ART. II. *Observations on the Zoology and Comparative Anatomy of the Skeleton of the Balænóptera* Rórqual, *or Broad-nosed Whale, now exhibiting at the Pavilion, King's Mews, Charing Cross.* By HENRY WILLIAM DEWHURST, Esq., Surgeon, Professor of Zoology and Comparative Anatomy.

## GENERAL HISTORY OF THE WHALE TRIBE.

THE whales constitute a tribe of mammiferous animals which, from their external appearance and peculiar habits of life in their native element, the water, appear at first sight to approach so near to the other kinds of oceanic inhabitants, that it is no wonder the ancient writers on natural history, who were but little acquainted with either the correct history or structure of these creatures, should arrange them as belonging to the class of Fishes.

There are no less than five species of whale which strictly appertain to the genus *B*alæ`na. There is the same number of species of the dolphin tribe, inhabiting the northern seas; and which have been commonly considered as whales by the public, without paying any attention to their distinguishing characters.

The natural history of the whale is an object well worthy the attention of the philosopher. In all probability it was the whale which gave rise to the fabulous stories of hyperborean monsters; such as the kraken, which has been stated to extend many thousand yards in length, like an immense bank of sand, or a reef of rocks, upon the surface of the water. Such exaggerations are, however, totally unnecessary for the purpose of exciting our wonder; for the animals in question, in their own proper dimensions, are sufficient for our astonishment. Those dimensions, when sufficient time has been allowed for the full developement of the animal, are certainly prodigious:—"There is no doubt," observes Baron Cuvier, "that whales have been seen at certain epochs, and in certain seas, appearing to measure 300 ft. in length, and to weigh more than 300,000 lbs. Among the various species of this genus, occasionally met with at the present day at a considerable distance from the arctic pole, there are some measuring from 70 to 100 ft. long."

It is in the order *C*etàcea that we find the largest animals; and the whale genus alone forms the most stupendous in the whole range of animated nature.

Whales generally congregate in numbers; the male never abandons the female, which suckles her young until the birth of its successor.

*The Organ of Smell.*—The great developement of the

nasal bones, and the power of the organ of smelling, enable these animals to scent odorous bodies at a great distance.*

*Non-existence of Teeth in Whales.*—Their being devoid of teeth forms a distinctive characteristic of the whales, from the other *C*etàcea with which they have been popularly allied; but instead of teeth we find a series of laminæ, or layers, of a substance resembling horn, denominated baleen, that has erroneously been called whalebone, and which is supposed to serve to retain their food.†

*The Organs of Vision.*—The eyes are extremely well adapted for the element which whales inhabit; and it is not a little remarkable that, notwithstanding the immense size of the animal, the whole diameter of each ocular globe does not exceed 3 in.: it is, in fact, about the size of an orange; and, according to Baron Cuvier, the crystalline lens is not larger than a pea, when it is dried. The eyes are placed in the posterior part of the head, in an orbit formed by cartilage and fat; the lower boundary of which is formed of a small process of bone, which connects the lateral portion of the cranium to the bones of the face. The situation of the eyes gives them the facility of perceiving objects both before and behind them, as also any that may be above their heads, when they are below the surface of the water. These organs are guarded by eyelids and eyelashes, as in quadrupeds and other Mammàlia; and from what I have myself witnessed, I should conceive these animals to be extremely quick-sighted, inasmuch as the seamen employed in the whale fishery suppose them to be able to perceive objects under water at a very considerable distance, and believe that the sight of a boat

* On perusing an excellent paper by Mr. Gordon, on the "Analogy between Vegetables and Animals," I observe that he doubts (p. 122.) whether this sense exists in the *C*etàcea. The following experiment will, I believe, remove that idea; it is recorded by Count Lacépède, in support of the commonly received opinion, that whales dislike bad odours:—"The Vice-Admiral Pleville-le-Peley, being one day at sea, with his fishers, perceived some whales above the horizon. He prepared to give way to them, but in order to stow away the cod-fish which were in the boat, he ordered a great quantity of putrid and pestiferous water, then in the hold, to be thrown overboard, and the hold itself properly cleaned out; as soon as the stinking water began to spread its noxious odour, the whales instantly made off and disappeared. The Admiral tried this experiment several times, and the results were uniformly the same."

† "The plates of baleen strain the water, which the whale takes into its mouth, and retain the small animals on which it subsists. For this purpose the baleen is in subtriangular plates, with the free edge fringed towards the mouth, the fixed edge attached to the palate, the broad end fixed to the gum, and the apex to the inside arch. These plates are placed across each other at regular distances." (*Fleming's Philosophy of Zoology.*)

and its oars frightens them exceedingly. In clear water, Captain Scoresby informs us that he has known them to discover each other at an amazing distance. This, however, is certain, that although they are capable of seeing objects through the medium of their native element, yet in the air they are unable to see far; that is to say, when they are lying on the surface of the water; consequently, from this cause, they are easily captured. The eyes are situated almost over the entrance to the ears.

*The Organ of Hearing.*—The organ of hearing is very nearly as acute as those of vision, by which means these animals are warned of any approaching danger. Thus it would seem that the great Author of nature had given them these advantages, as they multiply but little, in order that the species may be preserved. It is true, however, that they have no external ear, and the opening leading to the internal is almost imperceptible; but were this otherwise, it might probably embarrass them in their natural element: but when the delicate external scarf-skin is removed, a black spot is discovered behind the eye, beneath which is the canal leading to the organ of hearing. In short, the whale hears the smallest sounds under water; but above it, Captain Scoresby considers these animals extremely dull of hearing: for a noise in the air, such as is produced by a person loudly shouting, is not noticed when only at the distance of a ship's length; but a very slight splashing in calm water excites its attention, and occasions great alarm. The sailors frequently preserve the internal organ of hearing; the bone composing it is extremely dense, and capable of the highest polish: it is contained, according to M. Dubar, in two bones totally unconnected with the skull, or any of the envelopements of the brain; it is irregular, being united to it by means of firm ligaments. As in man, and other animals, this part is frequently denominated the petrous or rocky bone. Baron Cuvier describes the anatomy of the internal ear, which, according to this eminent zootomist (*Règne Animal*, iv. 414.), presents the following interesting peculiarities:—"From the external orifice there is a narrow cartilaginous tube proceeding to the tympanum or drum of the ear, winding through a bed of fat: this canal pierces the superior maxillary or jaw bone, and terminates above the spiracle or blow-hole in an orifice rendered, by means of a small valve, impenetrable to water. The internal ear is composed, similarly to that of other Mammàlia, of a labyrinth or cochlea, cochlearian orifice, three semicircular canals, a vestibulum and its orifice, a tympanum and its membrane, also articulated osselets placed within the

tympanum from its membrane to the vestibulary orifice, a Eustachian tube, with a canal leading from the membrane of the tympanum, and opening to the small external aperture already mentioned."

*The Organ of Touch.*—No portion of the whale has as yet been discovered by zootomists to which this organ can be referred; yet, from the great maternal protection afforded by this animal to its young, which it carries and preserves under its fins, I cannot believe it to be destitute of this important sense, which is found in every other known animal; besides, the habits and manners of the whale form sufficient evidence in my mind of its existence, and of the great pain it endures when the skin is wounded by the harpoon.

*The Embryo Whale.*—The young whale, when discovered in its earliest fœtal state, is generally about 17 in. in length, and of a white colour; but the cub when born is black, and varies from 10 to 14 ft., and Baron Cuvier asserts it to be 20 ft., which sometimes may be the case. Generally speaking, only one cub is produced, occasionally two, but never more. When the female suckles her offspring, she throws herself on one side on the surface of the water, and the young whale attaches itself to her breast. They continue suckling for a year, during which time they are named shortheads by the sailors, and yield above 50 barrels of blubber; at two years they are called stunts, and thrive but little when weaned, scarcely affording more than 20 barrels; after this period they are called skull-fish, and their age is wholly unknown.

*The Brain.*—The brain of the whale is, like the eye, extremely small in proportion to its enormous bulk. Captain Scoresby examined the brain of a whale 19 ft. long, and it weighed only about $3\frac{3}{4}$ lbs., notwithstanding the weight of the animal was near 11,200 lbs. Here the weight of the brain was about $\frac{1}{3000}$ part of that of the entire body, whilst that of an adult man is equal to $\frac{1}{33}$ part of the whole body.*

*The Mouth.*—This is generally of a serpentine form; the lips are about 20 or 25 ft. long, and display, when open, a cavity sufficiently large to afford a reception to a ship's large jolly-boat and her crew. Duhamel-Dumonceau relates that a whale captured in the bay of Sonsure, in 1726, had a mouth so wide, that, when opened, two men might go in without stooping.

*The Baleen or Whalebone.*—Teeth, of which the jaws are divested, are substituted in the upper jaw by two rows of laminæ, denominated baleen, erroneously denominated whale-

* Dewhurst's Dissertation on the Component Parts of an Animal Body, p. 57.

bone, or, as Captain Scoresby calls them, fins. They are suspended from the bones named by the seamen the crown-bone, which forms the upper part of the mouth. Each of these laminæ is composed of a species of stiff hair or bristle united longitudinally, and placed side by side. They are connected together at their origin by a species of rabbet, with a peculiar glutinous substance called gum, which is white, fibrous, tender, and tasteless: it also cuts like cheese, and bears some resemblance to the kernel of a cocoa-nut. The laminæ vary in number from 300 to 400 on each side, and are of a bluish black colour.

*Milk of the Whale.*—Dr. Jenner tasted the milk of the whale; and, according to him, it resembles that of most quadrupeds in appearance, and he was of opinion that it is exceedingly nutritious, that it contained more cream, and is rich and well flavoured.

*Velocity of the Whale.*—Whales descend with immense velocity, and frequently to the depth of 300 or 400 fathoms, and that in the space of five or six minutes; and are capable of ascending in a similar manner, so as to appear as if darting out of the water. When they perform this feat, the whole surface is thrown into the most violent agitation.

*Colour of the Whale.*—This is generally of a bluish or blackish grey, sometimes they are piebald; the aged animals contain the greatest quantity of greyish matter, mixed with white, whilst the younger are of a bluish black, and sucklings of a pale blue or bluish grey colour.

*Quantity of Blood in a Whale.*—The quantity of blood which circulates in the whale is much greater than that which circulates in the vessels of quadrupeds. The diameter of the aorta, or large artery arising from the heart, being sometimes more than 13 in.; and the late Mr. John Hunter estimated the quantity thrown into it, at every contraction of the heart, to vary from 10 to 15 gallons, and that with immense velocity. The heart of the whale is broad, flattened, and larger in this animal, in proportion to its size, than in any quadruped, as also are the blood-vessels.

*The Pectoral Fins.*—The fins are placed on each side of the chest, and contain bones similar to the anterior extremity of the digitated animals, strongly enveloped in strong condensed adipose membrane of a semi-cartilaginous substance. From the peculiarity of structure in the fin, they have received the name of swimming paws from Dr. Fleming, which term is now generally adopted.

*Longevity of the Whale.*—There are no certain data, on which we can form any accurate idea of the longevity of these

enormous animals. It may be presumed, however, that individuals of the larger species may have lived, according to the estimation of Baron Cuvier made respecting the B. *Rórqual* at Charing Cross, more than 1000 years. Should this be any thing like correct, we need not feel surprised that the genius of allegory should adopt the whale as the emblem of duration.

## HISTORY OF THE BALÆNÓPTERA *RÓRQUAL.*

Balænóptera, from *balæna*, a whale, and *pteron*, a wing or fin. *Rorqual*, in the Norwegian language, signifies *a whale with furrows;* hence it is very expressive of the distinguishing characteristics of this animal.

The history of the species of whale, whose skeleton I shall shortly proceed to describe, may not be uninteresting to the reader.

On the 4th of November, 1827, some fishermen of Ostend discovered the dead body of a female whale floating in the sea, between the coasts of England and Belgium. Not being able to tow the enormous carcass themselves, the master of the shallop Dolphin of Ostend, who had likewise discerned it, employed the aid of his vessel and crew to move it, but without success. They then called to their assistance two other vessels, and by their united efforts surmounted the difficulty, and were enabled to appear in sight of Ostend at 4 o'clock next day; as soon as they entered the harbour, the rope broke, and it was cast upon the eastern side.

The appearance of a whale of such enormous dimensions created a great sensation; inasmuch as those which had formerly been stranded or captured on the coast of Flanders were of much smaller dimensions, and none had appeared during the present century. These, however, we will briefly notice.

In the year 1178, the magistrates of Bruges offered to Count Philip a sea monster or whale, which had been thrown, in consequence of a great tempest, on the coast of Ostend. This animal measured 42 ft. in length. The formation of the mouth and head is recorded as bearing a resemblance to the beak of an eagle and the figure of a sword.

The chronicles of Flanders report, that, in the month of November, 1402 or 1403, there were thrown eight whales before the port of Ostend: the longest measured nearly 70ft., and produced nearly 24 tons of oil. On the 20th of January, 1762, there was discovered a dead whale, measuring 40 French feet in circumference, on the ride between Blankenberg and Ostend, nearer to the latter city. After having been exposed to the public for five days, it was sold for the benefit of

the sovereign, for the sum of 192 Flanders florins (about 16*l.* 13*s.* 4*d.*). Several of these creatures have at different times been killed or stranded upon the British coast. Captain Scoresby has recorded several of these events. One was captured on the coast of Scotland, in the year 1692. Another was 52 ft. long, and had been stranded near Eyemouth, on the 19th of June, 1752. Another, nearly 70 ft. in length, ran ashore on the coast of Cornwall, on the 18th of June, 1797. Three were killed on the north-west coast of Ireland, in the year 1762, and two in 1763. One or two have been killed in the river Thames. Another was embayed and destroyed in Balta Sound, Shetland, in the winter of 1817–18, some of whose remains were seen by Captain Scoresby, who thus states its dimensions:—Length, 82 ft.; lower jaw-bones, 21 ft. each; longest blade of the baleen or whalebone, about 3 ft. Instead of hair at the inner edge and point of each lamina, it had a fringe of bristly fibres, and was stiffer, harder, and more horny in its texture, than the same part in the common Greenland whale. The quantity of oil produced from the blubber of this animal was only about 5 tons, of very inferior quality, some of which was extremely viscid and bad. The total value of the whole, deducting all expenses of extracting the oil, &c., was no more than 60*l.* sterling. It had the usual sulci or furrows about the thorax and dorsal fin.

To return to our Rorqual: M. Herman Kessels of Ostend formed the idea of preserving so valuable an acquisition in zoology and comparative anatomy within the kingdom, instead of allowing it to be made a source of mere pecuniary profit. The perseverance, philanthropy, and enterprising spirit of this gentleman are well known. During the inclement winter of 1827, he contributed to the comforts, health, and happiness of thousands of the indigent of Ostend, by daily distributing food, soup, and warmth among them. To cover the great expenses of this benevolent act, he addressed himself to the wealthy of the town to further his beneficent design, which alone procured him the blessings of all who who had tasted of his bounty. M. Kessels had scarcely formed the idea of preparing the skeleton of this whale ere it was commenced; as he publicly purchased it for the sum of 6230 francs (about 259*l.* 11*s.* 8*d.*), jointly with M. Dubar, an eminent physician of Ostend, on the 16th of November, 1827. From the time the Rorqual was thrown into the harbour, considerable doubt was entertained in the minds of many scientific naturalists as to what species it belonged to; some declaring it a cachalot, others a gibbous whale, &c. &c.

However, from its possessing the longitudinal folds extending from the throat towards the middle of the trunk, it was indicated to be either a Rorqual, or the Finner of the whalers: the latter is the pike-headed whale of Pennant. Various reasons decided it to belong to the former species; but every work by professed naturalists exhibited contrary opinions. Even the illustrious Cuvier himself was in error, inasmuch as he states that all *C*etàcea with folds belong to one and the same species; whereas, according to Count Lacépède, the dorsal fin proved it to belong to the second class of the whale genus, which he has named Balænóptera.

Towards the end of November, 1827, M. Kessels went to Paris, where he consulted Baron Cuvier, and returned with Messrs. Dubar and Paret, the latter an eminent amateur naturalist, on the 20th of December. They had exhibited to this zoologist the whole of the drawings which had been taken of the animal; and he informed them that the Balænóptera *Rórqual* and the Balænóptera *Jubártes*, which Lacépède and other naturalists had described as two species, were only one and the same; as their distinguishing characters were so trifling that they might be easily confounded with each other. However, M. Dubar, notwithstanding this opinion, determined on considering it a Rorqual in the work which he published on this subject. To whatever species the individual specimen in question belongs, it is doubtless the largest animal that has ever been captured, and I do not hesitate to say that the skeleton is the most perfect in Europe.

The following measurements will give the reader some idea of the bulk of this animal: —

Total length of animal, 95 ft.; breadth, 18 ft. Length of the head, 22 ft.; length of the lower jaw-bones each, 22 ft.; height of the skull, 4½ ft. Length of the spine, 69½ ft.; number of bones composing it, 54. Length of ribs, 9 ft.; number (14 on each side), 28. Length of the fins, 12½ ft. Length of the fingers, 4½ ft. Width of the tail, 22½ ft.; length of the tail, 3 ft.

Weight of the animal when found, 249 tons, or 480,000 lbs.

Weight of the skeleton, only 35 tons, or 70,000 lbs.; being a little less than one seventh of the entire bulk.

Quantity of oil extracted from the blubber, 4000 gallons, or 40,000 lbs.

Weight of the rotten flesh buried in the sand, 85 tons, or 170,000 lbs.

The dissection of this animal commenced under the superintendence of Dr. Dubar, on the 14th of November; in the presence of a great number of medical and other scientific men. The workmen were sixty-two in number, who were employed both day and night; they constructed a wooden house close to the spot. By the 19th the skeleton was dissected out, and deposited in a place prepared for that purpose; but it was not until the 20th of April, 1828, that it was articulated,

and fit for exhibition. For this purpose the carpenters commenced on the 14th of January the construction of the pavilion for its reception, the same now at Charing Cross.

When completed, M. Kessels, with the greatest liberality, gave several grand entertainments to the scientific men of the town, as well as to the workmen who had been employed, and likewise to the poor of the town; in fact, there were several days of great rejoicings. Medals of gold were presented from M. Kessels, by the governor, the burgomaster, and by Lieutenant-colonel Dufrenery, commandant of the place, to the heads of the following Societies:—To M. Jacques de Ridder, as president of the Royal Society of Saint Sebastien; to M. Philippe de Brock, president of the Society of Saint Andrew; to M. Aimé Liebaert, president of the Royal Society of Rhetoric, who also received from the same gentleman the fourth medal, which had been offered as a prize to the musical department of the Society.

### CLASSIFICATION OF THE WHALE GENUS.

Naturalists of the present day divide these animals into two genera; viz. those which are without the dorsal fin form the true *B*alæ`næ; while those possessing it are, as already stated, placed by Count Lacépède in the second genus, and denominated the Balænóptera.

The Rorqual belongs to the second genus, and may be arranged as follows:—

Class, Mammàlia. Order, *C*etàcea. Tribe, *B*alæ`næ.
Genus, Balænóptera. Species, *Rórqual.*

This genus is found not to remain so much to the northward as the common Greenland whale (*B. M*ysticètns), inasmuch as I have already stated its occasional occurrence in the seas about Great Britain, Ireland, Norway, and other nations near the arctic seas; it has also been found in the Mediterranean, near the Straits of Gibraltar. The proportion of oil which whales of this genus and species furnish is not to be compared with that supplied from the *B*alæ`na *M*ysticètus; and the baleen, or whalebone, from its smallness, is not so valuable. These circumstances, together with its great velocity, make this species a matter of indifference to the whalers, who rarely attempt its capture. This protuberance, in conjunction with a series of longitudinal furrows from the throat to the anus, points out the individuals possessing them as either of the kind called pike-headed whale, or Rorquals. Both kinds are discovered near the 75th degree of north latitude. The Rorqual subsists principally upon herrings and smaller fish, and its consumption of these must be immense, when we consider its vast size.

The back of our whale, when captured, was of a blackish hue, and the belly white. The lower jaw is less pointed than those of the other *C*etàcea, which is also a distinguishing mark of this genus. The eye is situated near the opening of the posterior part of the lips; and as the condyles [knobs which fit into sockets at joints] of the lower jaw are very high, so that the top of the head is almost on a level with the neck, the visual organs are therefore so contiguous to the top of the head, that they frequently appear above the water, when the Rorqual is swimming on the surface. The pectoral fins are placed at a short distance from the opening of the mouth, and nearly at right angles with the lips when extended. The dorsal fin is situated above the opening of the anus, and is very small in proportion to the size of the animal. The tail is divided into two lobes, with a convexity on the posterior portion of each; the inner margins of each lobe unite directly in the middle, in a line with the termination of the spine.

The inhabitants of Kamtschatka make use of every portion of the Jubarte or pike-nosed whale. The oil serves them partly for fuel, in the preparation of their food, and affords them light. The delicate pieces of baleen, or whalebone, they make into threads for the manufacture of fishing-nets, lines, &c. The lower jaws are used as portions of sledges, handles of instruments, &c.; sometimes the ribs form the framework of their cabins; the nerves answer the purposes of cord; and the various portions of the stomach and intestines form vessels to contain their drink and oil. The skin, which they rudely tan, they form into sandals, bags, and harness.

## OBSERVATIONS ON THE ANATOMY OF THE SKELETON.

Having given a brief outline of the zoological characteristics of this whale, I now proceed to make some observations on the anatomy of the skeleton, which, as I have remarked above, is that of a female.

In this skeleton there are several anomalies by which it is rendered peculiar, when contrasted with the other Mammàlia. There are but two distinct kinds of articulation, viz. first, the hinge kind, as in the articulation of the lower jaw with the head; and, secondly, the ball and socket kind, forming the joint of the shoulder, on the articulation of the arm-bone with the scapula, or shoulder-blade. There are none of the movable or the semi-movable articulations. Those I have mentioned possess cartilaginous surfaces, as they do in other animals; and thus the effects of friction are prevented: the other bones are only united by ligaments, which, however, do not form any capsules; they are inter-

osseous, and serve more the purposes of agility than flexibility. The greatest portions of the skeleton are united through the medium of intervening cartilages, even to the fingers, that is, the bones within the pectoral fins. The sutures are imperfectly formed, and in some places the kind of suture termed harmonia can hardly be said to exist; in the head, especially, the union of the bones is so feeble, that they appear nearly disunited.

Most of the bones of these animals are very porous, and contain large quantities of very fine oil. The lower jaw-bones, which measure usually from 20 to 25 ft. in length, are frequently preserved on account of the oil, which can be drained from them when they are conveyed into a warm climate. When this is exhausted, these bones float freely in water. They have very little of the compact substance which usually characterises bones, and in some parts form portions which are denominated *epiphyses*, that are but feebly connected to the other bones; and in the spine thirteen transverse natural processes were found detached from the body of the bone, without any apparent cause. Another peculiarity exists in the articulation of the ribs, which are not united to the bodies of the vertebræ, as in other Mammàlia, but are connected through an intervening cartilage to the transverse processes of the dorsal vertebræ. This portion of the skeleton is pretty nearly solid.

According to the observations of Sir Charles Giesecké, the *B*alæ`na *M*ysticètus, or common whale, possesses thirteen ribs on each side; whilst in the B. *Rórqual* there are fourteen. An additional distinguishing character in the Rorqual is the circumstance of there being at the muzzle a few small blades of baleen, or whalebone, a character not found in any other species of the whale genus, with a small bristly tuft, like the mane of a horse, only much firmer in texture. This important feature in this animal is finely preserved in the skeleton. This fact has neither been mentioned by Pennant nor Cuvier, and the Rorqual in Lacépède's *Hist. Cetac.* is any thing but a true representation. There are no abdominal or hind limbs in any of these animals; neither is there any vestige of pelvis, with the exception of a small portion of bone analogous to the ossa pubis of quadrupeds.

*The Head.* — This portion of the whale bears some resemblance to a pyramid lying on its side, the point or apex being in the front, and the base attached to the spine. We may not improperly divide, for the purpose of description, the head into five surfaces, viz. a superior, an inferior, a posterior, and two lateral. The superior surface is of a triangular shape; its length being about 25 ft.: it is terminated anteriorly by the

muzzle or extremity of the palatine bones; and posteriorly by the vault of the skull, which is occupied by the brain, and is distinguished by the frontal bone, which, passing in a semi-lunar direction, terminates in a process that contributes to form the anterior portion of the zygomatic arch; thus exhibiting an analogy to quadrupeds. From the top and anterior part of the frontal bone the nasal bones are articulated by sutures, and extend the whole length of the upper part of the mouth. Beneath these are two vomeres [plough-share bones], forming two thin osseous laminæ, and these are closely connected to the inferior part of the frontal bone.

The superior surface of the palatine bones may be perceived externally, and they are of a more spongy texture than the preceding. They are of a triangular form, and are curved at the external margin. Towards the posterior part there are five or six large foramina [orifices], which afford a passage for the nutritive arteries, &c. Between the above bones there is a large space left in the upper part of the mouth, which affords a lodgment to the ethmoidal bone [a bone that, in the superior part of the human nose, resembles a sieve]; and also for the spiracles, through which the animal ejects water; and these are popularly denominated the blow-holes. The ethmoidal bone is placed in the cavity formed by the nasal bones, and by which it is concealed: it is light, spongy, and formed of thin laminæ.

The lateral surfaces of the skull are likewise nearly triangular, and extend superiorly only to the sides or parietes [walls] of the nose; presenting several furrows which afford a lodgement to several important blood-vessels and nerves. The use of these bones is to augment the nasal cavity; they are lined by a dense, thick, olfactory membrane, in which the organ of smell is situated.

The inferior surface, like the rest, is triangular, and is mostly formed by the principal part of the palatine bones, and likewise possesses a great number of furrows and canals which afford a passage to the nutritive vessels and nerves; in the exterior boundary there is a sulcus [furrow], which indicates the place where the baleen or whalebone is inserted. At the posterior part of this surface, and between the mastoid processes [processes of the neck bone, shaped like the nipple of the breast], the two bones containing the organ of hearing, denominated the petrous, or, as I term them, the acoustic bones, are placed. In the interior there is a nervous pulp, in which the sense of hearing is supposed to reside.

The posterior surface or base of the skull is of a semicircular form, with two large alæ or wings on its sides, at the

bottom of the pterygoid [wing-like] processes of the sphenoidal [wedge-like] bone. There are the humular or hook-like processes, to which the pharynx [upper part of the gullet] is attached. The great occipital foramen [orifice in the back of the head] for the passage of the spinal marrow from the brain, is situated a little above the preceding. On each side of this foramen [orifice] there are the semilunar condyles [knobs] of the occipital [hind head] bone, which are articulated with the atlas [the first bone of the neck] as in the other Mammàlia. The remainder of this portion of the skull is occupied by the greater part of the occipital and the mastoid processes.

The lateral surfaces are formed by the end of the palatine bones anteriorly; the zygomatic fossa [cavity] and its arch posteriorly. This surface embraces portions of the temporal, occipital, and the sphenoidal bones.

On viewing the head vertically, we find several interesting peculiarities; the occipital bone measures more than 3 ft. in thickness, and is very spongy in its texture, whilst the external table is at the same time extremely thin; consequently the specific gravity must be very little, notwithstanding its immense size. The nasal cavities are very largely developed, and in the living animal not only contain the olfactory membrane, but likewise the spiracles, or organs by means of which the whale is enabled to project water to a considerable height above the surface of the ocean. The cerebral cavity, when contrasted with the dimensions of the other portions of the body, is extremely small; beneath it is the point of union of the vomer with the occipital and part of the ethmoidal bones. With the exception of the lower jaw-bones, all those composing the head are of a spongy nature, and appear to be formed of a series of laminæ. The lower jaw, like the same portions of other animals, and of the human infant at birth, is formed of two distinct pieces of bone, united together at the point or chin by symphysis, or a thin layer of intervening cartilage; each one forms a curve terminating in its condyle, and measures 22 ft. in length from the chin to its articulation with the bones of the head. It is extremely hard and compact; the coronoid process which is separated from the condyles by an almost horizontal space, which occupies the place of a semilunar cavity found in the other Mammàlia, affords insertion to the temporal muscle. They articulate themselves with the glenoid cavities of the occipital bone, in such a manner as to form a perfect hinge joint. The superior margins of these bones are perfectly smooth, and exhibit not the slightest vestige of any alveolar cavities

for teeth, which are found in several genera of the order *C*etàcea.

There is a number of large foramina on the labial surface of these bones, for the passage of large blood-vessels. The anterior mental foramen is placed externally near the chin, and is sufficiently large to admit a man's thumb: this leads to a large canal, which traverses the body of the bone; it contains blood-vessels and nerves, which, having performed their important duties in nourishing the bone, pass out by another large hole on the inside of a hole that is situated about 2 ft. from the back of the condyle.

*The Os Linguale, or Bone of the Tongue.* — This is of a triangular shape, and its appendages make it appear an immense volume of bone; it is situated between the shoulders, and above the bones forming the sternum [bone of the chest or breast]. The body of this lingual bone is curved in its form, the convexity of which projecting anteriorly, its inferior margin is crescent-shaped. There is to be observed a semilunar cavity at its smallest part, which, with the cartilages and ligaments, aids in the living animal towards forming the cavity of the throat. On its sides are some asperities, which give attachment to some of its powerful ligaments, &c. The top contains a deep sulcus [furrow], likewise lined with a similar surface, for the purpose of allowing origin and insertion to the muscles of deglutition. The bony appendages of this bone are two in number, and are articulated by means of loose ligaments to two extremities of the lingual bone. They are curved throughout their length, the convexity approaching inwards, where is a large and almost circular space in their upper part, that in the living animal contains enormous masses of fat. The remainder of these appendages are smooth, and appear only to give connection to a few muscular fibres.

## THE STRUCTURE OF THE SPINE.

This portion of the skeleton is composed of fifty-four bones, and, with the head, forms a length which at first sight seems impossible to have belonged to an animated being, did we not know the creative power of an almighty and wondrous God.

As in most of the other Mammàlia, we can divide the bones of the spine into four series: cervical, dorsal, lumbar, and caudal.

*Of the Vertebræ or Bones of the Neck.* — The first three of these have no spinal processes; but it appears, from its projecting from the cranium, that the spinal marrow passes from the brain into its proper canal, which is formed by the

three lateral processes of the first three bones of the neck. (" Formé par des apophyses latérales des trois premières cervicales." *Dubar.*) This, it is to be observed, is only a supposition of the superintendent of the dissection, M. Dubar, who states that the soft parts were in such a state of decomposition, that it was almost impossible to distinguish it. The true spinal canal commences at the fifth cervical vertebra, and extends nearly to the last caudal vertebra, being lost at the fifty-fourth.

This canal is formed of a triangular shape, by a series of spinous processes which make the arch on the bodies of the bones composing the spine, for the reception of the spinal marrow.

*The Atlas, or the first Bone of the Neck.* — The anterior surface presents two articular fossæ [cavities] for the reception of the condyloid processes [knobs] of the occipital bone, and is the means of the head articulating upon the trunk; superiorly and laterally there are two canals capable of receiving the human little finger, which give passage to the vertebral vessels. The two transverse processes are tuberose and asperated [roughened], for the attachment of the adjacent muscles and lateral ligaments, permitting the head to perform the various motions intended for it by the great Author of nature. The posterior surface of this bone exhibits nothing beyond a few irregularities by which it is attached to the bone behind it. There is no hole or foramen in the transverse process of the atlas, for the passage of blood-vessels and nerves.

*The second Bone of the Spine* is of a curious yet regular shape, presenting an oval figure, the great diameter of which is transverse. This bone has no spinous, but has two enormous transverse processes; each of which possesses a very large foramen, which exceeds that of the occipital bone by twice its diameter. The third, fourth, and fifth cervical vertebræ have double transverse processes, so that they do not, as in the second, form a complete foramen or hole; and the fifth exhibits the rudiments of a spinous process. The sixth forms a curve on its body, that, when united, has its convexity downwards.

*The Bones of the Back.* — These are fifteen in number, although the ribs are but fourteen on each side; the first of which, being bicipital [two-headed], is united to the first two dorsal vertebræ. The transverse processes have at their extremity an articulating surface for the union of the ribs — a phenomenon peculiar to these animals; and, consequently, the motions of the ribs must be somewhat limited. The bodies and

processes of these vertebræ are very large, and in substance they are more dense and compact than the other vertebræ; which may be supposed to be thus made stronger

"By Him who never errs,"

in consequence of their having to support the whole weight of the chest, with the heart, lungs, &c. &c.; together with the fins or swimming paws, and shoulder bones. This portion of the spine is curved, the convexity is upwards: by this means the cavity of the chest is greatly enlarged.

*The Bones of the Loins* are sixteen in number, and bear considerable resemblance to the preceding, and are without any articulating surfaces; but it may be here observed, that there exists not the slightest vestige of any abdominal limbs: and there are found attached to these bones, by means of muscles, two little bones, forming the ossa pubis; and this forms the only vestige of a pelvis. But I shall revert to this subject presently.

*The caudal Vertebræ*, or those approaching towards the tail, are eighteen in number, and have bony appendages at their inferior surfaces, with the exception of the eight nearest to the tail where the appendages disappear. This portion of the spine tapers towards the extremity; and, where it joins the tail, it exhibits a slight curve, the convexity of which is placed inferiorly.

*Of the Ribs.* — These are fourteen on each side, and form the walls of the chest. The structure of these bones is dense, firm, and compact; which, with their size and thickness, renders the animal capable of resisting the most violent shocks: with the exception of the first, which is almost vertical, the others take a more posterior direction. The head of the first rib is double, and articulated with the transverse processes of the seventh and eighth vertebræ by means of tubercles received into the articulated fossæ [cavities] of the vertebræ. The dimensions of this rib are very considerable, and the sternal extremity of it is much larger than the sternum itself. There is but one actual sternal rib on each side which is fairly articulated with the sternum; whilst the others are, as in most other Mammàlia, connected to that bone by a thick and powerful intervening cartilage, of which only the first five pair are real true ribs, and form any attachment to the sternum: the others are united to each other as the false ribs usually are, and the last three are not connected at all; consequently, we not improperly denominate them floating ribs. The fourth rib is the longest, and measures 9 ft. in length; the others gradually diminish as they approach the four-

teenth, which is the smallest. The appearance of the chest as a whole will give the spectator a very good idea of the framework of a small sailing vessel; and it is impossible to form any accurate idea of the dimensions of this cavity, without making an examination of the interior: there only it is that a true conception can be formed.

*The Sternum or Breast-bone.* — This bone, when contrasted with the immense dimensions of the chest, is very small and spongy in its texture; and the layer of compact osseous tissue covering it is so thin as hardly to be perceived. The shape bears some rude resemblance to a cross, the apex or top of which is carried forward. This bone gives attachment to the first rib on each side, and is composed of three bones connected by cartilage. It has two plain surfaces, and exhibits nothing else worth mention.

*The Bones of the Pelvis.* — The pubic bones, which I have already cursorily mentioned, may not unaptly be considered as appendages of the spine. They are extremely small, and each has somewhat a triangular shape; but one of the angles is elongated upwards, and they bear altogether no small resemblance to the marsupial bones found in the kangaroo and other animals of New Holland, &c. They are found floating in the muscular walls of the abdomen; and the only connection they have with each other is by a very loose ligament. From their position, they, as far as we can perceive, can be of very little service to the animal, inasmuch as they neither possess size nor strength sufficient to protect the generative organs, or to guard, during the pregnant state, the fœtus within. However, there is not the least doubt but these bones must answer some important purpose in the animal economy, else the allwise Architect of the universe would never, in his wisdom, have constructed an organ insubservient to some useful function.

## THE ANATOMY OF THE THORACIC EXTREMITIES, OR PECTORAL FINS.

The whale being deprived of clavicles, or collar bones, the pectoral fins are composed of the shoulder-blades, and what are, strictly speaking, the pectoral fins.

*The Scapula or Shoulder-blade.* — This is placed on part of the last cervical vertebra, and partly on the first dorsal, which it partly covers; it is a very large bone, of which the superior part is semicircular, and the inferior nearly quadrangular. The external surface is extremely smooth: there is no spinous process; but one, analogous to the acromion process of other animals, projects about 15 in. beyond the neck of the scapula.

This must afford attachment to some of the muscles; the remaining muscles must form connections with the smooth surface, or with the superior margin of the bone.

The costal or internal surface has several strongly marked prominences and canals, which diverge towards the semicircular margin. These canals are evidently produced by the ribs during the fœtal or infantile state of the animal. The superior semicircular margin has several strongly marked asperities, where several very powerful muscles are inserted. The anterior margin, which is the shortest, is likewise the thickest at the inferior part of this, and at the anterior angle; the coracoid process [resembling a crow's beak], and the one analogous to the acromion just described, both of them projecting anteriorly, are separated by a very deep canal, which, in the recent state, is filled up with a very fat cellular tissue. The glenoid or articular cavity of the shoulder joint is found at the anterior margin of this bone: it is very flat, and there appears to be no attachment of the scapulo-humeral ligament, from which the animal enjoys motion at this part to a greater extent than the other Mammàlia; for the head of the brachium or arm-bone, which is enormous, can ultimately employ all its surfaces; in fact, it can describe full two thirds of a sphere. Besides, the pectoral extremity not being controlled by a clavicle, its actions are less likely to be limited. This is the largest flat bone in the skeleton, next to those of the head; its structure is rather spongy, being only covered with a thin layer of dense substance. The fins contain bones analogous to the superior extremities in man, which I proceed to describe.

*The Os Brachii, or Arm-bone,* is short, but thick; the head is directed obliquely from outwards to inwards, where it articulates itself with the glenoid cavity of the shoulder-blade by means of a smooth and even articular cartilage; its cubital extremity is almost flat, and is articulated by simple ligaments to the radius and ulna. All the external surface of this bone is asperated, for the insertion of the muscles of the shoulder, and also of those which give motion to the fin.

*Of the Bones of the Forearm.* — The radius is flat, larger and thicker than the ulna, and offers no striking peculiarity, except the hardness of its compact tissue. Its articulation with the body is the same as with the ulna. *The Ulna, or Cubitus,* forms the inferior margin of the forearm; it is flat but curved through all its length: at the brachial extremity is a flattened tuberose process, which gives origin to strong tendons passing to the extremity of the fingers. The carpal extremity is united to the hand by a powerful tendinous substance: all the body of the bone has externally a dense com-

pact tissue of ossific matter. *The interosseous Space*, or cavity, between the radius and ulna, is very narrow; it has a very thick membrane, not unlike a piece of leather.

*The Carpus, or Wrist.* — This is composed of six large bones; some in the form of a cube, others in that of a cylinder. They appear to have no articulated surfaces; but, on the contrary, are at very great distances from each other, and seem as though they were fixed in a thick tendinous substance, which envelopes them on all sides; so that, to preserve these bones in their natural state, it was impossible for M. Dubar to pay any attention to their particular shape.

*The Metacarpus, or Hand*, is composed of four long and thick bones, the two middle ones bearing a resemblance, but not in magnitude, to the thigh-bones of an ox; and, with the exception of the index, the three others are united to one and the same bone. They are slightly curved, and are of an equal thickness throughout.

*The Fingers.*—The fingers are four in number, and the two smallest are the longest and strongest. The first, or the index, has four phalanges; the second, seven; the third, six; and the fourth, five; each having a space for a nail.

These bones or phalanges are independent of those forming the metacarpus. All of them are separated from each other by long tendinous ligaments, which are very flexible. Thus we find great strength within a small space in this limb, because it was there required: thus illustrating the beauty of Providence, in accommodating every part to the office it is designed to perform.

*Of the Construction of the Tail.* — The manner in which this tremendous and only weapon of defence belonging to this animal is constructed is as beautiful in its mechanism as any other part of the animal. It is wholly composed of three layers of tendinous fibres, covered by the common cutis and cuticle; two of these layers are external, and the other internal. The direction of the fibres of the two external layers is the same as in the tail, forming a stratum about one third of an inch thick; but varying, in this respect, as the tail is thicker or thinner. The middle layer is composed entirely of tendinous fibres, passing directly across, between the two external ones above described, their length being in proportion to the thickness of the tail: a structure which gives an amazing degree of strength to this part. The substance of the tail is so firm and compact that the blood-vessels retain their dilated state even when cut across; and this section consists of a large vessel surrounded by as many small ones as can come into contact with its external surface: but which of these are arteries, and which veins, has not been ascertained.

*General Remark.* — The whale is of those animals that (no matter which species) was once considered worthy to grace the royal table, some portions having been prepared in the most savoury manner for the royal banquets: and historical records inform us, that, in ancient times, when a whale was thrown on any of the British coasts, the spoil was divided between the king and queen; the king asserting his claim to the head, and Her Majesty to the tail. Several statutes vest the property of a whale caught on the coasts or seas of Great Britain and Ireland in the person of His Majesty, who is, however, to give a proper remuneration to all persons who may be concerned in the capture of such a valuable prize.

8. *Gower Place, London University.*

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A SHORT notice of the individual whale, which forms the theme of the preceding paper, will be found in our Number for September, 1828, Vol. I. p. 283. A notice of a male spermaceti whale, captured on the coast of Kent on the 16th of February, 1829, occurs in Vol. II. p. 197—202. The capture of a beak-nosed whale, on the coast near Liverpool, noticed in the end of April, 1829, is recorded Vol. II. p. 391. A useful remark on the structure of the hands of the whale is given Vol. II. p. 457., where it is observed that their flatness, pliancy, great size, and strength, enable the whale to sustain the young closely compressed to its body, as was remarked by Aristotle. An engraving of the species of whale denominated *P*hysèter catòdon, is given in Vol. II. p. 477. fig. 114. Short descriptive notices of two whales captured on the coast of Norfolk, one in March, 1822, the other on Nov. 23. 1829, and also a notice of a third seen spouting off Cromer, Norfolk, in the autumn of 1822, will be found in Vol. III. p. 157. In Vol. IV. p. 163. a short description of one found dead in the Channel, near Brighton, on Dec. 29. 1830, also occurs: this measured 63 ft. in length. And a figure, and a general as well as technical description, of a grampus (*D*élphinus *O*rca), a species of cetaceous animal, captured in Lynn Harbour on the 19th of November, 1830, will be found in our Vol. IV. p. 339.—*J. D.*

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## ART. III. *On the Faculty of Scent in the Vulture.*

By CHARLES WATERTON, Esq.

" Et truncas inhonesto vulnere nares." *Æneid.* lib. vi.
" And nose demolish'd by a shameful blow."

I NEVER thought that I should have lived to see this bird deprived of its nose. But in the third number of *Jameson's Journal*, a modern writer has actually given " An account of the habits of the Turkey-Buzzard (*V*últur Aúra), with a view of exploding the opinion generally entertained of its extraordinary power of smelling;" and I see that a gentleman in your Magazine (Vol. III. p. 449.) gives to this writer the