an animal with squarely truncated head, which projects very little in front of the tip of the lower jaw. The blowhole is found at the left side of the anterior dorsal margin, the dorsal fin is not very strongly developed and between this and the flukes of the tail there are a few humps of smaller size (cf. fig. 3 g).

Flower (1888) published a figure of a sperm whale which corresponds in every detail with that of Scammon, in all probability it was made after the latter. Blanford (1888—1891) reproduced Flower's figure, which at about the same time appeared in the book of Flower and Lydekker (1891). This figure again was reproduced in Flower (1898), in Sclater and Sclater (1899), and in Sclater (1901).

Winge (1908) gives a figure of a sperm whale after Scammon. The figure is, however, reversed, so that the right side is represented and the blowhole is drawn at this, the wrong side. Scammon's figure moreover was the original for the drawing of the sperm whale in von Hayek (1893) and in Brandt (1911). In the 11th ed. of the *Encyclopaedia Britannica*, in the article Sperm-Whale (1910, by Flower or by Lydekker?) there is a figure corresponding with those cited above. Harmer (1926) gives a similar figure and states that it was made after Scammon's original. The head projects very little beyond the tip of the lower jaw, but in another figure in the same work (i.e., fig. 6 A) a ventral view of the head of a sperm whale is represented; here the lower jaw does not reach as far anteriorly as in the picture representing the side view.

The figure of Townsend (1930, p. 16) undoubtedly is after Scammon or after Flower; the one in van Deinse (1932) is, as stated by the author, after Townsend.

Scammon's figure is reproduced in Bailey (1936, pl. 49 fig. A). This figure is shaded so that the shallow longitudinal groove at the dorsal anterior part of the head is visible; moreover there is a slight indication of the keel in the foremost part of the underside of the head.

Southwell (1881, fig. 19) represents the skeleton of the sperm whale, after Flower (1869). The outline of the body has been added, probably after Scammon's figure. The head is squarely truncated, but projects hardly

1) Scammon, C. M., 1874. *Marine Mammals of the Northwestern Coast of North America, with an Account of the American Whale Fishery*. San Francisco and New York, plate XIV. Not seen; title from Hohman, 1928.

at all beyond the anterior part of the lower jaw. The anterior part of the skull extends to the foremost part of the head. Almost identical with Southwell's figure is the illustration in *Guide of the British Museum* (Lydekker, 1902, fig. 50), which shows a slightly more convex head that is not noticeably prolonged beyond the tip of the lower jaw. In the edition of 1902 to the explanation of the figure is added: "N.B. — It is possible that the termination of the muzzle may be less abrupt than is here represented". In later editions (Lydekker, 1906, 1909) this note is omitted. Besides in publications of the British Museum the figure is found in the following works: Hall (1913), Carpenter and Wilson-Baker (1915), and Russell and Yonge (1928). The figure of Scharff (1900, pl. 3 fig. 4), representing the skull of the sperm whale with the rest of the head in black, was made, as stated by the author, after the same original.

The figure of Hjort (1912, fig. 572) is after a drawing in the Bergen Museum. It shows all the characteristic details of Scammon's and Flower's figures. The same illustration is found in Sørensen (1912), Tesch (1920) and in Hjort (1933, 1937).

The figure in Brehm (1877, p. 719), representing a sperm whale swimming in the sea, undoubtedly is made after Scammon, as the animal shows all the characters of the original figure, and Scammon's account of the sperm whale forms the chief source of information of the author.

Besides the figure referred to above, Scammon published another figure of a sperm whale showing the manner of cutting-in. The outline of the latter figure corresponds closely with that of the first, the head, however, extends somewhat farther anteriorly beyond the lower jaw. This figure is reproduced in papers by Starbuck (1878, p. 53) and Hohman (1928, plate opposite p. 58).

28. The sperm whales of Pouchet and his collaborators.

Pouchet and his collaborators emphasized the fact that nearly all existing figures of sperm whales are incorrect as they represent the animal with a too short and too abruptly truncated muzzle.

In 1887 Pouchet examined an adult female sperm whale at the Azores, the head of which was approximately 3 m long. The illustrations (Pouchet and Beauregard, 1889a, pl. I figs. 1—3) show that the lower jaw is decidedly shorter than the rest of the head. Considered as a whole the head is more or less wedge-shaped, gradually tapering from the region of the eyes towards the anterior part. The head is compressed only in a lateral direction, the dorsoventral diameter does not diminish appreciably in anterior direction. On the foremost part of the head there is a distinct median ridge

(the "étrave") extending from the mouth opening to the middle of the dorsal part of the anterior surface (cf. fig. 3 n). In one of the figures (i.e., fig. 3) the blowhole is seen, and, in its vicinity, a distinct groove in the skin.

In 1890 a young male sperm whale with a length of 13.50 m stranded at the Ile de Ré (near La Rochelle), which could be examined by Pouchet and Beauregard (1890, 1891). In a later publication the authors (Pouchet and Beauregard, 1892) give the results of an examination of the head of a young male sperm whale (length of the head 147 cm) from the Azores. In this specimen again the head extends distinctly beyond the tip of the lower jaw (i.e., pl. I figs. 1 and 2). The "étrave" is less pronounced than in the specimen from 1887, though there is a pronounced keel on the under surface of the head before the extremity of the mandible (cf. fig. 3 o).

In a paper by Pouchet and Chaves (1890) there are photographs of a sperm whale of 15.50 m length from San Miquel in the Azores. One of the figures (i.e., pl. IX fig. 1) is a photograph of the ventral surface of the animal, it shows that the head is slightly tapering in front, and, before the palate, a distinct keel on the lower surface of the head. In another figure of the same plate the dorsal surface of the head is represented, the blowhole and the groove which runs parallel with the blowhole are clearly visible.

Repeatedly Pouchet and his collaborators remark that the mouth of sperm whales can be opened only for a very small distance. In this respect they are wrong as is sufficiently proven by photographs which were published in later years.

It is interesting that one of the figures of Nobre (1935, pl. 77 fig. 1), representing a photograph of a sperm whale from S. Miguel, Azores, almost certainly is taken from the same sperm whale after which Pouchet and Chaves' figures were made. The photograph then is taken from a slightly different angle, the shape of the animal and the surrounding rocks give evidence for the identity of the whale in the two pictures.

Plate IX of Beddard (1900) is after Pouchet and Chaves, as stated by the author.

In an illustrated edition of Prince Albert of Monaco's book (Monaco, 1913, p. 238) there is a figure of a sperm whale seen from the ventral surface, and another figure (p. 243) showing the head in front view. These figures are strikingly similar to certain illustrations of Pouchet and his collaborators. Probably, however, the cited figures are made after photographs from a sperm whale taken at the Azores on July 18, 1895. Richard (1936) remarks that the capture of this animal furnished the data for the chapter "La Mort d'un Cachalot" in Prince Albert's book.

29. The sperm whale from the Azores of 1888.

Prince Albert of Monaco (1888) describes and gives photographs of the head of a female sperm whale of comparatively small size which was caught off the Azores. The superficial layers were already largely torn off by sharks and other predatory fishes, but the outline still is accurately preserved (cf. fig. 4 f of the present paper). The head is rather short in comparison to its height, as the muzzle extends very little beyond the anterior part of the lower jaw. The anterior part of the head which projects beyond the mouth opening is regularly convex. In the lower jaw several teeth of fairly large size are visible.

30. Lillie's figure.

On the island of South Innishkea on the west coast of Ireland, Lillie (1910) had an opportunity for researches on whales captured by the local whaling station. During his stay two male sperm whales were caught, concerning which Lillie remarks (i.e., p. 788): "Their general appearance corresponded with the descriptions of previous observers. But, as there seems to be a little uncertainty concerning the shape of the head of this whale, a sketch is given (text-fig. 78) of the form of the head in the Innishkea specimens." Lillie's figure, an outline of which is given in fig. 2 n of the present paper, represents the animal with rather squarely truncated anterior part, which extends but very little beyond the extremity of the lower jaw. In Lillie's figure a lateral shallow groove in the dorsal part of the head is distinctly indicated, moreover the figure clearly shows the keeled ventral part of the anterior region of the muzzle.

31. Figures of sperm whales differing from those referred to above.

In the scientific literature and in books with more popular contents there are numerous illustrations of sperm whales, many of which are more or less diagrammatically represented, but others of rather artistical design. Usually the sperm whales are drawn with more or less squarely truncated head, projecting very little or not at all beyond the tip of the lower jaw. The original for these figures usually was one of the illustrations dealt with above or a combination of the characters of several previous illustrations, in many cases added by a personal idea of the artist for improvement. In this category may be mentioned the illustrations in the following works: Wood (1861), Figuier (1869), Pechuel-Loesche (1871, 1891), Southwell (1881, fig. 16; two spouts of water or vapour emerge from the head), Murie (1892), von Schubert (1882), Bolau (1884), Trouessart (1890?, side view and ventral view of the head, the lower jaw does not fully extend to the anterior

border), Anderson (1896), Heck (1897), Ménégau (1903—1904), Hutton and Drummond (1904), Ritzema Bos and Bos (1904), Beane (From Forecastle to Cabin, New York, 1905; not seen. The figure is reproduced in Hohman, 1928, p. 168), Bullen (1905, 1926?), Millais (1906), Soffel (1912), van Balen (1914), Bartsch (1917, figures after Bullen), Burn Murdoch (1917), Fitzsimons (1920), Snijders (1920), Thorburn (1921), Hopkins (1922?, figure on the title page), Morley and Hodgson (1927, figure opposite p. 3), de Beaux (1930), Nobre (1935, fig. 8). Moreover in the undated works of Lydekker and Jones figures of this kind are found. The figures in Jacobi (1914), Heck (1915), and Jennison (1927), which were made after models, belong to the same group. Brigham's (1902) figure of a model of a sperm whale shows a much too short head, not projecting beyond the tip of the lower jaw; moreover the eye is too large in this model. In Wood (1861) and in Burn Murdoch (1917) there are figures of the skull of sperm whales with an outline of the head. In both figures the head does not project beyond the extremity of the upper jaw.

The figure published by Turner (1872, 1912) after an engraving by an unknown artist on the mandible of a sperm whale shows an animal in which the head projects for some distance beyond the tip of the lower jaw. Six or seven small humps are represented between the dorsal fin and the flukes of the tail.

An excellent figure illustrating the relation of the skull to the soft parts of the head was published by Hentschel (1914, fig. 18). The figure shows that the head projects for a considerable distance beyond the extremity of the lower jaw. The figure by Peters (1930) too has good qualities, it was based partially on Hentschel's data, though the muzzle is less extended in front than in the specimen measured by Hentschel (1910). The small humps between the dorsal fin and the flukes are not indicated in Peters' figure (cf. fig. 4 b). This figure is found also in a later paper by Hentschel (1937, fig. 21), moreover in this paper twice an outline of the body is given corresponding with the cited figure (l. c., Pl. II and fig. 20).

A good figure of a sperm whale lying alongside a ship is given by Hopkins (1922?, plate opposite p. 74). It shows the lower jaw and the palate with the pits caused by the tops of the teeth of the lower jaw, and the well developed rostrum in front of the tip of the mandible.

A very good figure of a sperm whale was published by Howell (1930). The head of the animal extends for a considerable distance beyond the extremity of the lower jaw, the anterior part is slightly convex, and the keel in the ventral part of the foremost region of the head is indicated. Between the faintly indicated dorsal fin and the flukes there is one smaller hump (cf. fig. 3 h).

The figure of a sperm whale in Fraser (1937) is different again. The rather squarely truncated head extends considerably beyond the tip of the lower jaw. The grooves in the dorsal part of the head are indicated as well as the keel in the ventral region of the foremost part. The dorsal surface forms a smooth line to the dorsal fin which is followed by three or four humps gradually decreasing in size towards the posterior region (cf. fig. 4 h).

32. Twentieth century photographs of sperm whales.

In comparison to the extremely striking differences in the numerous drawings of sperm whales, the photographs of these animals, which as a matter of fact were taken mostly after 1900, show a good deal of similarity. Most photographs represent the ventral surface of the head showing the palate with the cavities in which the tips of the mandibular teeth fit when the mouth is closed.

A very good photograph of an adult male sperm whale is represented in Millais (1906, upper figure of plate opposite p. 288). The animal is taken from the ventral side and slightly in front view, so that in the foremost part the shallow longitudinal grooves of the dorsal part of the head are visible. The snout of the animal is about as thick as the rest of the head, the ventral part of the anterior region shows a distinct keel. Another sperm whale with an enormous head is figured by Ritchie and Edwards (1913, plate opposite p. 168). Here too the muzzle is as thick as the rest of the head, it is evenly convex in front. The photograph published by Freund (1932) represents a similar animal, and the one of Nichols (1926) too shows a sperm whale with enormous head and prolonged snout which has a convex extremity. The latter figure is reproduced in Russell and Yonge (1928, pl. 42). The specimen described by Hentschel (1910) had approximately the same shape of head. Hentschel's photograph of the ventral surface of the sperm whale showing the widely open mouth is moreover published in later papers (Hentschel, 1914, 1937), in a paper by Mohr (1930), and the central part of the figure in Jenkins (1932, plate opposite p. 96).

A photograph of the sperm whale described by Newman (1910) is found in a publication by Kükenthal (1914, pl. 3 c fig. 38). Here again the snout is enormously enlarged, protruding for a long distance beyond the mouth opening. In front the head has a square surface, the longitudinal shallow grooves in the dorsal region of the foremost part of the head are distinctly visible.

Chubb (1918, pl. XVI lower figure) and Richard (1936, pl. V fig. 7) represent figures of sperm whales of similar shape. In both specimens the

head extends anteriorly for a considerable distance beyond the palate, a distinct keel is visible on the ventral surface, and the head is gradually tapering in an anterior direction, the extremity being evenly rounded.

The photographs in publications by Harmer (1918 a, 1927) were taken after an animal which had been dead for some time, the shape of the head is described by Harmer (1918 a, p. 7) as follows: "The head (Fig. 1, A, B, C) was bluntly truncated in front, where it was of some thickness dorsally, diminishing in width ventrally and becoming a sharp edge on the lower surface; the ridge thus formed extending for some distance in front of the mouth to the truncated end of the head".

An excellent picture of a sperm whale is given by Townsend (1930). The animal is photographed here slightly obliquely in front view, the keel at the ventral surface and the longitudinal shallow grooves in the dorsal part of the head are distinctly visible. The figure shows a striking similarity to Pl. XI fig. 1 of the present paper. Townsend's figure is reproduced in Mell (1937, p. 347).

Andrews (1916) gives a number of photographs of sperm whales. One of these (l.c., p. 228) shows the ventral keel on the well developed muzzle. Another (l.c., p. 231) again clearly shows that the head extends considerably beyond the extremity of the lower jaw, the same applies to a third figure (l.c., p. 234). A fourth figure (l.c., p. 239) represents the head of a female sperm whale. This figure shows, as Andrews remarks, that the head of the female is much more pointed than that of the male. Another picture of a female sperm whale (possibly the same animal photographed from a slightly different angle) is represented in another paper by the same author (Andrews, 1911), it shows that the head is distinctly tapering in front. The keel on the ventral surface again is clearly visible.

A photograph from the Otago Witness showing the 36 male and 1 female sperm whales which stranded at Perkins Island, Tasmania, in 1911, is reproduced by Lillie (1915). In the foreground some animals are represented in front view, the head appears rather wedge-shaped in front. Similar pictures are that in the paper by Raven and Gregory (1933, p. 12), and those of Tomilin (1936), the latter taken after animals caught off Kamchatka. In these front views of the animals it is not apparent that the head extends considerably in front of the lower jaw.

In some books there are photographs as well as drawings of sperm whales. Whilst the photographs almost invariably show that the head is distinctly prolonged beyond the lower jaw, the drawings usually represent the animal with a muzzle of the same length or slightly longer than the lower jaw.

Millais (1906, upper figure of plate opposite p. 288) gives a photograph of a large bull sperm whale with a pronouncedly extending muzzle. The drawing opposite p. 282 in the same work shows the animal with a lower jaw reaching almost the anterior part of the head, and the same applies to the lower figure of the plate opposite p. 288, representing the method of feeding of the sperm whale.

Russell and Yonge (1928, fig. 20) give a reproduction of the outline and skeleton of the sperm whale from the British Museum Guides. As remarked above in this figure the lower jaw extends to the ventral ridge of the snout, the central part of the latter projecting very little beyond the tip of the lower jaw. The photograph in the same publication (l.c., pl. 42) shows distinctly enough the enormously enlarged muzzle.

The drawing of a sperm whale in Nobre (1935, p. 8) represents an animal with truncated head, the lower jaw nearly reaching the anterior border. On p. 77 of the same work a figure is found after a photograph; the ventral surface of the sperm whale is shown, the enormously elongated muzzle is seen projecting considerably beyond the lower jaw.

33. Young stages.

There are some records on young sperm whales and foetal stages of this animal, which are interesting, as the figures and descriptions of these specimens show that the head is strikingly different from that in adult animals.

The youngest known stage of a sperm whale is a foetus of $4\frac{1}{2}$ inches ($\pm 11\frac{1}{2}$ cm) length, described by Beddard (1919, figs. 1—4). At this stage the lower jaw is decidedly longer than the upper, the anterior part of the head is obliquely truncated, running backwards towards the dorsal region (cf. fig. 2 h). It is interesting that in this foetus two separate nostrils were present.

A somewhat older foetus (10 inches or $\pm 25\frac{1}{2}$ cm long) is described by Beddard in the same paper (Beddard, 1919, figs. 5—7). In this specimen the anterior part of the head is convex, the lower jaw extends as far anteriorly as the upper part of the head (cf. fig. 2 i). The two nostrils have united into a single blowhole at the dorsal part of a pronounced ridge in front of the head (the "étrave" of Pouchet).

In another paper the same author (Beddard, 1915) describes and figures a foetus of 20 inches (about 51 cm) total length. Beddard remarks (l.c., p. 110): "The tip of the snout is little if at all in advance of the lower jaw. The line of the head anteriorly is quite vertical" (cf. fig. 2 l).

Richard (1936, pl. VII fig. 3) figures a foetus of a sperm whale which