XXXVIII. *Obſervations on the Structure and Oeconomy of* Whales. *By* John Hunter, *Eſq. F. R. S.*; *communicated by Sir* Joſeph Banks, *Bart. P. R. S.*

Read June 28, 1787.

THE animals which inhabit the ſea are much leſs known to us than thoſe found upon land; and the œconomy of thoſe with which we are beſt acquainted is much leſs underſtood: we are, therefore, too often obliged to reaſon from analogy where information fails; which muſt probably ever continue to be the caſe, from our unfitneſs to purſue our reſearches in the unfathomable waters.

This unfitneſs does not ariſe from that part of our œconomy on which life and its functions depend; for the tribe of animals which is to be the ſubject of this Paper, has, in that reſpect, the ſame œconomy as man, but from a difference in the mechaniſm by which our progreſſive motion is produced.

The anatomy of the larger marine animals, when they are procured in a proper ſtate, can be as well aſcertained as that of any others; dead ſtructure being readily inveſtigated. But even ſuch opportunities too ſeldom occur, becauſe thoſe animals are only to be found in diſtant ſeas, which no one explores in purſuit of natural hiſtory; neither can they be brought to us alive from thence, which prevents our receiving their bodies in a ſtate

ſtate fit for diſſection. As they cannot live in air, we are unable to procure them alive.

Some of theſe aquatic animals yielding ſubſtances which have become articles of traffic, and in quantity ſufficient to render them valuable as objects of profit, are ſought after for that purpoſe; but gain being the primary view, the reſearches of the Naturaliſt are only conſidered as ſecondary points, if conſidered at all. At the beſt, our opportunities of examining ſuch animals do not often occur till the parts are in ſuch a ſtate as to defeat the purpoſes of accurate enquiry, and even theſe occaſions are ſo rare as to prevent our being able to ſupply, by a ſecond diſſection, what was deficient in a firſt. The parts of ſuch animals being formed on ſo large a ſcale, is another cauſe which prevents any great degree of accuracy in their examination; more eſpecially when it is conſidered, how very inconvenient for accurate diſſections are barges, open fields, and ſuch places as are fit to receive animals, or parts, of ſuch vaſt bulk.

As the opportunities of aſcertaining the anatomical ſtructure of large marine animals are generally accidental, I have availed myſelf, as much as poſſible, of all that have occurred; and, anxious to get more extenſive information, engaged a Surgeon, at a conſiderable expence, to make a voyage to Greenland, in one of the ſhips employed in the whale fiſhery, and furniſhed him with ſuch neceſſaries as I thought might be requiſite for examining and preſerving the more intereſting parts, and with inſtructions for making general obſervations; but the only return I received for this expence was a piece of whale's ſkin, with ſome ſmall animals ſticking upon it. From the opportunities which I have had of examining different animals of this order, I have gained a tolerably accurate idea of the

anatomical ſtructure of ſome genera, and ſuch a knowledge of the ſtructure of particular parts of ſome others, as to enable me to aſcertain the principles of their œconomy.

Thoſe which I have had opportunities of examining were the following:

Of the Delphinus Phocæna, or Porpoiſe, I have had ſeveral, both male and female.

Of the Grampus I have had two; one of them (Tab. XVI.) twenty-four feet long, the belly of a white colour, which terminated at once, the ſides and back being black; the other (Tab. XVII.) about eighteen feet long, the belly white, but leſs ſo than in the former, and ſhaded off into the dark colour of the back.

Of the Delphinus Delphis, or Bottle-noſe Whale (Tab. XVIII.) I had one ſent to me by Mr. JENNER, Surgeon, at Berkeley. It was about eleven feet long. I have alſo had one twenty-one feet long, reſembling this laſt in the ſhape of the head, but of a different genus, having only two teeth in the lower jaw (Tab. XIX.); the belly was white, ſhaded off into the dark colour of the back. This ſpecies is deſcribed by DALE, in his Antiquities of Harwich. The one which I examined muſt have been young; for I have a ſkull of the ſame kind, nearly three times as large, which muſt have belonged to an animal thirty or forty feet long.

Of the Balæna roſtrata of FABRICIUS, I had one, ſeventeen feet long (Tab. XX.).

The Balæna Myſticetus, or large Whalebone Whale, the Phyſeter Macrocephalus, or Spermaceti Whale, and the Monodon Monoceros, or Narwhale, have alſo fallen under my inſpection. Some of theſe I have had opportunities of examining with accuracy; while others I have only examined in part,

part, the animals having been too long kept before I procured them, to admit of more than a very ſuperficial inſpection.

From theſe circumſtances it will be readily ſuppoſed, that an accurate deſcription of all the different ſpecies is not to be expected; but having acquired a general knowledge of the whole tribe, from the different ſpecies which have come under my examination, I have been enabled to form a tolerable idea, even of parts which I have only had the opportunity of ſeeing in a very curſory way.

General obſervation would lead us to believe, that the whole of this tribe conſtitutes one order of animals, which Naturaliſts have ſubdivided into genera and ſpecies; but a deficiency in the knowledge of their œconomy has prevented them from making theſe diviſions with ſufficient accuracy; and this is not ſurpriſing, ſince the genera and ſpecies are ſtill in ſome meaſure undetermined even in animals with which we are better acquainted.

The animals of this order are in ſize the largeſt known, and probably, therefore, the feweſt in number of all that live in water. Size, I believe, in thoſe animals who feed upon others, is in an inverſe proportion to the number of the ſmaller; but, I believe, this tribe varies more in that reſpect than any we know, viewing it from the Whalebone Whale, which is ſeventy or eighty feet long, to the Porpoiſe that is five or ſix: however, if they differ as much among themſelves as the Salmon does from the Sprat, there is not that comparative difference in ſize that would at firſt appear. The Whalebone Whale is, I believe, the largeſt; the Spermaceti Whale the next in ſize (the one which I examined, although not full grown, was about ſixty feet long); the Grampus, which is an extenſive genus, is probably

probably from twenty to fifty feet long; under this denomination there is a number of ſpecies.

From my want of knowledge of the different genera of this tribe of animals, an incorrectneſs in the application of the anatomical account to the proper genus may be the conſequence; for when they are of a certain ſize, they are brought to us as Porpoiſes; when larger, they are called Grampus, or Fin-fiſh. A tolerably correct anatomical deſcription of each ſpecies, with an accurate Drawing of the external form, would lead us to a knowledge of the different genera, and the ſpecies in each; and, in order to forward ſo uſeful a work, I propoſe, at ſome future period, to lay before the Society deſcriptions and drawings of thoſe which have come under my own obſervation.

From ſome circumſtances in their digeſtive organs we ſhould be led to ſuppoſe, that they were nearly allied to each other; and that there was not the ſame variety, in this reſpect, as in land animals.

In the deſcription of this order of animals, I ſhall always keep in view their analogy to land animals, and to ſuch as occaſionally inhabit the water, as white Bears, Seals, Manatees, &c. with the differences that occur. This mode of referring them to other animals, better known, will aſſiſt the mind in underſtanding the preſent ſubject. It is not, however, intended in this Paper to give a particular account of the ſtructure of all the animals of this order, which I have had an opportunity of examining: I propoſe, at preſent, chiefly to confine myſelf to general principles, giving the great outlines as far as I am acquainted with them, minuteneſs being only neceſſary in the inveſtigation of particular parts.

In my account I ſhall pay ſome attention to the relations of men who have given facts without knowing their cauſes, whenever I find that ſuch facts can be explained upon true principles of the animal œconomy, but no further.

This order of animals has nothing peculiar to fiſh, except living in the ſame element, and being endowed with the ſame powers of progreſſive motion as thoſe fiſh that are intended to move with a conſiderable velocity: for I believe, that all that come to the ſurface of the water (which this order of animals muſt do) have conſiderable progreſſive motion; and this reaſoning we may apply to birds; for thoſe which ſoar very high have the greateſt progreſſive motion.

Although inhabitants of the waters, they belong to the ſame claſs as quadrupeds, breathing air, being furniſhed with lungs, and all the other parts peculiar to the œconomy of that claſs, and having warm blood; for we may make this general remark, that in the different claſſes of animals there is never any mixture of thoſe parts which are eſſential to life, nor in their different modes of ſenſation.

I ſhall divide what is called the œconomy of an animal, firſt, into thoſe parts and actions which reſpect its internal functions, and on which life immediately depends, as growth, waſte, repair, ſhifting or changing of parts, &c. the organs of reſpiration and ſecretion, in which we may include the powers of propagating the ſpecies.

Secondly, into thoſe parts and actions which reſpect external objects, and which are variouſly conſtructed, according to the kind of matter with which they are to be connected, whence they vary more than thoſe of the firſt diviſion. Theſe are the parts for progreſſive motion, the organs of ſenſe and

and the organs of digeſtion; all which either act, or are acted upon, by external matter.

This variation from external cauſes in many inſtances influences the ſhape of the whole, or particular parts, even giving a peculiar form to ſome which belong to the firſt order of actions, as the heart, which in this tribe, in the Seal, Otter, &c. is flattened, becauſe the cheſt is flattened for the purpoſe of ſwimming. The contents of the abdomen are not only adapted to the external form; but their direction in the cavity is, in ſome inſtances, regulated by it. The anterior extremity, or fin, although formed of diſtinct parts, in ſome degree ſimilar to the anterior extremities of ſome quadrupeds, being compoſed of ſimilar bones placed nearly in the ſame manner, yet are ſo formed and arranged as to fit them for progreſſive motion in the water only.

The external form of this order of animals is ſuch as fits them for dividing the water in progreſſive motion, and gives them power to produce that motion in the ſame manner as thoſe fiſh which move with a conſiderable velocity. On account of their inhabiting the water, their external form is more uniform than in animals of the ſame claſs which live upon land, the ſurface of the earth on which the progreſſive motion of the quadruped is to be performed being various and irregular, while the water is always the ſame.

The form of the head or anterior part of this order of animals is commonly a cone, or an inclined plane, except in the Spermaceti Whale, in which it terminates in a blunt ſurface. This form of head increaſes the ſurface of contact to the ſame volume of water which it removes, leſſens the preſſure, and is better calculated to bear the reſiſtance of the water through which the animal is to paſs; probably, on this account, the head

is larger than in quadrupeds, having more the proportion obſerved in fiſh, and ſwelling out laterally at the articulation of the lower jaw: this may probably be for the better catching their prey, as they have no motion of the head on the body; and this diſtance between the articulations of the jaw is ſomewhat ſimilar to the Swallow, Goat-ſucker, Bat, &c. which may alſo be accounted for, from their catching their food in the ſame manner as fiſh; and this is rendered ſtill more probable, ſince the form of the mouth varies according as they have or have not teeth. There is, however, in the Whale tribe more variety in the form of the head than of any other part, as in the Whalebone, Bottle-noſe, and Spermaceti Whales; though in this laſt it appears to owe its ſhape, in ſome ſort, to the vaſt quantity of ſpermaceti lodged there, and not to be formed merely for the catching of its prey. From the mode of their progreſſive motion, they have not the connection between the head and body, that is called the neck, as that would have produced an inequality inconvenient to progreſſive motion.

The body behind the fins or ſhoulders diminiſhes gradually to the ſpreading of the tail; but the part beyond the opening of the anus is to be conſidered as tail, although to appearance it is a continuation of the body. The body itſelf is flattened laterally; and, I believe, the back is much ſharper than the belly.

The projecting part, or tail, contains the power that produces progreſſive motion, and moves the broad termination, the motion of which is ſimilar to that of an oar in ſculling a boat; it ſuperſedes the neceſſity of poſterior extremities, and allows of the proper ſhape for ſwimming; that the form may be preſerved as much as poſſible, we find that all the projecting

parts, found in land animals of the ſame claſs, are either intirely wanting, as the external ear; are placed internally, as the teſticles; or are ſpread along under the ſkin, as the udder.

The tail is flattened horizontally, which is contrary to that of fiſh, this poſition of tail giving the direction to the animal in the progreſſive motion of the body. I ſhall not purſue this circumſtance further than to apply it to thoſe purpoſes in the animal œconomy, for which this particular direction is intended.

The two lateral fins, which are analogous to the anterior extremities in the quadruped, are commonly ſmall, varying however in ſize, and ſeem to ſerve as a kind of oars.

To aſcertain the uſe of the *fin* on the back is probably not ſo eaſy, as the large Whalebone and Spermaceti Whales have it not; one ſhould otherwiſe conceive it intended to preſerve the animal from turning.

I believe, like moſt animals, they are of a lighter colour on their belly than on their back: in ſome they are intirely white on the belly; and this white colour begins by a regular determined line, as in the Grampus, Piked Whale, &c.: in others, the white on the belly is gradually ſhaded into the dark colour of the back, as in the Porpoiſe. I have been informed, that ſome of them are pied upwards and downwards, or have the diviſions of colour in a contrary direction.

The element in which they live renders certain parts which are of importance in other animals uſeleſs in them, gives to ſome parts a different action, and renders others of leſs account.

The puncta lachrymalia with the appendages, as the ſac and duct, are in them unneceſſary; and the ſecretion from the lachrymal gland is not water, but mucus, as it alſo is in the Turtle;

and

and we may ſuppoſe only in ſmall quantity, the gland itſ being ſmall.

The urinary bladder is ſmaller than in quadrupeds; and i deed there is not any apparent reaſon why Whales ſhould ha one at all.

The tongue is flat, and but little projecting, as they neith have voice, nor require much action of this part, in applyi the food between the teeth for the purpoſe of maſtication, deglutition, being nearly ſimilar to fiſh in this reſpect, as w as in their progreſſive motion.

In ſome particulars they differ as much from one another any two genera of quadrupeds I am acquainted with.

The larynx, ſize of trachea, and number of ribs, dif exceedingly. The cæcum is only found in ſome of the The teeth in ſome are wanting. The blow-holes are two number in many, in others only one. The whalebone a ſpermaceti are peculiar to particular genera: all which conſ tute great variations. In other reſpects we find an uniformit which would appear to be independent of their living a moving only in the water, as in the ſtomach, liver, parts generation of both ſexes, and in the kidneys: in theſe l however, I believe, it depends in ſome degree upon their ſitu tion, although it is extended to other animals, the cauſe which I do not underſtand.

All animals have, I believe, a ſmell peculiar to themſelv how far this is connected with the other diſtinctions, I do r know, our organs not being able to diſtinguiſh with ſufficie accuracy.

The ſmell of animals of this tribe is the ſame with that the Seal, but not ſo ſtrong, a kind of ſour ſmell, which t

Seal has while alive; the oil has the ſame ſmell with that of the Salmon, Herring, Sprat, &c.

The obſervations reſpecting the weight of the fleſh of animals that ſwim, which I publiſhed in my obſervations on the œconomy of certain parts of animals, are applicable to theſe alſo; for the fleſh in this tribe is rather heavier than beef; two portions of muſcle of the ſame ſhape, one from the pſoas muſcle of the Whale, the other of an ox, when weighed in air, were both exactly 502 grains; but, weighed in water, the portion of the Whale was four grains heavier than the other. It is probable, therefore, that the neceſſary equilibrium between the water and the animal is produced by the oil, in addition to which the principal action of the tail is ſuch as tends either to raiſe them, or keep them ſuſpended in the water, according to the degree of force with which it acts.

From the tail being horizontal, the motion of the animal, when impelled by it, is up and down: two advantages are gained by this, it gives the neceſſary opportunity of breathing, and elevates them in the water; for every motion of the tail tends, as I ſaid before, to raiſe the animal: and that this may be effected, the greateſt motion of the tail is downwards, thoſe muſcles being very large, making two ridges in the abdomen; this motion of the tail raiſes the anterior extremity, which always tends to keep the body ſuſpended in the water.

Of the Bones.

The bones alone, in many animals, when properly united into what is called the ſkeleton, give the general ſhape and character of the animal. Thus a quadruped is diſtinguiſhed from a bird, and even one quadruped from another, it only requiring

requiring a ſkin to be thrown over the ſkeleton to make the ſpecies known; but this is not ſo decidedly the caſe with this order of animals, for the ſkeleton in them does not give us the true ſhape. An immenſe head, a ſmall neck, few ribs, and in many a ſhort ſternum, and no pelvis, with a long ſpine, terminating in a point, require more than a ſkin being laid over them to give the regular and characteriſtic form of the animal.

The bones of the anterior extremity give no idea of the ſhape of a fin, the form of which depends wholly upon its covering. The different parts of the ſkeleton, are ſo incloſed, and the ſpaces between the projecting parts are ſo filled up, as to be altogether concealed, giving the animal externally an uniform and elegant form, reſembling an inſect enveloped in its chryſalis coat.

The bones of the head are in general ſo large, as to render the cavity which contains the brain but a ſmall part of the whole; while, in the human ſpecies, and in birds, this cavity conſtitutes the principal bulk of the head. This is, perhaps, moſt remarkable in the Spermaceti Whale; for on a general view of the bones of the head, it is impoſſible to determine where the cavity of the ſkull lies, till led to it by the foramen magnum occipitale. The ſame remark is applicable to the large Whalebone and Bottle-noſe Whale; but in the Porpoiſe, where the brain is larger in proportion to the ſize of the animal, the ſkull makes the principal part of the head.

Some of the bones in one genus differ from thoſe of another. The lower jaw is an inſtance of this. In the Spermaceti and Bottle-noſe Whales, the Grampus, and the Porpoiſe, the lower jaws, eſpecially at the poſterior ends, reſemble each other;

other; but in both the large and ſmall Whalebone Whales, the ſhape differs conſiderably. The number of ſome particular bones varies likewiſe very much.

The Piked Whale has ſeven vertebræ in the neck, twelve which may be reckoned to the back, and twenty-ſeven to the tail, making forty-ſix in the whole.

In the porpoiſe there are five cervical vertebræ, and one common to the neck and back, fourteen proper to the back, and 30 to the tail, making in the whole fifty-one.

The ſmall Bottle-noſe Whale, caught near Berkeley, in the number of cervical vertebræ reſembled the Porpoiſe; it had ſeventeen in the back, and thirty-ſeven in the tail, in all ſixty.

In the Porpoiſe, four of the vertebræ of the neck are anchyloſed; and in every animal of this order, which I have examined, the atlas is by much the thickeſt, and ſeems to be made up of two joined together, for the ſecond cervical nerve paſſes through a foramen in this vertebra. There is no articulation for rotatory motion between the firſt and ſecond vertebræ of the neck.

The ſmall Bottle-noſe Whale had eighteen ribs on each ſide, the Porpoiſe ſixteen. The ends of the ribs that have two articulations, in the whole of this tribe, I believe, are articulated with the body of the vertebræ above, and with the tranſverſe proceſſes below, by the angles; ſo that there is one vertebra common to the neck and back. In the large Whalebone Whale the firſt rib is bifurcated, and conſequently articulated to two vertebræ.

The ſternum is very flat in the Piked Whale; it is only one very ſhort bone; and in the Porpoiſe it is a good deal longer. In the ſmall Bottle-noſe it is compoſed of three

bones, and is of ſome length. In the Piked Whale the firſt rib, and in the Porpoiſe the three firſt, are articulated with the ſternum.

As a contraction, correſponding to the neck in quadrupeds, would have been improper in this order of animals, the vertebræ of the neck are thin, to make the diſtance between the head and ſhoulders as ſhort as poſſible, and in the ſmall Bottle-noſe Whale are only ſix in number.

The ſtructure of the bones is ſimilar to that of the bones of quadrupeds; they are compoſed of an animal ſubſtance, and an earth that is not animal: theſe ſeem only to be mechanically mixed, or rather the earth thrown into the interſtices of the animal part. In the bones of fiſhes this does not ſeem to be the caſe, the earth in many fiſh being ſo united with the animal part, as to render the whole tranſparent, which is not the caſe when the animal part is removed by ſteeping the bone in cauſtic alkali: nor is the animal part ſo tranſparent when deprived of the earth. The bones are leſs compact than thoſe of quadrupeds that are ſimilar to them.

Their form ſomewhat reſembles what takes place in the quadruped, at leaſt in thoſe whoſe uſes are ſimilar, as the vertebræ, ribs, and bones of the anterior extremities have their articulations in part alike, although not in all of them. The articulation of the lower jaw, of the carpus, metacarpus, and fingers, are exceptions. The articulation of the lower jaw is not by ſimple contact either ſingle or double, joined by a capſular ligament, as in the quadruped; but by a very thick intermediate ſubſtance of the ligamentous kind, ſo interwoven that its parts move on each other, in the interſtices of which is an oil. This thick matted ſubſtance may anſwer the ſame purpoſe as the double joint in the quadruped.

The

The two fins are analogous to the anterior extremities of the quadruped, and are alſo ſomewhat ſimilar in conſtruction. A fin is compoſed of a ſcapula, os humeri, ulna, radius, carpus, and metacarpus, in which laſt may be included the fingers, becauſe the number of bones are thoſe which might be called fingers, although they are not ſeparated, but included in one general covering with the metacarpus. They have nothing analogous to the thumb, and the number of bones in each is different; in the fore-finger there are five bones, in the middle and ring-finger ſeven, and in the little finger four. The articulation of the carpus, metacarpus, and fingers, is different from that of the quadruped, not being by capſular ligament, but by intermediate cartilages connected to each bone. Theſe cartilages between the different bones of the fingers are of conſiderable length, being nearly equal to one-half of that of the bone; and this conſtruction of the parts gives firmneſs, with ſome degree of pliability, to the whole.

As this order of animals cannot be ſaid to have a pelvis, they of courſe have no os ſacrum, and therefore the vertebræ are continued on to the end of the tail; but with no diſtinction between thoſe of the loins and tail. But as thoſe vertebræ alone would not have had ſufficient ſurface to give riſe to the muſcles requiſite to the motion of the tail, there are bones added to the fore-part of ſome of the firſt vertebræ of the tail, ſimilar to the ſpinal proceſſes on the poſterior ſurface.

From all theſe obſervations we may infer, that the ſtructure, formation, arrangement, and the union of the bones, which compoſe the forms of parts in this order of animals, are much upon the ſame principle as in quadrupeds.

The fleſh or muſcles of this order of animals is red, reſembling that of moſt quadrupeds, perhaps more like that of the

Bull or Horſe than any other animal: ſome of it is very firm; and about the breaſt and belly it is mixed with tendon.

Although the body and tail is compoſed of a ſeries of bones connected together and moved as in fiſh, yet it has its movements produced by long muſcles, with long tendons, which renders the body thicker, while the tail at its ſtem is ſmaller than that of any other ſwimmer, whoſe principal motion is the ſame. Why this mode of applying the moving powers ſhould not have been uſed in fiſh, is probably not ſo eaſily anſwered; but in fiſh the muſcles of the body are of nearly the ſame length as the vertebræ.

The depreſſor muſcles of the tail, which are ſimilar in ſituation to the pſoæ, make two very large ridges on the lower part of the cavity of the belly, riſing much higher than the ſpine, and the lower part of the aorta paſſes between them.

Theſe two large muſcles, inſtead of being inſerted into two extremities as in the quadruped, go to the tail, which may be conſidered in this order of animals as the two poſterior extremities united into one.

Their muſcles, a very ſhort time after death, loſe their fibrous ſtructure, become as uniform in texture as clay or dough, and even ſofter. This change is not from putrefaction, as they continue to be free from any offenſive ſmell, and is moſt remarkable in the pſoæ muſcles, and thoſe of the back.

Of the Conſtruction of the Tail.

The mode in which the tail is conſtructed is, perhaps, as beautiful, as to the mechaniſm, as any 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, the other internal. The direction of the fibres of the 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 amazing ſtrength to this part.

The ſubſtance of the tail is ſo firm and compact, that the 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 in contact with its external ſurface; which of theſe are arteries, and which veins, I do not know.

The fins are merely covered with a ſtrong condenſed adipoſe membrane.

Of the Fat.

The fat of this order of animals, except the ſpermaceti, is what we generally term oil. It does not coagulate in our atmoſphere, and is probably the moſt fluid of animal fats; but the fat of every different order of animals has not a peculiar degree of ſolidity, ſome having it in the ſame ſtate, as the Horſe and Bird. What I believe approaches neareſt to ſpermaceti, is the fat of ruminating animals, called tallow.

The fat is differently ſituated in different orders of animals; probably for particular purpoſes, at leaſt in ſome we can aſſign a final intention. In the animals, which are the ſubject of the preſent Paper, it is found principally on the outſide of the muſcles, immediately under the ſkin, and is in conſiderable quantity. It is rarely to be met with in the interſtices of the muſcles, or in any of the cavities, ſuch as the abdomen or about the heart.

In

In animals of the ſame claſs living on land, the fat is more diffuſed: it is ſituated, more eſpecially when old, in the interſtices of muſcles, even between the faſciculi of muſcular fibres, and is attached to many of the viſcera; but many parts are free from fat, unleſs when diſeaſed, as the penis, ſcrotum, teſticle, eyelid, liver, lungs, brain, ſpleen, &c.

In fiſh its ſituation is rather particular, and is moſt commonly in two modes; in the one, diffuſed through the whole body of the fiſh, as in the Salmon, Herring, Pilchard, Sprat, &c.; in the other, it is found in the liver only, as in all of the Ray kind, Cod, and in all thoſe called White-fiſh, there being none in any other part of the body *. The fat of fiſh appears to be diffuſed through the ſubſtance of the parts which contain it, but is probably in diſtinct cells. In ſome of theſe fiſh, where it is diffuſed over the whole body, it is more in ſome parts than others, as on the belly of the Salmon, where it is in larger quantity.

The fat is differently incloſed in different orders of animals. In the quadruped, thoſe of the Seal kind excepted, in the bird, amphibia, and in ſome fiſh, it is contained in looſe cellular membrane, as if in bags, compoſed of ſmaller ones, by which means the larger admit of motion on one another, and on their connecting parts; which motion is in a greater or leſs degree, as is proper or uſeful. Where motion could anſwer no purpoſe, as in the bones, it is confined in ſtill ſmaller cells. The fat is in a leſs degree in the ſoles of the feet, palms of the hands, and in the breaſts of many animals. In this order of animals and the Seal kind, as far as I yet know, it is diſpoſed of in two ways; the ſmall quantity found in the cavities of the body,

* The Sturgeon is, however, an exception, having its fat in particular ſituations, and in the interſtices of parts, as in other animals.

and

and interſtices of parts, is in general diſpoſed in the ſame way as in quadrupeds; but the external, which includes the principal part, is incloſed in a reticular membrane, apparently compoſed of fibres paſſing in all directions, which ſeem to confine its extent, allowing it little or no motion on itſelf, the whole, when diſtended, forming almoſt a ſolid body. This, however, is not always the caſe in every part of animals of this order; for under the head, or what may be rather called neck, of the Bottle-noſe, the fat is confined in larger cells, admitting of motion. This reticular membrane is very fine in ſome, and very ſtrong and coarſe in others, and even varies in different parts of the ſame animal. It is fine in the Porpoiſe, Spermaceti, and large Whalebone Whale; coarſe in the Grampus and ſmall Whalebone Whale *: in all of them it is fineſt on the body, becoming coarſer towards the tail, which is compoſed of fibres without any fat: which is alſo the caſe in the covering of the fins. This reticular net-work in the Seal is very coarſe; and in thoſe which are not fat, when it collapſes, it looks almoſt like a fine net with ſmall meſhes. This ſtructure confines the animal to a determined ſhape, whereas in quadrupeds fat when in great quantity deſtroys all ſhape.

The fat differs in conſiſtence in different animals, and in different parts of the ſame animal, in which its ſituation is various. In quadrupeds, ſome have the external fat ſofter than the internal; and that incloſed in bones is ſofteſt nearer to their extremities. Ruminating animals have that ſpecies of fat called tallow, and in their bones they have either hard fat or marrow, or fluid fat called Neat's-foot oil. In this order of animals, the internal fat is the leaſt fluid, and is nearly of the conſiſtence of Hog's-lard; the

* Where it is fine, it yields the largeſt quantity of oil, and requires the leaſt boiling.

external is the common train oil; but the Spermaceti Whale differs from every other animal I have examined, having the two kinds of fat juſt mentioned, and another which is totally different, called ſpermaceti, of which I ſhall give a particular account.

What is called ſpermaceti is found every where in the body in ſmall quantity, mixed with the common fat of the animal, bearing a very ſmall proportion to the other fat. In the head it is the reverſe, for there the quantity of ſpermaceti is large when compared to that of the oil, although they are mixed, as in the other parts of the body.

As the ſpermaceti is found in the largeſt quantity in the head, and in what would appear on a ſlight view to be the cavity of the ſkull, from a peculiarity in the ſhape of that bone, it has been imagined by ſome to be the brain.

Theſe two kinds of fat in the head are contained in cells, or cellular membrane, in the ſame manner as the fat in other animals; but beſides the common cells there are larger ones, or ligamentous partitions going acroſs, the better to ſupport the vaſt load of oil, of which the bulk of the head is principally made up.

There are two places in the head where this oil lies; theſe are ſituated along its upper and lower part: between them paſs the noſtrils, and a vaſt number of tendons going to the noſe and different parts of the head.

The pureſt ſpermaceti is contained in the ſmalleſt and leaſt ligamentous cells: it lies above the noſtril, all along the upper part of the head, immediately under the ſkin, and common adipoſe membrane. Theſe cells reſemble thoſe which contain the common fat in the other parts of the body neareſt the ſkin. That which lies above the roof of the mouth, or between it

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and the noſtril, is more intermixed with a ligamentous cellular membrane, and lies in chambers whoſe partitions are perpendicular. Theſe chambers are ſmaller the nearer to the noſe, becoming larger and larger towards the back part of the head, where the ſpermaceti is more pure.

This ſpermaceti, when extracted cold, has a good deal the appearance of the internal ſtructure of a water melon, and is found in rather ſolid lumps.

About the noſe, or anterior part of the noſtril, I diſcovered a great many veſſels, having the appearance of a plexus of veins, ſome as large as a finger. On examining them, I found they were loaded with the ſpermaceti and oil; and that ſome had correſponding arteries. They were moſt probably lymphatics; therefore I ſhould ſuppoſe, that their contents had been abſorbed from the cells of the head. We may the more readily ſuppoſe this, from finding many of the cells, or chambers, almoſt empty; and as we may reaſonably believe that this animal had been ſome time out of the ſeas in which it could procure proper food, it had perhaps lived on the ſuperabundance of oil.

The ſolid maſſes are what are brought home in caſks for ſpermaceti.

I found, by boiling this ſubſtance, that I could eaſily extract the ſpermaceti and oil which floated on the top from the cellular membrane. When I ſkimmed off the oily part, and let it ſtand to cool, I found that the ſpermaceti cryſtalliſed, and the whole became ſolid; and by laying this cake upon any ſpongy ſubſtance, as chalk, or on a hollow body, the oil drained all off, leaving the ſpermaceti pure and white. Theſe cryſtals were only attached to each other by edges, forming a ſpongy maſs; and by melting this pure ſpermaceti, and allowing it to cry-

ſtalliſe, it was reduced in appearance to half its bulk, the cryſtals being ſmaller, and more blended, conſequently leſs diſtinct.

The ſpermaceti mixes readily with other oils, while it is in a fluid ſtate, but ſeparates or cryſtalliſes whenever it is cooled to a certain degree; like two different ſalts being diſſolved in water, one of which will cryſtalliſe with a leſs degree of evaporation than the other; or, if the water is warm, and fully ſaturated, one of the ſalts will cryſtalliſe ſooner than the other, while the ſolution is cooling. I wanted to ſee whether ſpermaceti mixed equally well with the expreſſed oils of vegetables when warm, and likewiſe ſeparated and cryſtalliſed when cold, and on trial there ſeemed to be no difference. When very much diluted with the oil, it is diſſolved or melted by a much ſmaller degree of heat than when alone; and this is the reaſon, perhaps, that it is in a fluid ſtate in the living body.

If the quantity of ſpermaceti is ſmall in proportion to the other oil, it is, perhaps, nearly in that proportion longer in cryſtalliſing; and when it does cryſtalliſe, the cryſtals are much ſmaller than thoſe that are formed where the proportion of ſpermaceti is greater. From the ſlowneſs with which the ſpermaceti cryſtalliſes when much diluted with its oil, from a conſiderable quantity being to be obtained in that way, and from its continuing for years to cryſtalliſe, one would be induced to think, that perhaps the oil itſelf is converted into ſpermaceti.

It is moſt likely, that if we could diſcover the exact form of the different cryſtals of oils, we ſhould thence be able to aſcertain both the different ſorts of vegetable oils, expreſſed and eſſential, and the different ſorts of animal oils, much better than by any other means; in the ſame manner as we know ſalts by the forms into which they ſhoot.

The ſpermaceti does not become rancid, or putrid, nearly ſo ſoon as the other animal oils; which is moſt probably owing to the ſpermaceti being for the moſt part in a ſolid ſtate; and I ſhould ſuppoſe, that few oils would become ſo ſoon rancid as they do, if they were always preſerved in that degree of cold which rendered them ſolid: neither does this oil become ſo ſoon putrid as the fleſh of the animal; and therefore, although the oil in the cells appeared to be putrid before boiling, it was ſweet when deprived of the cellular ſubſtance. The ſpermaceti is rather heavier than the other oil.

In this animal then we find two ſorts of oil, beſides the deeper ſeated fat, common to all of this claſs; one of which cryſtalliſes with a much leſs degree of cold than the other, and of courſe requires a greater degree of heat to melt it, and forms, perhaps, the largeſt cryſtals of any expreſſed oil we know: yet the fluid oil of this animal will cryſtalliſe in an extreme hard froſt, much ſooner than moſt eſſential oils, though not ſo ſoon as the expreſſed oils of vegetables. Camphire, however, is an exception, ſince it cryſtalliſes in our warmeſt weather, and when melted with expreſſed oil of vegetables, if the oil is too much ſaturated for that particular degree of cold, cryſtalliſes exactly like ſpermaceti.

In the Ox the tallow, and what is called Neat's-foot oil, cryſtalliſe in different degrees of cold. The tallow congeals with rather leſs cold than the ſpermaceti; but the other oil is ſimilar to what is called the train oil in the Whale.

I have endeavoured to diſcover the form of the cryſtals of different ſorts of oil; but could never determine exactly what that was, becauſe I could never find any of the cryſtals ſingle, and by being always united, the natural form was not diſtinct.

It is the adipoſe covering from all of the Whale kind that is brought home in ſquare pieces, called flitches, and which, by being boiled, yields the oil on expreſſion, leaving the cellular membrane. When theſe flitches have become in ſome degree putrid, there iſſues two ſorts of oil; the firſt is pure, the laſt ſeems incorporated with part of the animal ſubſtance, which has become eaſy of ſolution from its putridity, forming a kind of butter. It is unctuous to the touch, ropy, coagulates or becomes harder by cold, ſwims upon water, not being ſoluble in it; and the pure oil, ſeparating in the ſame manner from this, ſwims above all.

What remains, after all the oil is extracted, retains a good deal of its form, is almoſt wholly convertible into glue, and is ſold for that purpoſe.

The cellular, or rather what ſhould be called the uniting membrane in this order of animals, is ſimilar to that in the quadruped; we find it uniting muſcle to muſcle, and muſcle to bone, for their eaſy motion on one another.

The cellular membrane, which is the receptacle for the oil near the ſurface of the body is in general very different from that in the quadruped, as has been already obſerved.

Of the Skin.

The covering of this order of animals conſiſts of a cuticle and cutis.

The cuticle is ſomewhat ſimilar to that on the ſole of the foot in the human ſpecies, and appears to be made up of a number of layers, which ſeparate by ſlight putrefaction; but this I ſuſpect ariſes in ſome degree from there being a ſucceſſion of cuticles formed. It has no degree of elaſticity or toughneſs,

but tears eaſily; nor do its fibres appear to have any particular direction. The internal ſtratum is tough and thick, and in the Spermaceti Whale its internal ſurface, when ſeparated from the cutis, is juſt like coarſe velvet, each pile ſtanding firm in its place; but this is not ſo diſtinguiſhable in ſome of the others, although it appears rough from the innumerable perforations.

It is the cuticle that gives the colour to the animal; and in parts that are dark, I think, I have ſeen a dirty coloured ſubſtance waſhed away in the ſeparation of the cuticle from the cutis, which muſt be a kind of rete mucoſum.

The cutis in this tribe is extremely villous on its external ſurface, anſwering to the rough ſurface of the cuticle, and forming in ſome parts ſmall ridges, ſimilar to thoſe on the human fingers and toes. Theſe villi are ſoft and pliable; they float in water, and each is longer or ſhorter according to the ſize of the animal. In the Spermaceti Whale they were about a quarter of an inch long; in the Grampus, Bottle-noſe and Piked Whales, much ſhorter; in all, they are extremely vaſcular.

The cutis ſeems to be the termination of the cellular membrane of the body more cloſely united, having ſmaller interſtices, and becoming more compact. This alteration in the texture is ſo ſudden as to make an evident diſtinction between what is ſolely connecting membrane, and ſkin, and is moſt evident in lean animals; for in the change from fat to lean, the ſkin does not undergo an alteration equal to what takes place in the adipoſe membrane, although it may be obſerved, that the ſkin itſelf is diminiſhed in thickneſs. In fat animals the diſtinction between ſkin and cellular membrane is much leſs, the gradation from the one to the other ſeeming to be ſlower; for the cells of both membrane and ſkin being loaded with fat, the whole

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has more the appearance of one uniform ſubſtance. This uniformity of the adipoſe membrane and ſkin is moſt obſervable in the Whale, Seal, Hog, and the human ſpecies; and is not only viſible in the raw but in the dreſſed hides; for in dreſſed ſkins the external is much more compact in texture than the inner ſurface, and is in common very tough.

In ſome animals the cutis is extremely thick, and in ſome parts much more ſo than others: where very thick, it appears to be intended as a defence againſt the violence of their own ſpecies or other animals. In moſt quadrupeds it is muſcular, contracting by cold, and relaxing by heat. Many other ſtimulating ſubſtances make it contract; but cold is probably that ſtimulus by which it was intended to be generally affected.

The ſkin is extremely elaſtic in the greateſt number of quadrupeds, and in its contracted ſtate may be ſaid to be rather too ſmall for the body; by this elaſticity it adapts itſelf to the changes which are conſtantly taking place in the parts, and it is from the want of it, that it becomes too large in ſome old animals. In all animals it is more elaſtic in ſome parts than others, eſpecially in thoſe where there is the greateſt motion. How far theſe variations take place in the Whale I do not exactly know; but a looſe elaſtic ſkin in this tribe would appear to be improper as an univerſal covering, conſidering the progreſſive motion of the animal, and the medium in which it moves; therefore it appears to be kept always on the ſtretch, by the adipoſe membrane being loaded with fat, which does not allow the ſkin to recede when cut. It is, however, more elaſtic at the ſetting on of the eyelids, round the opening of the prepuce, the nipples, the ſetting on of the fins, and under the jaw, to allow of motion in thoſe parts; and

and here there is more reticular, and leſs adipoſe membrane. But in the Piked Whale there is probably one of the moſt ſtriking inſtances of an elaſtic cuticular contraction: for though the whole ſkin of the fore part of the neck and breaſt of the animal, as far down as the middle of the belly, be extremely elaſtic; yet to render it ſtill more ſo, it is ribbed longitudinally like a ribbed ſtocking, which gives an increaſed lateral elaſticity. Theſe ribs are, when contracted, about five-eighths of an inch broad, covered with the common ſkin of the animal; but in the hollow part of the rib, it is of a ſofter texture, with a thinner cuticle. This part is poſſeſſed of the greateſt elaſticity; why it ſhould be ſo elaſtic is difficult to ſay, as it covers the thorax, which can never be increaſed in ſize; yet there muſt be ſome peculiar circumſtance in the œconomy of the ſpecies requiring this ſtructure, which we as yet know nothing of.

The ſkin is intended for various purpoſes. It is the univerſal covering given for the defence of all kinds of animals; and that it might anſwer this purpoſe well, it is the ſeat of one of the ſenſes.

Of the Mode of catching their Food.

The mouths of animals are the firſt parts to be conſidered reſpecting nouriſhment or food, and are ſo much connected with every thing relative to it, as not only to give good hints whether the food is vegetable or animal, but alſo reſpecting the particular kind of either, eſpecially of animal food. The mouth not only receives the food, but is the immediate inſtrument for catching it. As it is a compound inſtrument in many animals, having parts of various conſtructions belonging to it, I ſhall at preſent conſider it in this tribe no further than as

connected

connected with their mode of catching the food, and adapting and diſpoſing it for being ſwallowed. It is probable, that theſe animals do not require either a diviſion of the food, or a maſtication of it in the mouth, but ſwallow whatever they catch, whole; for we do not find any of them furniſhed with parts capable of producing either effect. The mouth in moſt of this tribe is well adapted for catching the food; the jaws ſpread as they go back, making the mouth proportionally wider than in many other animals.

There is a very great variety in the formation of the mouths of this tribe of animals, which we have many opportunities of knowing, from the head being often brought home when the other parts of the animal are rejected; a circumſtance which frequently leaves us ignorant of the particular ſpecies to which it belonged.

Some catch their food by means of teeth, which are in both jaws, as the Porpoiſe and Grampus; in others, they are only in one jaw, as in the Spermaceti Whale; and in the large Bottle-noſe Whale, deſcribed by DALE, there are only two ſmall teeth in the anterior part of the lower jaw. In the Narwhale only two tuſks in the fore part of the upper jaw *; while in ſome others there are none at all. In thoſe which have teeth in both jaws, the number in each varies conſiderably; the ſmall Bottle-noſe had forty-ſix in the upper, and fifty in the lower; and in the jaws of others there are only five or ſix in each.

The teeth are not diviſible into different claſſes, as in quadrupeds; but are all pointed teeth, and are commonly a good deal ſimilar. Each tooth is a double cone, one point being

* I call theſe tuſks to diſtinguiſh them from common teeth. A tuſk is that kind of tooth which has no bounds ſet to its growth, excepting by abraſion, as the tuſk of the Elephant, Boar, Sea-horſe, Manatee, &c.

faſtened

faſtened in the gum, the other projecting: they are, however, not all exactly of this ſhape. In ſome ſpecies of Porpoiſe the fang is flattened, and thin at its extremity; in the Spermaceti Whale the body of the tooth is a little curved towards the back part of the mouth; this is alſo the caſe in ſome others. The teeth are compoſed of animal ſubſtance and earth, ſimilar to the bony part of the teeth in quadrupeds. The upper teeth are commonly worn down upon the inſide, the lower on the outſide; this ariſes from the upper jaw being in general the largeſt.

The ſituation of the teeth, when firſt formed, and their progreſs afterwards, as far as I have been able to obſerve, is very different in common from thoſe of the quadruped. In the quadruped the teeth are formed in the jaw, almoſt ſurrounded by the alveoli, or ſockets, and riſe in the jaw as they increaſe in length; the covering of the alveoli being abſorbed, the alveoli afterwards riſe with the teeth, covering the whole fang; but in this tribe the teeth appear to form in the gum, upon the edge of the jaw, and they either ſink in the jaw as they lengthen, or the alveoli riſe to incloſe them: this laſt is moſt probable, ſince the depth of the jaw is alſo increaſed, ſo that the teeth appear to ſink deeper and deeper in the jaw. This formation is readily diſcovered in jaws not full grown; for the teeth increaſe in number as the jaw lengthens, as in other animals. The poſterior part of the jaw becoming longer, the number of teeth in that part increaſes, the ſockets becoming ſhallower and ſhallower, and at laſt being only a ſlight depreſſion.

It would appear, that they do not ſhed their teeth, nor have they new ones formed ſimilar to the old, as is the caſe with moſt other quadrupeds, and alſo with the Alligator. I have never been able to detect young teeth under the roots of the old ones; and indeed the ſituation in which they are firſt formed

makes it in ſome degree impoſſible, if the young teeth follow the ſame rule in growing with the original ones, as they probably do in moſt animals.

If it is true, that the Whale tribe do not ſhed their teeth, in what way are they ſupplied with new ones, correſponding in ſize with the increaſed ſize of the jaw? It would appear, that the jaw, as it increaſes poſteriorly, decays at the ſymphyſis, and while the growth is going on, there is a conſtant ſucceſſion of new teeth, by which means the new-formed teeth are proportioned to the jaw. The ſame mode of growth is evident in the Elephant, and in ſome degree in many fiſh; but in theſe laſt the abſorption of the jaw is from the whole of the outſide along where the teeth are placed. The depth of the alveoli ſeems to prove this, being ſhallow at the back part of the jaw, and becoming deeper towards the middle, where they are the deepeſt, the teeth there having come to the full ſize. From this forwards they are again becoming ſhallower, the teeth being ſmaller, the ſockets waſting, and at the ſymphyſis there are hardly any ſockets at all. This will make the exact number of teeth in any ſpecies uncertain.

Some genera of this tribe have another mode of catching their food, and retaining it till ſwallowed, which is by means of the ſubſtance called Whalebone. Of this there are two kinds known; one very large, probably from the largeſt Whale yet diſcovered; the other from a ſmaller ſpecies.

This whalebone, which is placed on the inſide of the mouth, and attached to the upper jaw, is one of the moſt ſingular circumſtances belonging to this ſpecies, as they have moſt other parts in common with quadrupeds. It is a ſubſtance, I believe, peculiar to the Whale, and of the ſame nature as horn, which I ſhall uſe as a term to expreſs what conſti-

tutes

tutes hair, nails, claws, feathers, &c. it is wholly compoſed of animal ſubſtance, and extremely elaſtic *.

Whalebone conſiſts of thin plates of ſome breadth, and in ſome of very conſiderable length, their breadth and length in ſome degree correſponding to one another; and when longeſt they are commonly the broadeſt, but not always ſo. (See Tab. XXII.) Theſe plates are very different in ſize in different parts of the ſame mouth, more eſpecially in the large Whalebone Whale, whoſe upper jaw does not paſs parallel upon the under, but makes an arch, the ſemidiameter of which is about one-fourth of the length of the jaw. The head in my poſſeſſion is nineteen feet long, the ſemidiameter not quite five feet: if this proportion is preſerved, thoſe Whales which have whalebone fifteen feet long muſt be of an immenſe ſize.

Theſe plates are placed in ſeveral rows, encompaſſing the outer ſkirts of the upper jaw, ſimilar to teeth in other animals. They ſtand parallel to each other, having one edge towards the circumference of the mouth, the other towards the center or cavity. They are placed near together in the Piked Whale, not being a quarter of an inch aſunder where at the greateſt diſtance, yet differing in this reſpect in different parts of the ſame mouth; but in the great Whale the diſtances are more conſiderable.

The outer row is compoſed of the longeſt plates; and theſe are in proportion to the different diſtances between the two jaws, ſome being fourteen or fifteen feet long, and twelve or fifteen inches broad; but towards the anterior and poſterior part of the mouth, they are very ſhort: they riſe for half a foot or more, nearly of equal breadths, and afterwards ſhelve off from their inner ſide until they come near to a point at the

* From this it muſt appear, that the term bone is an improper one.

outer: the exterior of the inner rows are the longeſt, correſponding to the termination of the declivity of the outer, and become ſhorter and ſhorter till they hardly riſe above the gum.

The inner rows are cloſer than the outer, and riſe almoſt perpendicularly from the gum, being longitudinally ſtraight, and have leſs of the declivity than the outer. The plates of the outer row laterally are not quite flat, but make a ſerpentine line, more eſpecially in the Piked Whale the outer edge is thicker than the inner. All round the line made by their outer edges, runs a ſmall white bead, which is formed along with the whalebone, and wears down with it. The ſmaller plates are nearly of an equal thickneſs upon both edges. In all of them, the termination is in a kind of hair, as if the plate was ſplit into innumerable ſmall parts, the exterior being the longeſt and ſtrongeſt.

The two ſides of the mouth compoſed of theſe rows meet nearly in a point at the tip of the jaw, and ſpread or recede laterally from each other as they paſs back; and at their poſterior ends, in the Piked Whale, they make a ſweep inwards, and come very near each other, juſt before the opening of the œſophagus. In the Piked Whale there were above three hundred in the outer rows on each ſide of the mouth. Each layer terminates in an oblique ſurface, which obliquity inclines to the roof of the mouth, anſwering to the gradual diminution of their length; ſo that the whole ſurface, compoſed of theſe terminations, forms one plane riſing gradually from the roof of the mouth; from this obliquity of the edge of the outer row, we may in ſome meaſure judge of the extent of the whole baſe, but not exactly, as it makes a hollow curve, which increaſes the baſe.

The

The whole ſurface reſembles the ſkin of an animal covered with ſtrong hair, under which ſurface the tongue muſt immediately lie, when the mouth is ſhut; it is of a light-brown colour in the Piked Whale, and is darker in the large Whale.

In the Piked Whale, when the mouth is ſhut, the projecting whalebone remains entirely on the inſide of the lower jaw, the two jaws meeting every where along their ſurface; but how this is effected in the large Whale I do not certainly know, the horizontal plane made by the lower jaw being ſtraight, as in the Piked Whale; but the upper jaw being an arch cannot be hid by the lower. I ſuppoſe, therefore, that a broad upper lip, meeting as low as the lower jaw, covers the whole of the outer edges of the exterior rows.

The whalebone is continually wearing down, and renewing in the ſame proportion, except when the animal is growing it is renewed faſter, and in proportion to the growth.

The formation of the whalebone is extremely curious, being in one reſpect ſimilar to that of the hair, horns, ſpurs, &c.; but it has beſides another mode of growth and decay, equally ſingular.

Theſe plates form upon a thin vaſcular ſubſtance, not immediately adhering to the jaw-bone; but having a more denſe ſubſtance between, which is alſo vaſcular. This ſubſtance, which may be called the nidus of the whalebone, ſends out (the above) thin broad proceſſes, anſwering to each plate, on which the plate is formed, as the Cock's ſpur or the Bull's horn, on the bony core, or a tooth on its pulp; ſo that each plate is neceſſarily hollow at its growing end, the firſt part of the growth taking place on the inſide of this hollow.

Beſides

Beſides this mode of growth, which is common to all ſuch ſubſtances, it receives additional layers on the outſide, which are formed upon the above-mentioned vaſcular ſubſtance extended along the ſurface of the jaw. This part alſo forms upon it a ſemi-horny ſubſtance between each plate, which is very white, riſes with the whalebone, and becomes even with the outer edge of the jaw, and the termination of its outer part forms the bead above mentioned. This intermediate ſubſtance fills up the ſpaces between the plates as high as the jaw, acts as abutments to the whalebone, or is ſimilar to the alveolar proceſſes of the teeth, keeping them firm in their places. (See Tab. XXIII.)

As both the whalebone and intermediate ſubſtance are conſtantly growing, and as we muſt ſuppoſe a determined length neceſſary, a regular mode of decay muſt be eſtabliſhed, not depending entirely on chance, or the uſe it is put to.

In its growth, three parts appear to be formed; one from the riſing core, which is the center, a ſecond on the outſide, and a third being the intermediate ſubſtance. Theſe appear to have three ſtages of duration; for that which forms on the core, I believe, makes the hair, and that on the outſide makes principally the plate of whalebone; this, when got a certain length, breaks off, leaving the hair projecting, becoming at the termination very brittle; and the third, or intermediate ſubſtance, by the time it riſes as high as the edge of the ſkin of the jaw, decays and ſoftens away like the old cuticle of the ſole of the foot when ſteeped in water.

The uſe of the whalebone, I ſhould believe, is principally for the retention of the food till ſwallowed; and do ſuppoſe the fiſh they catch are ſmall, when compared with the ſize of the mouth.

The œſophagus, as in other animals, begins at the fauces, or poſterior part of the mouth; and, although circular at this part, is ſoon divided into two paſſages by the epiglottis paſſing acroſs it, as will be deſcribed hereafter. Below its attachment to the trachea, it paſſes down in the poſterior mediaſtinum, at ſome diſtance from the ſpine, to which it is attached by a broad part of the ſame membrane, and its anterior ſurface makes the poſterior part of a cavity behind the pericardium.

Paſſing through the diaphragm it enters the ſtomach, and is lined with a very thick, ſoft, and white cuticle, which is continued into the firſt cavity of the ſtomach.

The inner, or true coat, is white, of a conſiderable denſity, and not muſcular; but thrown into large longitudinal folds by the contraction of the muſcular fibres of the œſophagus, which are very ſtrong. It is very glandular; for on its inner ſurface, eſpecially near the fauces, orifices of a vaſt number of glands are viſible.

The œſophagus is larger in proportion to the bulk of the animal than in the quadruped, although not ſo much ſo as it uſually is in fiſh, which we may ſuppoſe ſwallow their food much in the ſame way. In the Piked Whale it was three inches and an half wide.

The ſtomach, as in other animals, lies on the left ſide of the body, and terminates in the pylorus towards the right.

The duodenum paſſes down on the right ſide, very much as in the human ſubject, excepting that it is more expoſed from the colon not croſſing it. It lies on the right kidney, and then paſſes to the left ſide behind the aſcending part of the colon and root of the meſentery, comes out on the left ſide, and getting on the edge of the meſentery becomes a looſe inteſtine,

teſtine, forming the jejunum. In this courſe behind the meſentery it is expoſed, as in moſt quadrupeds, not being covered by it, as in the human. The jejunum and ilium paſs along the edge of the meſentery downwards to the lower part of the abdomen. The ilium near the lower end makes a turn towards the right ſide, and then mounting upwards, round the edge of the meſentery, paſſes a little way on the right, as high as the kidney, and there enters the colon, or cæcum. The cæcum lies on the lower end of the kidney, conſiderably higher than in the human body, which renders the aſcending part of the colon ſhort. The cæcum is about ſeven inches long, and more like that of the Lion or Seal than of any other animal I know.

The colon paſſes obliquely up the right ſide, a little towards the middle of the abdomen; and when as high as the ſtomach, croſſes to the left, and acquires a broad meſocolon: at this part it lies upon the left kidney, and in its paſſage down gets more and more to the middle line of the body. When it has reached the lower part of the abdomen, it paſſes behind the uterus, and along with the vagina, in the female; between the two teſticles, and behind the bladder and root of the penis, in the male, bending down to open on what is called the belly of the animal; and in its whole courſe it is gently convoluted. In thoſe which have no cæcum, and therefore can hardly be ſaid to have a colon, the inteſtine before its termination in the rectum makes the ſame kind of ſweep round the other inteſtines, as the colon does where there is a cæcum.

The inteſtines are not large for the ſize of the animal, not being larger in thoſe of eighteen or twenty-four feet long than in the Horſe, the colon not much more capacious than the jejunum and ilium, and very ſhort; a circumſtance common to carni-

vorous animals. In the Piked Whale, the length from the ſtomach to the cæcum is 28 yards and an half, length of cæcum ſeven inches, of the colon to the anus two yards and three quarters. The ſmall inteſtines are juſt five times the length of the animal, the colon with the cæcum a little more than one-half the length.

Thoſe parts that reſpect the nouriſhment of this tribe do not all ſo exactly correſpond as in land animals; for in theſe one in ſome degree leads to the other. Thus the teeth in the ruminating tribe point out the kind of ſtomach, cæcum, and colon; while in others, as the Horſe, Hare, Lion, &c. the appearances of the teeth only give us the kind of colon and cæcum; but in this tribe, whether teeth or no teeth, the ſtomachs do not vary much, nor does the circumſtance of cæcum ſeem to depend on either teeth or ſtomach. The circumſtances by which, from the form of one part we judge what others are, fail us here; but this may ariſe from not knowing all the circumſtances. The ſtomach, in all that I have examined, conſiſts of ſeveral bags, continued from the firſt on the left towards the right, where the laſt terminates in duodenum. The number is not the ſame in all; for in the Porpoiſe, Grampus, and Piked Whale, there are five; in the Bottle-noſe ſeven. Their ſize reſpecting one another differs very conſiderably; ſo that the largeſt in one ſpecies may in another be only the ſecond. The two firſt in the Porpoiſe, Bottle-noſe, and Piked Whale, are by much the largeſt; the others are ſmaller, although irregularly ſo.

The firſt ſtomach has, I believe, in all very much the ſhape of an egg, with the ſmall end downwards. It is lined every where with a continuation of the cuticle from the œſophagus. In the Porpoiſe the œſophagus enters the ſuperior end of the ſto-

mach. In the Piked Whale its entrance is a little way on the poſterior part of the upper end, and is oblique.

The ſecond ſtomach in the Piked Whale is very large, and rather longer than the firſt. It is of the ſhape of the Italic *S*, paſſing out from the upper end of the firſt on its right ſide, by nearly as large a beginning as the body of the bag. In the Porpoiſe it by no means bears the ſame proportion to the firſt, and opens by a narrower orifice; then paſſing down along the right ſide of the firſt ſtomach, it bends a little outwards at the lower end, and terminates in the third. Where this ſecond ſtomach begins, the cuticle of the firſt ends. The whole of the inſide of this ſtomach is thrown into unequal rugæ, appearing like a large irregular honeycomb. In the Piked Whale the rugæ are longitudinal, and in many places very deep, ſome of them being united by croſs bands; and in the Porpoiſe the folds are very thick, maſſy, and indented into one another. This ſtomach opens into the third by a round contracted orifice, which does not ſeem to be valvular.

The third ſtomach is by much the ſmalleſt, and appears to be only a paſſage between the ſecond and fourth. It has no peculiar ſtructure on the inſide, but terminates in the fourth by nearly as large an opening as its beginning. In the Porpoiſe it is not above one, and in the Bottle-noſe about five inches long.

The fourth ſtomach is of a conſiderable ſize; but a good deal leſs than either the firſt or ſecond. In the Piked Whale it is not round, but ſeems flattened between the ſecond and fifth. In the Porpoiſe it is long, paſſing in a ſerpentine courſe almoſt like an inteſtine. The internal ſurface is regular, but villous, and opens on its right ſide into the fifth, by a round opening ſmaller than the entrance from the third.

The fifth ſtomach is in the Piked Whale round, and in the Porpoiſe oval; it is ſmall, and terminates in the pylorus, which has little of a valvular appearance. Its coats are thinner than thoſe of the fourth, having an even inner ſurface, which is commonly tinged with bile.

The Piked Whale and, I believe, the large Whalebone Whale, have a cæcum; but it is wanting in the Porpoiſe, Grampus, and Bottle-noſe Whale.

The ſtructure of the inner ſurface of the inteſtine is in ſome very ſingular, and different from that of the others.

The inner ſurface of the duodenum in the Piked Whale is thrown into longitudinal rugæ, or valves, which are at ſome diſtance from each other, and theſe receive lateral folds. The duodenum in the Bottle-noſe ſwells out into a large cavity, and might almoſt be reckoned an eighth ſtomach; but as the gall ducts enter it I ſhall call it duodenum.

The inner coat of the jejunum, and ilium, appears in irregular folds, which may vary according as the muſcular coat of the inteſtine acts: yet I do not believe, that their form depends intirely on that circumſtance, as they run longitudinally, and take a ſerpentine courſe when the gut is ſhortened by the contraction of the longitudinal muſcular fibres. The inteſtinal canal of the Porpoiſe has ſeveral longitudinal folds of the inner coat paſſing along it, through the whole of its length. In the Bottle-noſe the inner coat, through nearly the whole track of the inteſtine, is thrown into large cells, and theſe again ſubdivided into ſmaller; the axis of which cells is not perpendicular to a tranſverſe ſection of the inteſtine, but oblique, forming pouches with the mouths downwards, and acting almoſt like valves, when any thing is attempted to be paſſed in a contrary direction: they begin faintly in the duodenum, before it makes

its quick turn, and terminate near the anus. The colon and rectum have the rugæ very flat, which ſeems to depend intirely on the contraction of the gut.

The rectum near the anus appears, for four or five inches, much contracted, is glandular, covered by a ſoft cuticle, and the anus ſmall.

I never found any air in the inteſtines of this tribe; nor indeed in any of the aquatic animals.

The meſenteric artery anaſtomoſes by large branches.

There is a conſiderable degree of uniformity in the liver of this tribe of animals. In ſhape it nearly reſembles the human, but is not ſo thick at the baſe, nor ſo ſharp at the lower edge, and is probably not ſo firm in its texture. The right lobe is the largeſt and thickeſt, its falciform ligament broad, and there is a large fiſſure between the two lobes, in which the round ligament paſſes. The liver towards the left is very much attached to the ſtomach, the little epiploon being a thick ſubſtance. There is no gall-bladder; the hepatic duct is large, and enters the duodenum about ſeven inches beyond the pylorus.

The pancreas is a very long, flat body, having its left end attached to the right ſide of the firſt cavity of the ſtomach: it paſſes acroſs the ſpine at the root of the meſentery, and near to the pylorus joins the hollow curve of the duodenum, along which it is continued, and adheres to that inteſtine, its duct entering that of the liver near the termination in the gut.

Although this tribe cannot be ſaid to ruminate, yet in the number of ſtomachs they come neareſt to that order; but here I ſuſpect that the order of digeſtion is in ſome degree inverted. In both the ruminants, and this tribe, I think it muſt be allowed that the firſt ſtomach is a reſervoir. In the ruminants the preciſe uſe of the ſecond and third ſtomachs is perhaps not known; but

but digeſtion is certainly carried on in the fourth; while in this tribe, I imagine, digeſtion is performed in the ſecond, and the uſe of the third and fourth is not exactly aſcertained.

The cæcum and colon do not aſſiſt in pointing out the nature of the food and mode of digeſtion in this tribe. The Porpoiſe which has teeth, and four cavities to the ſtomach, has no cæcum, ſimilar to ſome land animals, as the Bear, Badger, Racoon, Ferret, Polecat, &c.; neither has the Bottle-noſe a cæcum which has only two ſmall teeth in the lower jaw; and the Piked Whale, which has no teeth, has a cæcum, almoſt exactly like the Lion, which has teeth and a very different kind of ſtomach.

The food of the whole of this tribe, I believe, is fiſh; probably each may have a particular kind, of which it is fondeſt, yet does not refuſe a variety. In the ſtomach of the large Bottle-noſe, I found the beaks of ſome hundreds of Cuttle-fiſh. In the Grampus I found the tail of a Porpoiſe; ſo that they eat their own genus. In the ſtomach of the Piked Whale, I found the bones of different fiſh, but particularly thoſe of the Dog-fiſh. From the ſize of the œſophagus we may conclude, that they do not ſwallow fiſh ſo large in proportion to their ſize as many fiſh do, that we have reaſon to believe take their food in the ſame way: for fiſh often attempt to ſwallow what is larger than their ſtomachs can at one time contain, and part remains in the œſophagus till the reſt is digeſted.

The epiploon on the whole is a thin membrane; on the right ſide it is rather a thin net-work, though on the left it is a complete membrane, and near to the ſtomach of the ſame ſide becomes of a conſiderable thickneſs, eſpecially between the two firſt bags of the ſtomach. It has little or no fat, except what

what ſlightly covers the veſſels in particular parts. It is attached forwards, all along to the lower part of the different bags conſtituting the ſtomach, and on the right to the root of the meſentery, between the ſtomach and tranſverſe arch of the colon, firſt behind to the tranſverſe arch of the colon and root of the meſentery, then to the poſterior ſurface of the left or firſt bag of the ſtomach, behind the anterior attachment. In ſome of this tribe there is the uſual paſſage behind the veſſels going to the liver, common to all quadrupeds I am acquainted with; but in others, as the ſmall Bottle-noſe, there is no ſuch paſſage, which by the cavity behind the ſtomach in the epiploon of this animal becomes a circumſcribed cavity.

The ſpleen is involved in the epiploon, and is very ſmall for the ſize of the animal. There are in ſome, as the Porpoiſe, one or two ſmall ones, about the ſize of a nutmeg, often ſmaller, placed in the epiploon behind the other. Theſe are ſometimes met with likewiſe in the human body.

The kidnies in the whole of this tribe of animals are conglomerated, being made up of ſmaller parts, which are only connected by cellular membrane, blood-veſſels, and ducts, or infundibula; but not partially connected by continuity of ſubſtance, as in the human body, the Ox, &c.: every portion is of a conical figure, whoſe apex is placed towards the center of the kidney, the baſe making the external ſurface; and each is compoſed of a cortical and tubular ſubſtance, the tubular terminating in the apex, which apex makes the mamilla. Each mamilla has an infundibulum, which is long, and at its beginning wide, embracing the baſe of the mamilla, and becoming ſmaller. Theſe infundibula unite at laſt, and form the ureter. The whole kidney is an oblong flat body, broader and thicker at the upper end than the lower, and has the

appearance

appearance of being made up of different parts placed close together, almost like the pavement of a street.

The ureter comes out at the lower end, and passes along to the bladder, which it enters very near the urethra.

The bladder is oblong, and small for the size of the animal. In the female the urethra passes along to the external sulcus or vulva, and opens just under the clitoris, much as in the human subject.

Whether being inhabitants of the water makes such a construction of kidney necessary I cannot say; yet one must suppose it to have some connection with such situation, since we find it almost uniformly take place in animals inhabiting the water, whether wholly, as this tribe, or occasionally, as the Manatee, Seal, and White Bear: there is, however, the same structure in the Black Bear, which, I believe, never inhabits the water. This, perhaps, should be considered in another light, as nature keeping up to a certain uniformity in the structure of similar animals; for the Black Bear in construction of parts is, in every other respect as well as this, like the White Bear.

The capsulæ renales are small for the size of the animal, when compared to the human, as indeed they are in most animals. They are flat, and of an oval figure; the right lies on the lower and posterior part of the diaphragm somewhat higher than the kidney; the left is situated lower down, by the side of the aorta, between it and the left kidney. They are composed of two substances; the external having the direction of its fibres or parts towards the center; the internal seeming more uniform, and not having so much of the fibrous appearance.

The blood of animals of this order is, I believe, similar to that of quadrupeds; but I have an idea, that the red globules

are

are in larger proportion. I will not pretend to determine how far this may aſſiſt in keeping up the animal heat; but as theſe animals may be ſaid to live in a very cold climate or atmoſphere, and ſuch as readily carries off heat from the body, they may want ſome help of this kind.

It is certain that the quantity of blood in this tribe and in the Seal is comparatively larger than in the quadruped, and therefore probably amounts to more than that of any other known animal.

This tribe differs from fiſh in having the red blood carried to the extreme parts of the body, ſimilar to the quadruped.

The cavity of the thorax is compoſed of nearly the ſame parts as in the quadruped; but there appears to be ſome difference, and the varieties in the different genera are greater.

The general cavity is divided into two, as in the quadruped, by the heart and mediaſtinum.

The heart in this tribe, and in the Seal, is probably larger in proportion to their ſize than in the quadruped, as alſo the blood-veſſels, more eſpecially the veins.

The heart is incloſed in its pericardium, which is attached by a broad ſurface to the diaphragm, as in the human body. It is compoſed of four cavities *, two auricles, and two ventricles: it is more flat than in the quadruped, and adapted to the ſhape of the cheſt. The auricles have more faſciculæ, and theſe paſs more acroſs the cavity from ſide to ſide than in many other animals; beſides, being very muſcular, they are very elaſtic,

* As the circulation is a permanent part of the conſtitution reſpecting the claſs to which the animal belongs, and as the kind of heart correſponds with the circulation, theſe ſhould be conſidered in the claſſing of animals. Thus we have animals whoſe hearts have only one cavity, others with two, three, and four cavities.

for being ſtretched they contract again very conſiderably. There is nothing uncommon or particular in the ſtructure of the ventricles, in the valves of the ventricles, or in that of the arteries.

The general ſtructure of the arteries reſembles that of other animals; and where parts are nearly ſimilar, the diſtribution is likewiſe ſimilar. The aorta forms its uſual curve, and ſends off the carotid and ſubclavian arteries.

Animals of this tribe, as has been obſerved, have a greater proportion of blood than any other known, and there are many arteries apparently intended as reſervoirs, where a larger quantity of arterial blood ſeemed to be required in a part, and vaſcularity could not be the only object. Thus we find, that the intercoſtal arteries divide into a vaſt number of branches, which run in a ſerpentine courſe between the pleura, ribs, and their muſcles, making a thick ſubſtance ſomewhat ſimilar to that formed by the ſpermatick artery in the Bull. Thoſe veſſels, every where lining the ſides of the thorax, paſs in between the ribs near their articulation, and alſo behind the ligamentous attachment of the ribs, and anaſtomoſe with each other. The medulla ſpinalis is ſurrounded with a net-work of arteries in the ſame manner, more eſpecially where it comes out from the brain, where a thick ſubſtance is formed by their ramifications and convolutions; and theſe veſſels moſt probably anaſtomoſe with thoſe of the thorax.

The ſubclavian artery in the Piked Whale, before it paſſes over the firſt rib, ſends down into the cheſt arteries which aſſiſt in forming the plexus on the inſide of the ribs; I am not certain but the internal mammary arteries contribute to form the anterior part of this plexus. The motion of the blood in ſuch muſt be very ſlow; the uſe of which we do not readily ſee. The deſcending aorta ſends off the intercoſtals, which are very large, and give branches to this plexus; and when it has reached the abdomen, it ſends off, as in the quadruped, the different

branches to the viſcera, and the lumbar arteries, which are likewiſe very large for the ſupply of that vaſt maſs of muſcles which moves the tail.

In our examination of particular parts, the ſize of which is generally regulated by that of the whole animal, if we have only been accuſtomed to ſee them in thoſe which are ſmall or middle-ſized, we behold them with aſtoniſhment in animals ſo far exceeding the common bulk as the Whale. Thus the heart and aorta of the Spermaceti Whale appeared prodigious, being too large to be contained in a wide tub, the aorta meaſuring a foot in diameter. When we conſider theſe as applied to the circulation, and figure to ourſelves, that probably ten or fifteen gallons of blood are thrown out at one ſtroke, and moved with an immenſe velocity through a tube of a foot diameter, the whole idea fills the mind with wonder.

The veins, I believe, have nothing particular in their ſtructure, excepting in parts requiring a peculiarity, as in the folds of the ſkin on the breaſt in the Piked Whale, where their elaſticity was to be increaſed.

Of the Larynx.

The larynx in moſt animals living on land is a compound organ, adapted both for reſpiration, deglutition, and ſound, which laſt is produced in the actions of reſpiration; but in this tribe the larynx, I ſuppoſe, is only adapted to reſpiration, as we do know that they have any mode of producing ſound.

It is compoſed of os hyoides, thyroid, cricoid, and two arytenoid cartilages, with the epiglottis. It varies very much in ſtructure and ſize, when compared in animals of different genera. Theſe cartilages were much ſmaller in the Bottle-noſe of twenty-four feet long, than in the Piked Whale of ſeventeen feet, while the os hyoides was much larger.

In

In the Bottle-noſe, the os hyoides is compoſed of three bones, beſides two whoſe ends are attached to it, being placed above the os hyoides, making five in all. In the Porpoiſe, Piked Whale, &c. it is but one bone, ſlightly bent, having a broad thin proceſs paſſing up, which is a little forked: it has no attachment to the head by means of other bones, as in many quadrupeds.

The thyroid cartilage in the Piked Whale is broad from ſide to ſide, but not from the upper to the lower part: it has two lateral proceſſes, which are long, and paſs down the outſide of the cricoid, near to its lower end, and are joined to it much as in the human ſubject. Theſe differ in ſhape in different animals of this tribe.

The cricoid cartilage is broad and flat, making the poſterior and lateral part of the larynx, and is much deeper behind, and laterally, than before. It is extremely thick and ſtrong, flattened on the poſterior ſurface, and hollowed from the upper edge to the lower. It terminates by a thick edge on the poſterior part above, but irregularly at the lower edge, in the cartilages of the larynx.

The two arytenoid cartilages are extremely projecting, and united to each other till near their ends; are articulated on the upper edge of the cricoid, but ſend down a proceſs, which paſſes on the inſide of the cricoid, being attached to a bag in the Piked Whale, which is formed below the thyroid and before the cricoid cartilages; they croſs the cavity of the larynx obliquely, making the paſſage, at the upper part, a groove between them: the cavity at this place ſwells out laterally, but is very narrow between the anterior and poſterior ſurfaces. The paſſage above between the arytenoid and thyroid cartilages is wide from ſide to ſide, and is continued down on the outſide of the proceſſes of

the arytenoid cartilage, as well as between them, ending below the thyroid, which is folliculated on its inner ſurface on the fore part of the cricoid cartilage.

The epiglottis makes a third part of the paſſage, and compleats the glottis by forming it into a canal, in ſeveral of this tribe; but in the Piked Whale it was not attached to the two arytenoid cartilages, but only in contact, or incloſing them at their baſe, ſo as to make them form a complete canal.

I could not obſerve any thing like a thyroid gland.

From the glottis and epiglottis being ſo connected as to make but one canal, and from the thyroid and cricoid cartilages being ſo flattened in ſome between the anterior and poſterior ſurface, the paſſage through theſe parts is very ſmall or contracted; but the trachea ſwells out again into a very conſiderable ſize. Its larger branches are in proportion to the trunk, and enter the lungs at the upper end along with the blood-veſſels.

Of the Lungs.

The lungs are two oblong bodies, one on each ſide of the cheſt, and are not divided into ſmaller lobes, as in the human ſubject. They are of conſiderable length, but not ſo deep between the fore and back part, as in the quadruped, from the heart being broad, flat, and of itſelf filling up the fore part of the cheſt. They paſs further down on the back part than in the quadruped, by which their ſize is increaſed, and riſe higher up in the cheſt than the entrance of the veſſels, coming to a point at the upper end. From the entrance of the veſſels they are connected downwards, along their whole inner edge, by a ſtrong attachment (in which there are in ſome lymphatic glands) to

the poſterior mediaſtinum. The lungs are extremely elaſtic in their ſubſtance, even ſo much ſo as to ſqueeze out any air that may be thrown into them, and to become almoſt at once a ſolid maſs, having a good deal the appearance, conſiſtence, and feel of an ox's ſpleen. The branches of the bronchiæ which ramify into the lungs have not the cartilages flat, but rather rounded; a conſtruction which admits of greater motion between each.

The pulmonary cells are ſmaller than in quadrupeds, which may make leſs air neceſſary, and they communicate with each other, which thoſe of the quadruped do not; for by blowing into one branch of the trachea, not only the part to which it immediately goes, but the whole lungs are filled.

As the ribs in this tribe do not completely make the cavity of the thorax, the diaphragm has not the ſame attachments as in the quadruped, but is connected forwards to the abdominal muſcles, which are very ſtrong, being a mixture of muſcular and tendinous fibres.

The poſition of the diaphragm is leſs tranſverſe than in the quadruped, paſſing more obliquely backwards, and coming very low on the ſpine, and higher up before; which makes the cheſt longeſt in the direction of the animal at the back, and gives room for the lungs to be continued along the ſpine.

The parts immediately concerned in inſpiration are extremely ſtrong; the diaphragm remarkably ſo. The reaſon of this muſt at once appear; it neceſſarily requiring great force to expand in a denſe medium like water, eſpecially too when the vacuity is to be filled with one which is rarer, and is to water a ſpecies of vacuum, the preſſure being much greater on the external ſurface than the counter-preſſure from within. But expiration on the other hand muſt be much more eaſily performed;

formed; the natural elaſticity of the parts themſelves, with the preſſure of the water on the external ſurface of the body, being greater than the reſiſtance of the air from within, will both tend to produce expiration without any immediate action of muſcles.

The diaphragm, in theſe animals, appears to be the principal agent in inſpiration; and the cavity of the thorax not being intirely ſurrounded by bony parts, is of courſe leſs eaſily expanded, and the apparatus for its expanſion in all directions, as in the quadruped, does not exiſt here.

The Blow-hole, or Paſſage for the Air.

As the noſe in every animal that breathes air is a common paſſage for the air, and is alſo the organ of ſmelling; I ſhall deſcribe it in this tribe as inſtrumental to both theſe purpoſes.

There is a variety in ſome ſpecies of this animal which is, I believe, peculiar to this order; that is, the want of the ſenſe of ſmelling; none of thoſe which I have yet examined having that ſenſe, except the two kinds of Whalebone Whale: ſuch of courſe have neither the olfactory nerves, nor the organ; therefore, in them, the noſtrils are intended merely for reſpiration; but others have the organ placed in this paſſage as in other animals.

The membranous portion of the poſterior noſtrils is one canal; but when in the bony part, in moſt of them, it is divided into two; the Spermaceti Whale, however, is an exception. In thoſe which have it divided, it is in ſome continued double through the anterior ſoft parts, opening by two orifices, as in the Piked Whale; but in others, it unites again in the membranous part, making externally only one orifice, as in the

Porpoiſe, Grampus, and Bottle-noſe. At its beginning in the fauces, it is a roundiſh hole, ſurrounded by a ſtrong ſphincter muſcle, for graſping the epiglottis; beyond this, the canal becomes larger, and opens into the two paſſages in the bones of the head. This part is very glandular, being full of follicles, whoſe ducts ramify in the ſurrounding ſubſtance, which appears fatty and muſcular like the root of the tongue, and theſe ramifications communicate with one another, and contain a viſcid ſlime.

In the Spermaceti Whale, which has a ſingle canal, it is thrown a little to the left ſide. After theſe canals emerge from the bones near the external opening, they become irregular, and have ſeveral ſulci paſſing out laterally, of irregular forms, with correſponding eminences. The ſtructure of theſe eminences is muſcular and fatty, but leſs muſcular than the tongue of a quadruped.

In the Porpoiſe there are two ſulci on each ſide; two large and two ſmall, with correſponding eminences of different ſhapes, the large ones being thrown into folds. The Spermaceti Whale has the leaſt of this ſtructure; the external opening in it comes farther forwards towards the anterior part of the head, and is conſequently longer than in others of this order. Near to its opening externally, it forms a large ſulcus, and on each ſide of this canal is a cartilage, which runs nearly its whole length. In all that I have examined, this canal, forwards from the bones, is intirely lined with a thick cuticle of a dark colour.

In thoſe which have only one external opening, it is tranſverſe, as in the Porpoiſe, Grampus, Bottle-noſe and Spermaceti Whale, &c.; where double, they are longitudinal, as in the Piked Whale, and the large Whalebone Whale. Theſe openings

openings form a paſſage for the air in reſpiration to and from the lungs; for it would be impoſſible for theſe animals to breathe air through the mouth; indeed, I believe, the human ſpecies alone breathe by the mouth, and in them it is moſtly from habit; for in quadrupeds the epiglottis conducts the air into the noſe.

In the whole of this tribe, the ſituation of the opening on the upper ſurface of the head is well adapted for this purpoſe, being the firſt part that comes to the ſurface of the water in the natural progreſſive motion of the animal; therefore it is to be conſidered principally as a reſpiratory organ, and where it contains the organ of ſmell, that is only ſecondary.

As the animals of this order do not live in the medium which they inſpire, the organs conducting the air to the lungs are in ſome ſort particularly conſtructed, that the water in which they live may not interfere with the air they breathe.

The projecting glottis, which has been deſcribed, paſſes into the poſterior noſtrils, by which means it croſſes the fauces, dividing them into two paſſages. The enlargement at the termination of the glottis, obſerved in ſome of them, would ſeem to be intended to prevent its retraction; but, as it ſeems confined to the Porpoiſe and Grampus, it may, perhaps, in them anſwer ſome other purpoſe.

The beginning of the poſterior noſtrils, which anſwers to the palatum molle in the quadruped, having a ſphincter, the glottis is graſped by it, which renders its ſituation ſtill more ſecure, and the paſſages through the head, acroſs the fauces and along the trachea, are rendered one continued canal; this union of glottis and epiglottis with the poſterior noſtril, making only a kind of joint, admits of motion, and of dilatation and contraction of the fauces, in deglutition, from the epiglottis moving more in or out of the poſterior noſtril.

This

This conſtruction of parts anſwers a purpoſe ſimilar to that of the epiglottis in the quadruped; it may be conſidered as the epiglottis and the arytenoid cartilages joining, to make a tubular or cylindrical epiglottis, inſtead of a valvular one.

The reaſons why there ſhould be ſo peculiar a conſtruction of parts do not at firſt appear; but we certainly ſee by it an abſolute guard placed upon the lungs, that no water ſhould get into them.

This tribe being without the projecting tongue of the quadruped, and wanting its extenſive motion, and the power of ſucking things into the mouth, may probably require the conſtruction between the air and lungs to be more perfect; but how far it is ſo, I will not pretend to ſay.

The ſize of the Brain differs much in different genera of this tribe, and likewiſe in the proportion it bears to the bulk of the animal. In the Porpoiſe, I believe, it is largeſt, and perhaps in that reſpect comes neareſt to the human.

The ſize of the cerebellum in proportion to that of the cerebrum is ſmaller in the human ſubject than in any animal with which I am acquainted. In many quadrupeds, as the Horſe, Cow, &c. the diſproportion in ſize between cerebellum and cerebrum is not great, and in this tribe it is ſtill leſs; yet not ſo ſmall as in the bird, &c.

The whole brain in this tribe is compact, the anterior part of the cerebrum not projecting ſo far forwards as in either the quadruped or in the human ſubject; neither is the medulla oblongata ſo prominent, but flat, lying in a kind of hollow made by the two lobes of the cerebellum.

The brain is compoſed of cortical and medullary ſubſtances, very diſtinctly marked; the cortical being, in colour, like the tubular ſubſtance of a kidney; the medullary, very white.

Theſe ſubſtances are nearly in the ſame proportion as in the human brain. The two lateral ventricles are large, and in thoſe that have olfactory nerves are not continued into them as in many quadrupeds; nor do they wind ſo much outwards as in the human ſubject, but paſs cloſe round the poſterior ends of the thalami nervorum opticorum. The thalami themſelves are large; the corpora ſtriata ſmall; the crura of the fornix are continued along the windings of the ventricles, much as in the human ſubject. The plexus choroides is attached to a ſtrong membrane, which covers the thalami nervorum opticorum, and paſſes through the whole courſe of the ventricle, much as in the human ſubject.

The ſubſtance of the brain is more viſibly fibrous than I ever ſaw it in any other animal, the fibres paſſing from the ventricles as from a center to the circumference, which fibrous texture is alſo continued through the cortical ſubſtance. The whole brain in the Piked Whale weighed four pounds ten ounces.

The nerves going out from the brain, I believe, are ſimilar to thoſe of the quadruped, except in the want of the olfactory nerves in the genus of the Porpoiſe.

The medulla ſpinalis is much ſmaller in proportion to the ſize of the body than in the human ſpecies, but ſtill bears ſome proportion to the quantity of brain; for in the Porpoiſe, where the brain is largeſt, the medulla ſpinalis is largeſt; yet this did not hold good in the Spermaceti Whale, the ſize of the medulla ſpinalis appearing to be proportionally larger than the brain, which was ſmall when compared to the ſize of the animal. It has a cortical part in the center, and terminates about the twenty-fifth vertebra, beyond which is the cauda equina, the dura mater going no lower. The nerves which go

off from the medulla ſpinalis are more uniform in ſize than in the quadruped, there being no ſuch inequality of parts, nor any extremities to be ſupplied, except the fins.

The medulla ſpinalis is more fibrous in its ſtructure than in other animals; and when an attempt is made to break it longitudinally, it tears with a fibrous appearance, but tranſverſely it breaks irregularly.

The dura mater lines the ſkull, and forms in ſome the three proceſſes anſwerable to the diviſions of the brain, as in the human ſubject; but in others, this is bone. Where it covers the medulla ſpinalis, it differs from all the quadrupeds I am acquainted with, incloſing the medulla cloſely, and the nerves immediately paſſing out through it at the lower part, as they do at the upper, ſo that the cauda equina, as it forms, is on the outſide of the dura mater.

As the Organs of Senſe are variouſly formed in different animals, fitted for the various modes of impreſſion; and as the modes are either increaſed or varied, according to circumſtances which make no part of the ſenſe itſelf, but which are neceſſary for the œconomy of the animal, we find the ſenſes in this tribe varied in their conſtruction, and in ſome a ſenſe is even wholly wanting.

The organs of ſenſe, which appear to be adapted to every mode of life, are thoſe of touch and taſte; but thoſe of ſmell, ſight, and hearing, probably require to be varied according to circumſtances. Thus ſmell may be increaſed by a mode of impregnation, hearing by the vibration of different mediums, and ſight by the different powers of refraction of different mediums; therefore, as animals are intended by nature to be differently circumſtanced, ſo are the ſenſes formed.

Of the Senſe of Touch.

The cutis in this tribe appears, in general, particularly well calculated for ſenſation; the whole ſurface being covered with villi, which are ſo many veſſels, and we muſt ſuppoſe, nerves. Whether this ſtructure is only neceſſary for acute ſenſation, or whether it is neceſſary for common ſenſation, where the cuticle is thick, and conſiſting of many layers, I do not know. We may obſerve, that where it is neceſſary the ſenſe of touch ſhould be accurate, the villi are uſually thick and long, which probably is neceſſary, becauſe in moſt parts of the body, where the more acute ſenſations of touch are required, ſuch parts are covered by a thick cuticle. Of this the ends of our fingers, toes, and the foot of the hoofed animals, are remarkable examples.

Whether this ſenſe is more acute in water, I am not certain, but ſhould imagine it is.

Of the Senſe of Taſte.

The tongue, which is the organ of taſte, is alſo endowed with the ſenſe of touch. It is likewiſe to be conſidered, in the greateſt number of animals, as an inſtrument for mechanical purpoſes; but probably leſs ſo in this tribe than any other. However, even in theſe, it muſt have been formed with this view, ſince, merely as an organ of taſte, it would only have required ſurface, yet is a projecting body endowed with motion. In ſome, it is better adapted for motion than in others; and I ſhould ſuppoſe this to be requiſite, on account of the difference in the mode of catching the food, and in the act of ſwallowing. It is moſt projecting in thoſe with teeth, probably for the better conducting

conducting the food, ſtep by ſtep, to the œſophagus; whereas, it does not ſeem ſo neceſſary to have ſuch management of the tongue in thoſe which have no teeth, and catch their food by merely opening the mouth, and ſwimming upon it, or by having their prey carried in by the water. In the Porpoiſe and Grampus it is firm in texture, compoſed of muſcle and fat, being pointed and ſerrated on its edges, like that of the Hog.

In the Spermaceti Whale the tongue was almoſt like a feather-bed. In the Piked Whale it was but gently raiſed, hardly having any lateral edges, and its tip projecting but little, yet, like every other tongue, compoſed of muſcle and fat. The extent between the two jaw bones in this Whale was very conſiderable, taking in the whole width of the head or upper jaw, and of courſe including the whalebone. This extent of ſurface, between jaw and jaw, having but little projection of tongue, is almoſt flat from ſide to ſide, is extremely elaſtic when contracted, and throws the inner membrane into a vaſt number of very ſmall folds, that run parallel to one another, but which are again thrown into a cloſe ſerpentine courſe by the elaſticity of the part in a contrary direction. From the tongue being capable of but little motion, there is only a ſmall maſs of muſcle required; and from the thinneſs of the jaw bones, the diſtance between the lower ſurface of the mouth and external ſurface of the ſkin is but ſmall; and this ſkin being ribbed, and very elaſtic, is capable of conſiderable diſtention, by which the cavity of the mouth can be enlarged.

The tongue of the large Whalebone Whale, I ſhould ſuppoſe, roſe in the mouth conſiderably; the two jaws at the middle being kept at ſuch a diſtance on account of the whalebone, ſo that the ſpace between, when the mouth is ſhut, muſt be filled up by the tongue.

Of the Senſe of Smelling.

In this tribe of animals there is ſomething very remarkable in what relates to the ſenſe of ſmelling; nor have I been able to diſcover the particular mode by which it is performed.

When we conſider theſe animals as quadrupeds, and only conſtructed differently in external form for progreſſive motion through water, we muſt ſee that it was neceſſary that all the ſenſes ſhould correſpond with this medium: we muſt therefore be at a loſs to conceive how they ſmell, ſince we may obſerve, that the organ for ſmelling water, as in fiſh, is very different from that formed to ſmell air; and as we muſt ſuppoſe this tribe are only to ſmell water, being the medium in which ſuch odoriferous particles can be diffuſed, we ſhould expect their organ to be ſimilar to that of fiſh; but in that caſe nature would have been obliged to have attached the noſe of a fiſh to an animal conſtructed like a quadruped; and it is contrary to the laws which are eſtabliſhed in the animal creation to mix parts of different animals together.

In many of this tribe there is no organ of ſmell at all; and in thoſe which have ſuch an organ, it is not that of a fiſh, therefore probably not calculated to ſmell water. It becomes difficult, therefore, to account for the manner in which ſuch animals ſmell the water; and why the others ſhould not have had ſuch an organ *,

* Is the mode of ſmelling in fiſh ſimilar to taſting in other animals? Or is the air contained in the water impregnated with the odoriferous parts, and this air the fiſh ſmells? If ſo, it is ſomewhat ſimilar to the breathing of fiſh, it not being the water which produces the effect there, but the air contained in it. This I proved by experiments, and is mentioned by Dr. PRIESTLEY.

which,

which, I believe, is peculiar to the large and ſmall Whale-bone Whales.

Although it is not the external air which they inſpire that produces ſmell, I believe it is the air retained in the noſtril out of the current of reſpiration, which by being impregnated with the odoriferous particles contained in the water during the act of blowing, is applied to the organ of ſmell. It might be ſuppoſed, that they could ſmell the air on the ſurface of the water by every inſpiration, as animals do on land; and probably they may: but this will not give them the power to ſmell the odoriferous particles of their prey in the water at any depth; and as their organ is not fitted to be affected by the application of water, and as they cannot ſuck water into the noſtril, without the danger of its paſſing into the lungs, it cannot be by its application to this organ that they are enabled to ſmell.

Some have the power of throwing the water from the mouth through the noſtril, and with ſuch force as to raiſe it thirty feet high: this muſt anſwer ſome important purpoſe, although not immediately evident to us.

As the organ appears to be formed to ſmell air only, and as I conceive the ſmelling of the external air could not be of uſe as a ſenſe. I therefore believe, that they do not ſmell in inſpiration; yet let us conſider how they may be ſuppoſed to ſmell the odoriferous particles of the water.

The organ of ſmell is out of the direct road of the current of air in inſpiration; it is alſo out of the current of water when they ſpout; may we not ſuppoſe then, that this ſinus contains air, and as the water paſſes in the act of throwing it out, that it impregnates this reſervoir of air, which immediately affects the ſenſe of ſmell. This operation is probably performed in the time of expiration, becauſe it is ſaid that this

water

water is ſometimes very offenſive; but all this I only give as conjecture.

If the above ſolution is juſt, then only thoſe which have the organ of ſmell can ſpout, a fact worthy of enquiry.

The organ of ſmell would appear to be leſs neceſſary in theſe animals than in thoſe which live in air, ſince ſome are wholly deprived of it; and the organ in thoſe which have it is extremely ſmall, when compared with that of other animals, as well as the nerve which is to receive the impreſſion, as was obſerved above.

Of the Senſe of Hearing.

The ear is conſtructed much upon the ſame principle as in the quadruped; but as it differs in ſeveral reſpects, which it is neceſſary to particulariſe, to convey a perfect idea of it the whole ſhould be deſcribed. As this would exceed the limits of this Paper, I ſhall content myſelf with a general deſcription, taking notice of thoſe material points in which it differs from that of the quadruped.

This organ conſiſts of the ſame parts as in the quadruped; an external opening, with a membrana tympani, an Euſtachian tube, a tympanum with its proceſſes, and the ſmall bones. There is no external projection forming a funnel, but merely an external opening. We can eaſily aſſign a reaſon why there ſhould be no projecting ear, as it would interfere with progreſſive motion; but the reaſon why it is not formed as in birds, is not ſo evident; whether the percuſſions of water could be collected into one point as air, I cannot ſay. The tympanum is conſtructed with irregularities, ſo much like thoſe of an external ear, that I could ſuppoſe it to have a ſimilar effect.

The

The external opening begins by a ſmall hole, ſcarcely perceptible, ſituated on the ſide of the head a little behind the eye. It is much longer than in other animals, in conſequence of the ſize of the head being ſo much increaſed beyond the cavity that contains the brain. It paſſes in a ſerpentine courſe, at firſt horizontally, then downwards, and afterwards horizontally again, to the membrana tympani, where it terminates. In its whole length it is compoſed of different cartilages, which are irregular and united together by cellular membrane, ſo as to admit of motion, and probably of lengthening or ſhortening, as the animal is more or leſs fat.

The bony part of the organ is not ſo much incloſed in the bones of the ſkull as in the quadruped, conſiſting commonly of a diſtinct bone or bones, cloſely attached to the ſkull, but in general readily to be ſeparated from it; yet in ſome it ſends off, from the poſterior part, proceſſes which unite with the ſkull. It varies in its ſhape, and is compoſed of the immediate organ and the tympanum.

The immediate organ is, in point of ſituation to that of the tympanum, ſuperior and internal, as in the quadruped. The tympanum is open at the anterior end, where the Euſtachian tube begins.

The Euſtachian tube opens on the outſide of the upper part of the fauces: in ſome higher in the noſe than others; higheſt, I believe, in the Porpoiſe. From the cavity of the tympanum, where it is rather largeſt, it paſſes forwards and inwards, and near its termination appears very much faſciculated, as if glandular.

The Euſtachian tube and tympanum communicate with ſeveral ſinuſes, which paſſing in various directions ſurround the bone of the ear. Some of theſe are cellular, ſimilar to the cells of the maſtoid proceſs in the human ſubject, although not bony. There is a portion of this cellular ſtructure of a

particular kind, being white, ligamentous, and each part rather rounded than having flat ſides *. One of the ſinuſes paſſing out of the tympanum cloſe to the membrana tympani, goes a little way in the ſame direction, and communicates with a number of cells.

The whole function of the Euſtachian tube is perhaps not known; but it is evidently a duct from the cavity of the ear, or a paſſage for the mucus of theſe parts; the external opening having a particular form would incline us to believe, that ſomething was conveyed to the tympanum.

The bony part of the organ is very hard and brittle, rendering it even difficult to be cut with a ſaw, without its chipping into pieces. That part which contains the immediate organ is by much the hardeſt, and has a very ſmall portion of animal ſubſtance in it; for when ſteeped in an acid, what remains is very ſoft, almoſt like a jelly, and laminated. The bone is not only harder in its ſubſtance, but there is on the whole more ſolid bone than in the correſponding parts of quadrupeds, it being thick and maſſy.

The part containing the tympanum is a thin bone, coiled upon itſelf, attached by one end to the portion which contains the organ; and this attachment in ſome is by cloſe contact only, as in the Narwhale; in others, the bones run into one another, as in the Bottle-noſe and Piked Whales.

The concave ſide of the tympanum is turned towards the organ, its two edges being cloſe to it; the outer is irregular, and in many only in contact, as in the Porpoiſe: while in

* Theſe communications with the Euſtachian tube may be compared to a large bag on the baſes of the ſkull of the Horſe and Aſs, which is a lateral ſwell of the membranous part of the tube, and when diſtended will contain nearly a quart.

others

others the union is by bony continuity, as in the Bottle-noſe Whale, leaving a paſſage on which the membrana tympani is ſtretched, and another opening, which is the communication with the ſinuſes.

The ſurface of the bone containing the immediate organ oppoſite to the mouth of the tympanum is very irregular, having a number of eminences and cavities. The cavity of the tympanum is lined with a membrane, which alſo covers the ſmall bones with their muſcles, and appears to have a thin cuticle. This membrane renders the bones, muſcles, tendons, &c. very obſcure, which are ſeen diſtinctly when that is removed. It appears to be a continuation of the perioſteum, and the only uniting ſubſtance between the ſmall bones. Beſides the general lining, there is a plexus of veſſels, which is thin and rather broad, and attached by one edge, the reſt being looſe in the cavity of the tympanum, ſomewhat like the plexus choroides in the ventricles of the brain. The cavity, we may ſuppoſe, intended to increaſe ſound, probably by the vibration of the bone; and from its particular formation we can eaſily conceive, that the vibrations are conducted, or reflected, towards the immediate organ, it being in ſome degree a ſubſtitute for the external ear.

The external opening being ſmaller than in any animals of the ſame ſize, the membrana tympani is nearly in the ſame proportion. In the Bottle-noſe Whale, the Grampus, and Porpoiſe, it is ſmooth and concave externally, but of a particular conſtruction on the inner ſurface; for a tendinous proceſs paſſes from it towards the malleus, converging as it proceeds from the membrane, and becoming thinner till its inſertion into that bone. I could not diſcover whether it had any muſcular fibres which could affect the action of the malleus. In

the Piked Whale, the termination of the external opening, inſtead of being ſmooth and concave, is projecting, and returns back into the meatus for above an inch in length, is firm in texture, with thick coats, is hollow on its inſide, and its mouth communicating with the tympanum; one ſide being fixed to the malleus, ſimilar to the tendinous proceſs which goes from the inſide of the membrana tympani in the others.

A little way within the membrana tympani, are placed the ſmall bones, which are three in number, as in the quadruped, Malleus, Incus, and Stapes; but in the Bottle-noſe Whale there is a fourth, placed on the tendon of the Stapedæus muſcle. Theſe bones are as it were ſuſpended between the bone of the tympanum, and that of the immediate organ.

The malleus has two attachments, beſides that with the incus; one cloſe to the bone of the tympanum, which, in the Porpoiſe, is only by contact, but in others by a bony union; the other attachment is formed by the tendon, above deſcribed, being united to the inner ſurface of the membrana tympani. Its baſe articulates with the incus.

The incus is attached by a ſmall proceſs to the tympanum, and is ſuſpended between the malleus and ſtapes. The proceſs by which it articulates with the ſtapes is bent towards that

The ſtapes ſtands on the veſtibulum, by a broad oval baſe. In many of this tribe, the opening from ſide to ſide of the ſtapes is ſo ſmall as hardly to give the idea of a ſtirrup.

The muſcles which move theſe bones are two in number, and tolerably ſtrong. One ariſes from that projecting part of the tympanum which goes to form the Euſtachian tube, and running backwards is inſerted into a ſmall depreſſion on the anterior part of the malleus. The uſe of this muſcle ſeems to

be to tighten the membrana tympani; but in thoſe which have the malleus anchyloſed with the tympanum, we can hardly conjecture its uſe. The other has its origin from the inner ſurface of the tympanum, and paſſing backwards is inſerted into the ſtapes by a tendon, in which I found a bone in the large Bottle-noſe. This muſcle gives the ſtapes a lateral motion. What particular uſe in hearing may be produced by the action of theſe muſcles, I will not pretend to ſay; but we muſt ſuppoſe, whatever motion is given to the bones muſt terminate in the movement of the ſtapes.

The immediate organ of hearing is contained in a round, bony proceſs, and conſiſts of the Cochlea and Semicircular Canals, which ſomewhat reſemble the quadruped; but, beſides the two ſpiral turns of the cochlea, there is a third, which makes a ridge within that continued from the foramen rotundum, and follows the turns of the canal.

The cochlea is much larger, when compared with the ſemicircular canals, than in the human ſpecies and quadruped.

We may reckon two paſſages into the immediate organ of hearing, the foramen rotundum, and foramen ovale. They are at a greater diſtance than in the quadruped. The foramen rotundum is placed much more on the outer ſurface of the bone, and not in the cavity of the bony tympanum; but may be ſaid to communicate with the ſurrounding cellular part of the tympanum. The foramen rotundum, which is the beginning of one of theſe turns, appears to be only one end of a tranſverſe groove, which is afterwards cloſed in the middle, forming a canal with the two ends open; ſo that this foramen appears to have two beginnings; but the other opening is probably only a paſſage for blood-veſſels going to the cochlea.

From

From this foramen begins the inner turn of the cochlea, which is the largeſt, eſpecially at its beginning; the other begins from the veſtibulum. The cochlea is a ſpiral canal coiled within itſelf, and divided into two by a thin ſpiral bony plate, which is compleated in the recent ſubject, and forms two perfect canals.

In the recent ſubject, the foramen rotundum is lined with the membrane of the tympanum, which terminates in a blind end, forming a kind of membrana cochleæ. The other opening, in the recent ſubject, communicates with the ſpiral turn, beyond the membranous termination of the foramen rotundum.

The foramen ovale has a little projection inwards all round, on which the ſtapes ſtands: within this is the veſtibulum, which is common to the other ſpiral turn of the cochleæ, and the ſemicircular canals; this canal of the cochlea paſſes out firſt in a direction contrary to its general courſe, but ſoon makes a turn into the ſpiral. It is round, and not merely a diviſion of the cochlea into two by a ſeptum, but has a membrane of its own, which is attached to the thin bony plate, and lines that part of the cochlea in ſuch a manner as to retain its ſtructure when the bone is removed. The cochlea in ſome compleats one turn and an half; in others, more. It is not a ſpiral on a plane, or cylinder, but on a cone.

I have already obſerved, that by looking in at the foramen rotundum, we ſee two ſmall ridges; the uppermoſt is the ſwell of the canal from the veſtibulum juſt deſcribed; the lower ridge, which is alſo a canal, may be obſerved juſt to paſs along the foramen belonging to this canal, cloſe to the ſeptum between the two; a circumſtance, I believe, peculiar to this tribe. Its beginning is cloſe to the veſtibulum, but does not open from it, and paſſes along the firſt deſcribed ſpiral

turn to its apex: when opened, it appears to be a canal full of ſmall perforations, probably the paſſages of the branches from the auditory nerve.

This bony proceſs has ſeveral perforations in it; one of them large, for the paſſage of the ſeventh pair of nerves. The ſize of the portio mollis, before its entrance into the organ, is very large, and bears no proportion to that which enters. The paſſage for this nerve is very wide, and ſeems to have an irregular blind conical, and ſomewhat ſpiral, termination; its being ſpiral ariſes from the cloſeneſs to the point of the cochlea.

In the terminating part there are a number of perforations into the cochlea, and one into the ſemicircular canals, which afford a paſſage to the different diviſions of the auditory nerve. There is a conſiderable foramen in its anterior ſide near the bottom, for the paſſage of the portio dura, and which is continued backward to the cavity of the tympanum near the ſtapes, and emerges near the poſterior and upper part of this bone.

Of the Organ of Seeing.

The eye in this tribe of animals is conſtructed upon nearly the ſame principle as that of quadrupeds, differing, however, in ſome circumſtances; by which it is probably better adapted to ſee in the medium through which the light is to paſs. It is upon the whole ſmall for the ſize of the animal, which would lead to the ſuppoſition, that their locomotion is not great; for, I believe, animals that ſwim are in this reſpect ſimilar to thoſe that fly; and as this tribe come to the ſurface of the medium in which they live, they may be conſidered in the ſame view with birds which ſoar; and we find, birds

that

that fly to great heights, and move through a conſiderable ſpace, in ſearch of food, have their eyes larger in proportion to their ſize.

The eyelids have but little motion, and do not conſiſt of looſe cellular membrane, as in quadrupeds, but rather of the common adipoſe membrane of the body; the connexion, however, of their circumference with the common integuments is looſe, the cellular membrane being leſs loaded with oil, which allows of a ſlight fold being made upon the ſurrounding parts in opening the eyelids. This is not to an equal degree in them all, being leſs ſo in the Porpoiſe than in the Piked Whale.

The tunica conjunctiva, where it is reflected from the eyelid to the eyeball, is perforated all round by ſmall orifices of the ducts of a circle of glandular bodies lying behind it.

The lachrymal gland is ſmall; its uſe being ſupplied by thoſe above-mentioned; and the ſecretion from them all, I believe, to be a mucus ſimilar to what is found in the Turtle and Crocodile. There are neither puncta nor lachrymal duct, ſo that the ſecretion, whatever it be, is waſhed off into the water.

The muſcles which open the eyelids are very ſtrong: they take their origin from the head, round the optic nerve, which in ſome requires their being very long, and are ſo broad as almoſt to make one circular muſcle round the whole of the interior ſtraight muſcles of the eye itſelf. They may be divided into four; a ſuperior, an inferior, and one at each angle: as they paſs outwards to the eyelids, they diverge and become broader, and are inſerted into the inſide of the eyelids almoſt equally all round. They may be termed the dilatores of the eyelids; and, before they reach their inſertion, give off the external ſtraight muſcles, which are ſmall, and inſerted into the ſclerotic coat before the tranſverſe axis of the eye:

theſe

theſe may be named the elevator, depreſſor, adductor, and abductor, and may be diſſected away from the others as diſtinct muſcles. Beſides theſe four going from the muſcles of the eyelid to the eye itſelf, there are two which are larger, and incloſe the optic nerve with the plexus. As theſe paſs outwards they become broad, may in ſome be divided into four, and are inſerted into the ſclerotic coat, almoſt all round the eye, rather behind its tranſverſe axis.

The two oblique muſcles are very long; they paſs through the muſcles of the eyelids, are continued on to the globe of the eye, between the two ſets of ſtraight muſcles, and at their inſertions are very broad; a circumſtance which gives great variation to the motion of the eye.

The ſclerotic coat gives ſhape to the eye, both externally and internally, as in other animals; but the external ſhape and that of the internal cavity are very diſſimilar, ariſing from the great difference in the thickneſs of this coat in different parts. The external figure is round, except that it is a little flattened forwards; but that of the cavity is far otherwiſe, being made up of ſections of various circles, being a little lengthened from the inner ſide to the outer, a tranſverſe ſection making a ſhort ellipſis.

In the Piked Whale the long axis is two inches and three-quarters, the ſhort axis two inches and one-eighth.

The poſterior part of the cavity is a tolerably regular curve, anſwering to the difference in the two axiſes; but forwards, near the cornea, the ſclerotic coat turns quickly in, to meet

rotic coat and the bottom of the eye not above an inch and a quarter.

In the Piked Whale the ſclerotic coat, at its poſterior part, is very thick: near the extreme of the ſhort axis it was half an inch, and at the long axis one-eighth of an inch thick. In the Bottle-noſe Whale, the extreme of the ſhort axis was half an inch thick, and the extremes of the long axis about a quarter of an inch, or half the other.

The ſclerotic coat becomes thinner as it approaches to its union with the cornea, where it is thin and ſoft. It is extremely firm in its texture, where thick, and from a tranſverſe ſection would ſeem to be compoſed of tendinous fibres, intermixed with ſomething like cartilage; in this ſection four paſſages for veſſels remain open. This firmneſs of texture precludes all effect of the ſtraight muſcles on the globe of the eye, by altering its ſhape, and adapting its focus to different diſtances of objects, as has been ſuppoſed to be the caſe in the human eye.

The cornea makes rather a longer ellipſis than the ball of the eye; the ſides of which are not equally curved, the upper being moſt conſiderably ſo. It is a ſegment of a circle ſomewhat ſmaller than that of the eyeball, is ſoft and very flaccid.

The tunica choroides reſembles that of the quadruped; and its inner ſurface is of a ſilver hue, without any nigrum pigmentum.

The nigrum pigmentum only covers the ciliary proceſſes, and lines the inſide of the iris.

The retina appears to be nearly ſimilar to that of the quadruped.

The arteries going to the coats of the eye form a plexus paſſing round the optic nerve, reſembling, in its appearance, that of the ſpermatic artery in the Bull and ſome other animals.

The

The cryſtalline humor reſembles that of the quadruped; but whether it is very convex or flattened, I cannot determine, thoſe I have examined having been kept too long to preſerve their exact ſhape and ſize. The vitreous humor adhered to the retina at the entrance of the optic nerve.

The optic nerve is very long in ſome ſpecies, owing to the vaſt width of the head.

I ſhall not at preſent conſider the eye in animals of this tribe, as it reſpects the power of viſion, that being performed on a general principle common to every animal inhabiting the water; more eſpecially as I am only maſter of the conſtruction and formation of the eye, and not of the ſize, ſhape, and denſities of the humors; yet, from reaſoning, we muſt ſu poſe them to correſpond with the ſhape of the eye, and the medium through which the light is to paſs.

Of the Parts of Generation.

The parts of generation in both ſexes of this order of animals come nearer in form to thoſe of the ruminating than of any others; and this ſimilarity is, perhaps, more remarkable in the female than in the male; for their ſituation in the male muſt vary on account of external form, as was before obſerved.

The teſticles retain the ſituation in which they were formed, as in thoſe quadrupeds in which they never come down into the ſcrotum. They are ſituated near the lower part of the abdomen, one on each ſide, upon the two great depreſſors of the tail. At this part of the abdomen, the teſticles come in contact with the abdominal muſcles anteriorly.

The vaſa deferentia paſs directly from the epididymis behind the bladder, or between it and the rectum, into the urethra;

and there are no bags ſimilar to thoſe called veſiculæ ſeminales in certain other animals.

The ſtructure of the penis is nearly the ſame in them all, and formed much upon the principle of the quadruped. It is made up of two crura, uniting into one corpus cavernoſum, and the corpus ſpongioſum ſeems firſt to enter the corpus cavernoſum. In the Porpoiſe, at leaſt, the urethra is found nearly in the center of the corpus cavernoſum; but towards the glans ſeems to ſeparate or emerge from it, and becoming a diſtinct ſpongy body, runs along its under ſurface, as in quadrupeds. The corpus cavernoſum in ſome is broader from the upper part to the lower than from ſide to ſide; but in the Porpoiſe has the appearance of being round, becoming ſmaller forwards, ſo as to terminate almoſt in a point ſome diſtance from the end of the penis. The glans does not ſpread out as in many quadrupeds, but ſeems to be merely a plexus of veins covering the anterior end of the penis, yet is extended a good way further on, and is in ſome no more than one vein deep.

The crura penis are attached to two bones, which are nearly in the ſame ſituation and in the ſame part of the pelvis as thoſe to which the penis is attached in quadrupeds; but theſe bones are only for the inſertion of the crura, and not for the ſupport of any other part, like the pelvis in thoſe animals which have poſterior extremities, neither do they meet at the fore part, or join the vertebræ of the back.

The erectores penis are very ſtrong muſcles, having an origin and inſertion ſimilar to thoſe of the human ſubject.

The acceleratores muſcles are likewiſe very ſtrong; and there is a ſtrong and long muſcle, ariſing from the anus, and paſſing forwards to the bulb of the penis, that runs along the under ſurface of the urethra, and is at laſt loſt or inſerted in the cor-

pus ſpongioſum. This muſcle draws the penis into the prepuce, and throws that part of the penis that is behind its inſertion into a ſerpentine form. It is common to moſt animals that draw back the penis into what is called the ſheath, and may be called the retractor penis.

In all the females which I have examined, the parts of generation are very uniformly the ſame; conſiſting of the external opening, the vagina, the two horns of the uterus, Fallopian tubes, fimbriæ, and ovaria.

The external opening is a longitudinal ſlit, or oblong opening, whoſe edges meet in two oppoſite points, and the ſides are rounded off, ſo as to form a kind of ſulcus. The ſkin and parts on each ſide of this ſulcus are of a looſer texture than on the common ſurface of the animal, not being loaded with oil, and allowing of ſuch motion of one part on another as admits of dilatation and contraction. The vagina paſſes upwards and backwards towards the loins, ſo that its direction is diagonal reſpecting the cavity of the abdomen, and then divides into the two horns, one on each ſide of the loins; theſe afterwards terminating in the Fallopian tubes, to which the ovaria are attached. From each ovarium there is a ſmall fold of the peritoneum, which paſſes up towards the kidney of the ſame ſide, as in moſt quadrupeds.

The inſide of the vagina is ſmooth for about one-half of its length, and then begins to form ſomething ſimilar to valves projecting towards the mouth of the vagina, each like an os tincæ; theſe are about ſix, ſeven, eight, or nine in number. Where they begin to form, they hardly go quite round, but the laſt are complete circles. At this part too the vagina becomes ſmaller, and gradually decreaſes in width to its termination. From the laſt projecting part, the paſſage is continued

nued up to the opening of the two horns, and the inner ſurface of this laſt part is thrown into longitudinal rugæ, which are continued into the horns. Whether this laſt part is to be reckoned common uterus or vagina, and that the laſt valvular part is to be conſidered as os tincæ, I do not know; but from its having the longitudinal rugæ, I am inclined to think it is uterus, this ſtructure appearing to be intended for diſtinction.

The horns are an equal diviſion of this part; they make a gentle turn outwards, and are of conſiderable length. Their inner ſurface is thrown into longitudinal rugæ, without any ſmall protuberances for the cotyledons to form upon, as in thoſe of ruminating animals; and where they terminate, the Fallopian tubes begin.

In the Bottle-noſe Whale, where the Fallopian tubes opened into the horns of the uterus, they were ſurrounded by pendulous bodies hanging looſe in the horns.

The Fallopian tubes, at their termination in the uterus, are remarkably ſmall for ſome inches, and then begin to dilate rather ſuddenly; and the nearer to the mouth the more this dilatation increaſes, like the mouth of a French horn, the termination of which is five or ſix inches in diameter. They are very full of longitudinal rugæ through their whole length.

The ovaria are oblong bodies, about five inches in length; one end attached to the mouth of the Fallopian tube, and the other near to the horn of the uterus. They are irregular on their external ſurface, reſembling a capſula renalis or pancreas. They have no capſula, but what is formed by the long Fallopian tube.

How the male and female copulate, I do not know; but it is alledged, that their poſition in the water is erect at that time, which I can readily ſuppoſe may be true; for otherwiſe,

if

if the connexion is long, it would interfere with the act of reſpiration, as in any other poſition the upper ſurface of the heads of both could not be at the ſurface of the water at the ſame time. However, as in the parts of generation they moſt reſemble thoſe of the ruminating kind, it is poſſible they may likewiſe reſemble them in the duration of the act of copulation; for, I believe, all the ruminants are quick in this act.

Of their uterine geſtation I as yet know nothing; but it is very probable, that they have only a ſingle young one at a time, there being only two nipples. This ſeemed to be the caſe with the Bottle-noſe Whale, caught near Berkeley, which had been ſeen for ſome days with one young one following it, and they were both caught together.

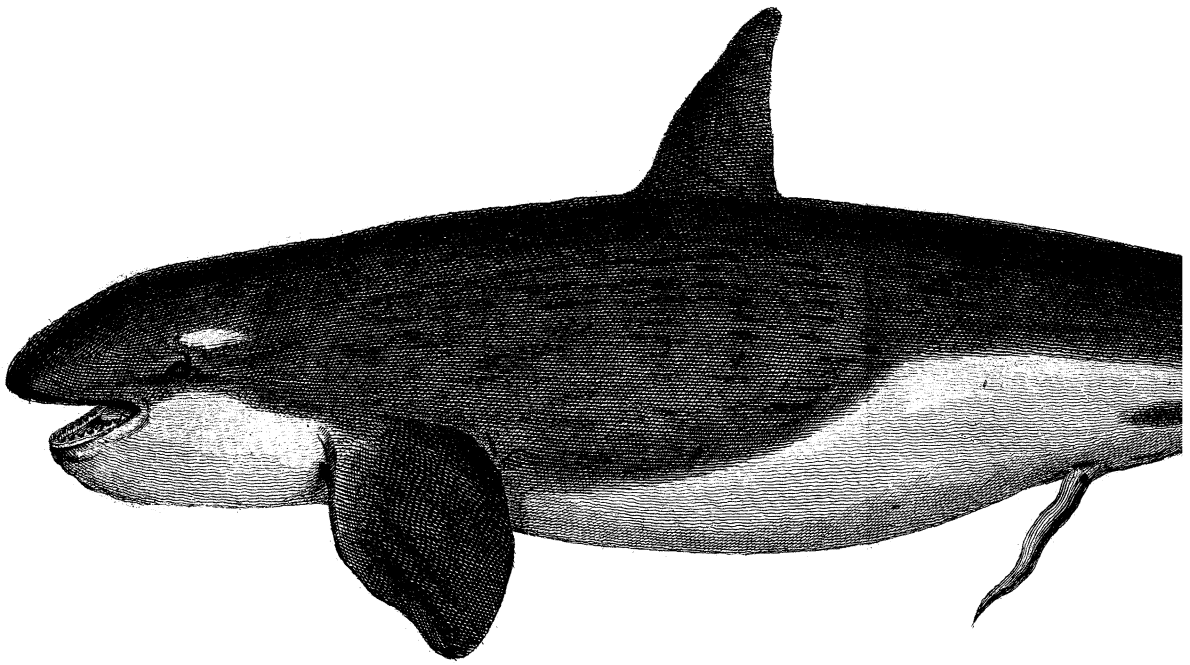
The glands for the ſecretion of milk are two; one on each ſide of the middle line of the belly at its lower part. The poſterior ends, from which go out the nipples, are on each ſide of the opening of the vagina, in ſmall ſulci. They are flat bodies lying between the external layer of fat and abdominal muſcles, and are of conſiderable length, but only one-fourth of that in breadth. They are thin, that they may not vary the external ſhape of the animal, and have a principal duct, running in the middle through the whole length of the gland, and collecting the ſmaller lateral ducts, which are made up of thoſe ſtill ſmaller. Some of theſe lateral branches enter the common trunk in the direction of the milk's paſſage, others in the contrary direction, eſpecially thoſe neareſt to the termination of the trunk in the nipple. The trunk is large, and appears to ſerve as a reſervoir for the milk, and terminates externally in a projection, which is the nipple. The lateral portions of the ſulcus which incloſes the nipple, are compoſed of parts looſer in texture than the common adipoſe membrane, which is probably to admit of the elongation or projection of

the nipple. On the outſide of this there is another ſmall fiſſure, which, I imagine, is likewiſe intended to give greater facility to the movements of all theſe parts.

The milk is probably very rich; for in that caught near Berkeley with its young one, the milk, which was taſted by Mr. JENNER and Mr. LUDLOW, Surgeon, at Sodbury, was rich like Cow's milk to which cream had been added.

The mode in which theſe animals muſt ſuck would appear to be very inconvenient for reſpiration, as either the mother or young one will be prevented from breathing at the time, their noſtrils being in oppoſite directions, therefore the noſe of one muſt be under water, and the time of ſucking can only be between each reſpiration. The act of ſucking muſt likewiſe be different from that of land animals; as in them it is performed by the lungs drawing the air from the mouth backwards into themſelves, which the fluid follows, by being forced into the mouth from the preſſure of the external air on its ſurface; but in this tribe, the lungs having no connexion with the mouth, ſucking muſt be performed by ſome action of the mouth itſelf, and by its having the power of expanſion.

EXPLA-



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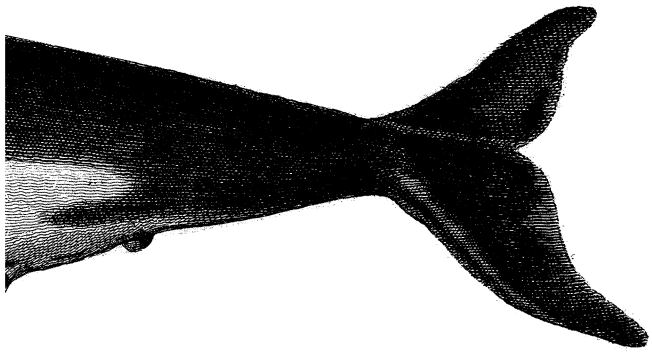

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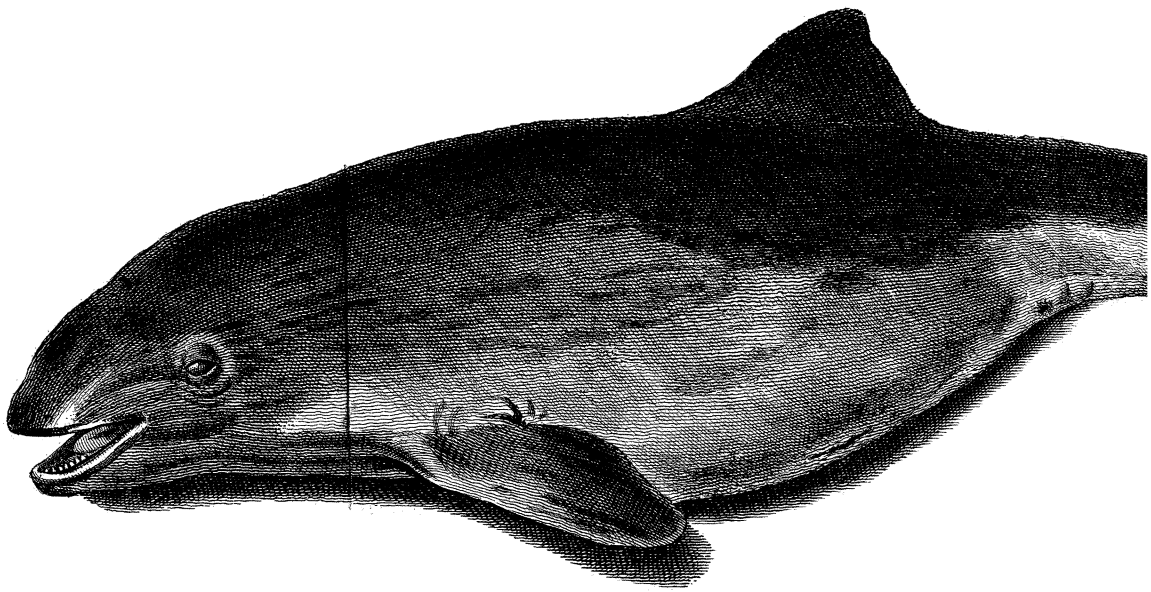

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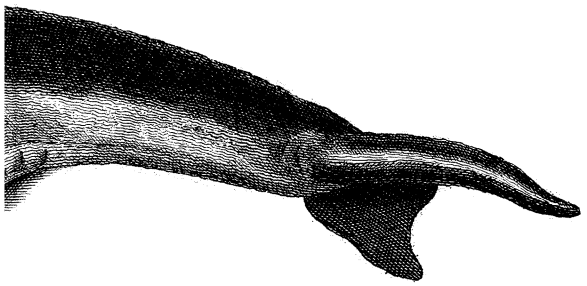

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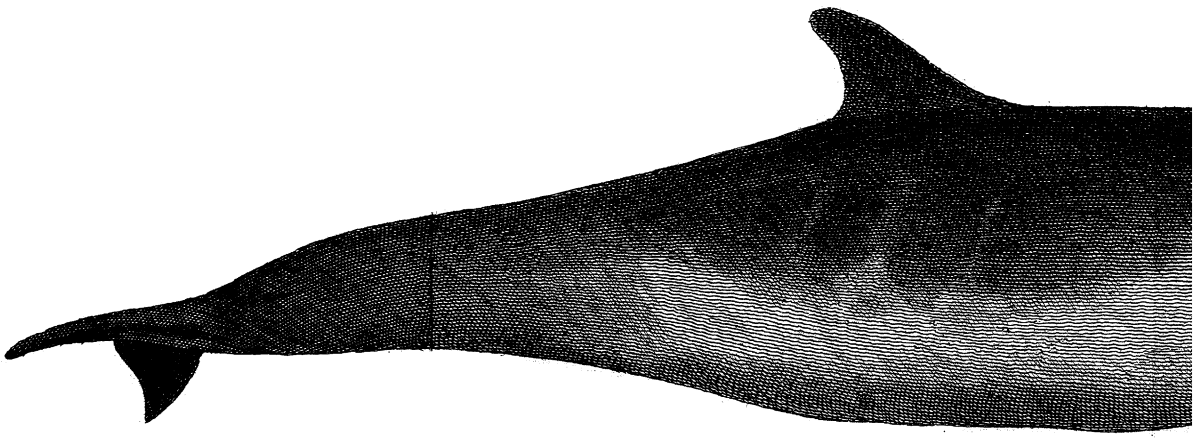
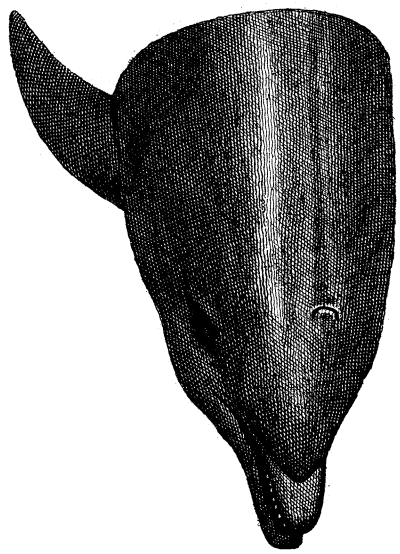
Fig. 1.





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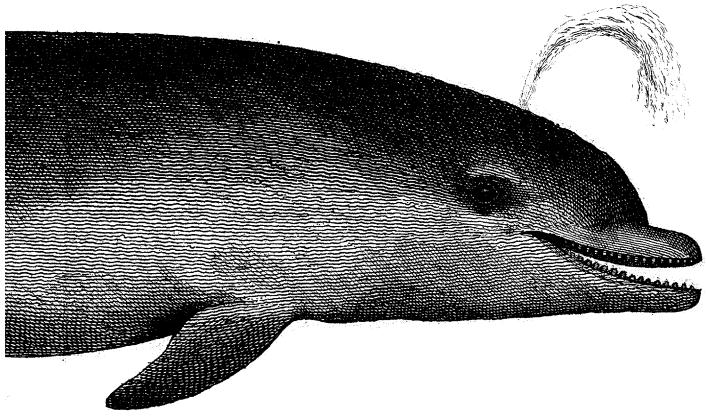

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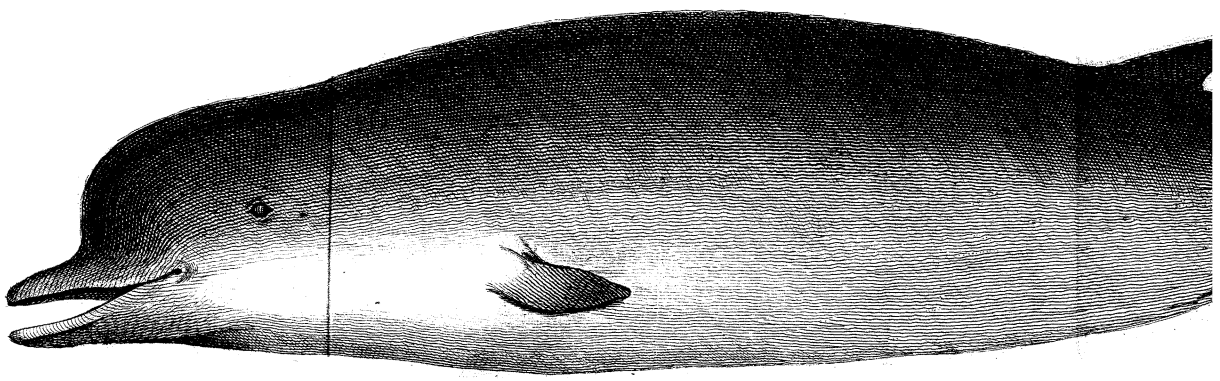

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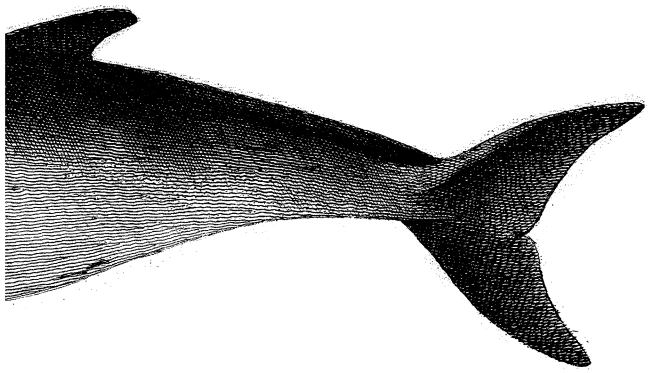
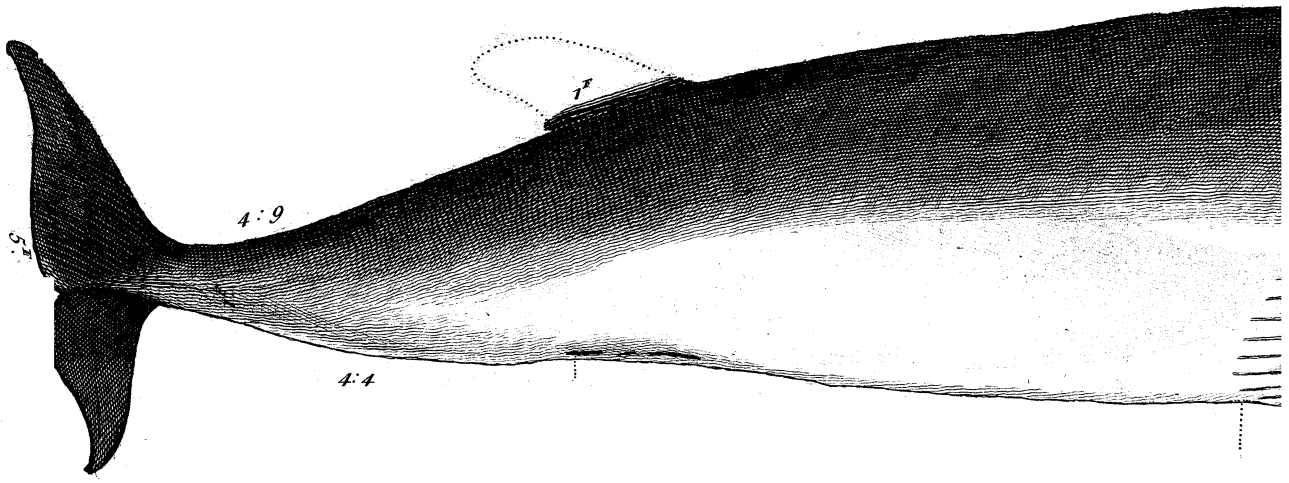


Basire Sc.

	F.	I.
Whole Length	17	0
Upper Jaw from Eye to Eye	1	8
Lower Jaw	2	6
Within the Whalebone	0	10½
Greatest length of Whalebone	0	5

Fig



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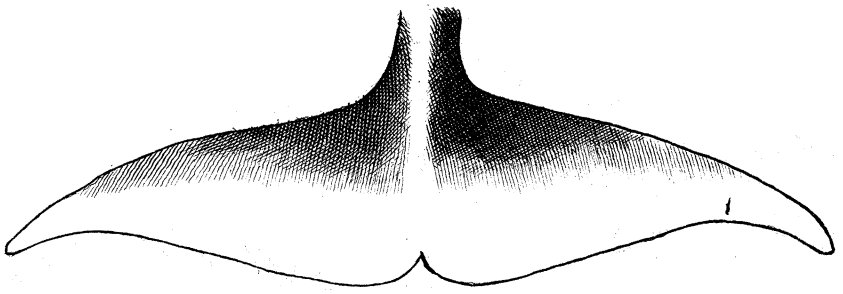
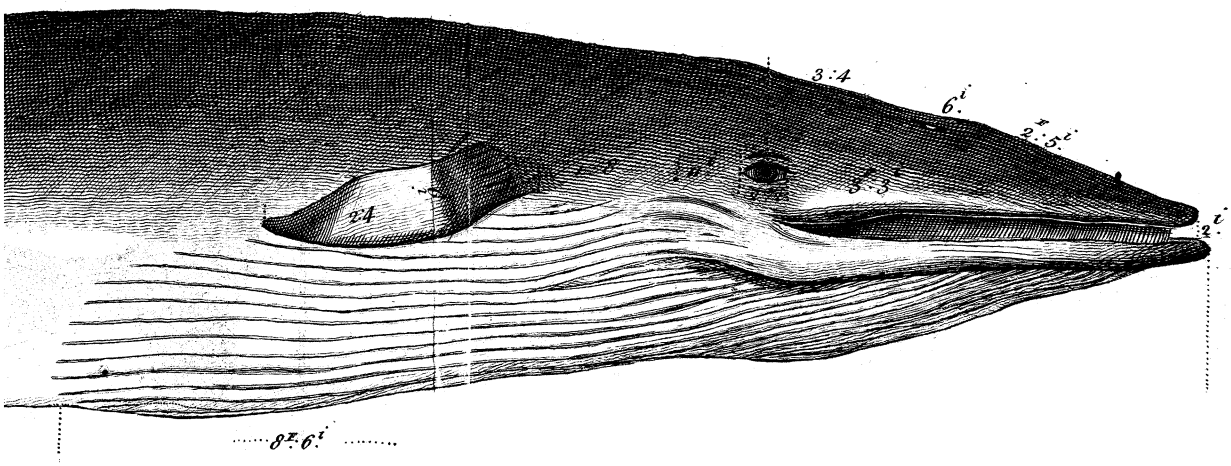


Balæn

Bell. d.

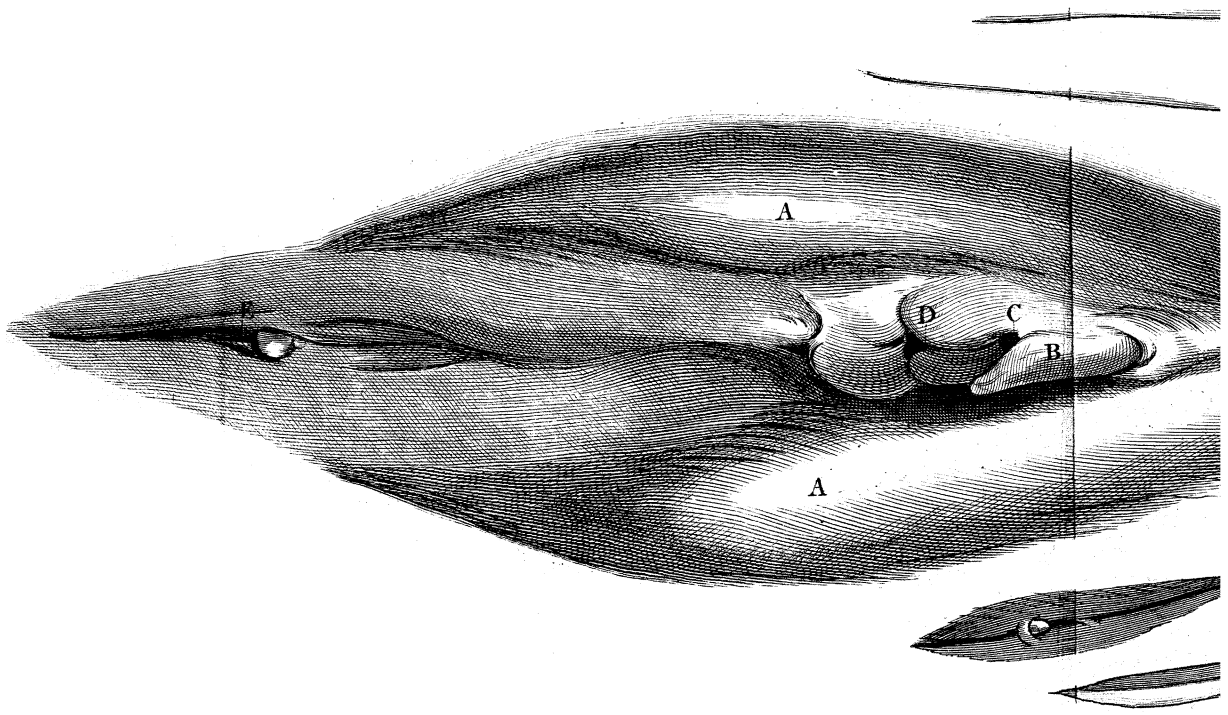
I.
0
8
6
10½
5

Fig. 1.



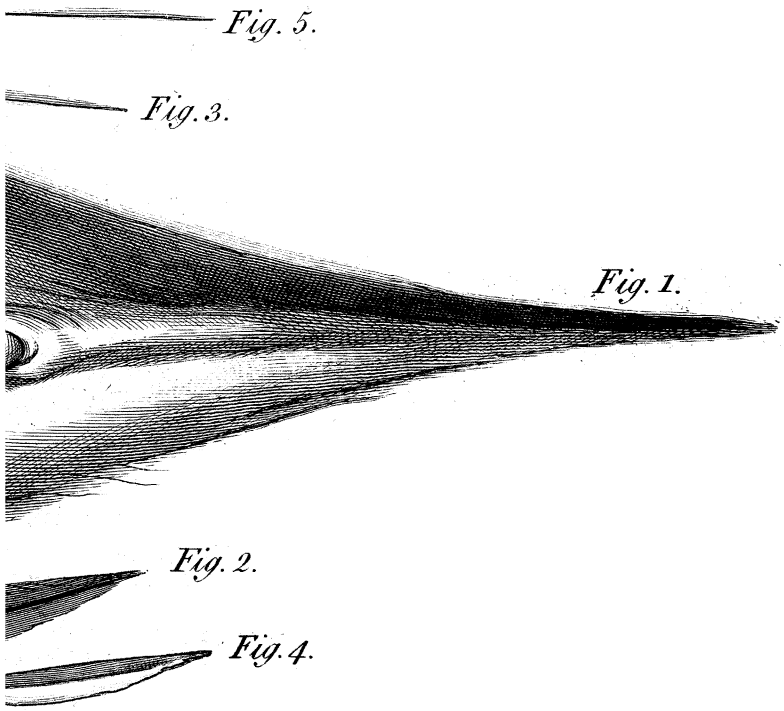
Balæna Rostrata.
Fabricius.

Basire Sc.



Foot inches
1 . 3

Bell. d.



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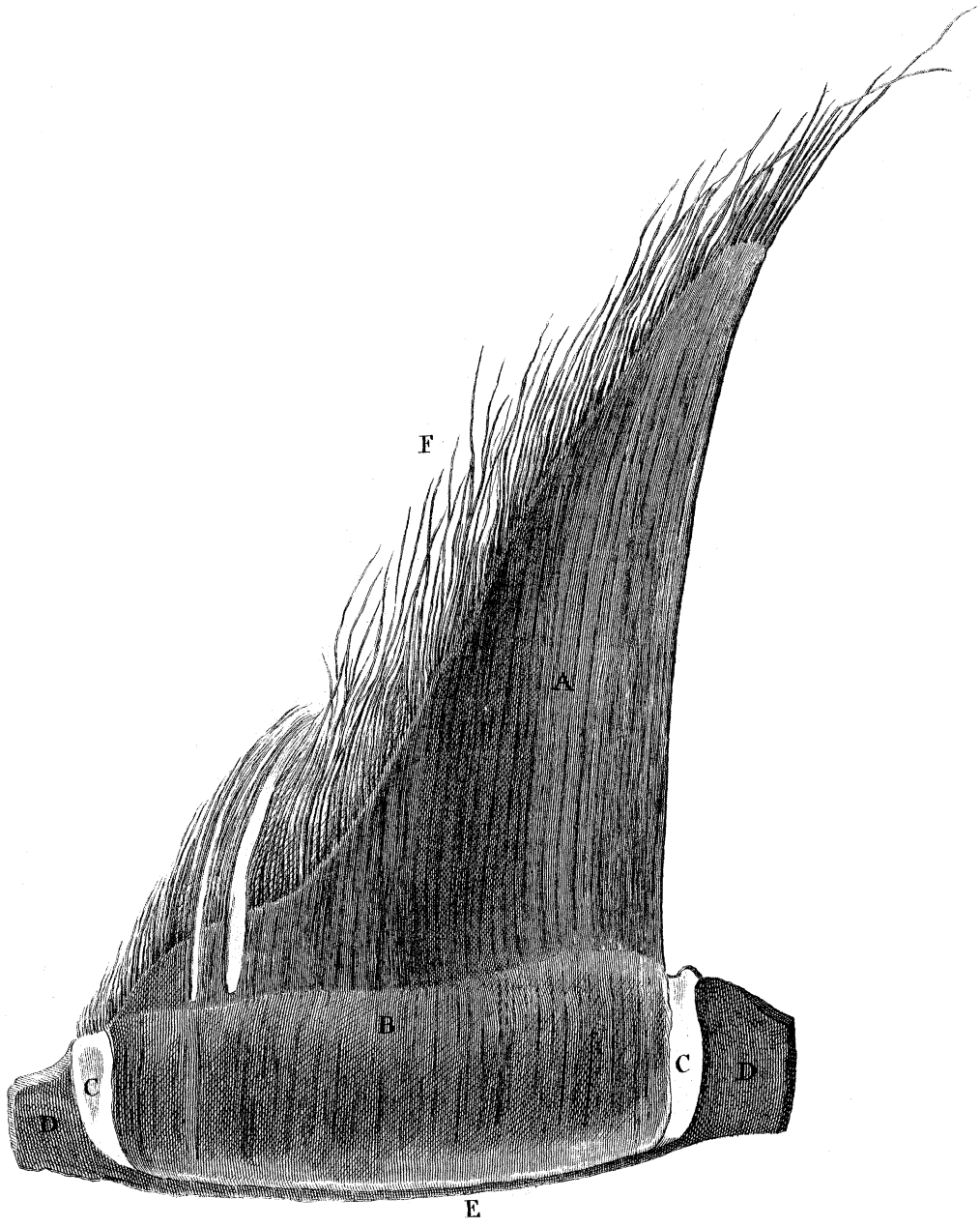
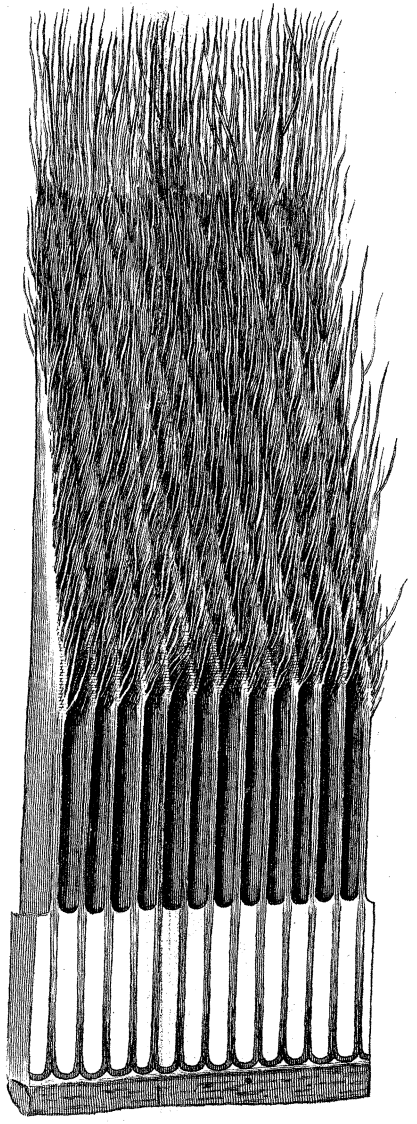

F
A
B
C
C
D
D
E

Fig. 1.



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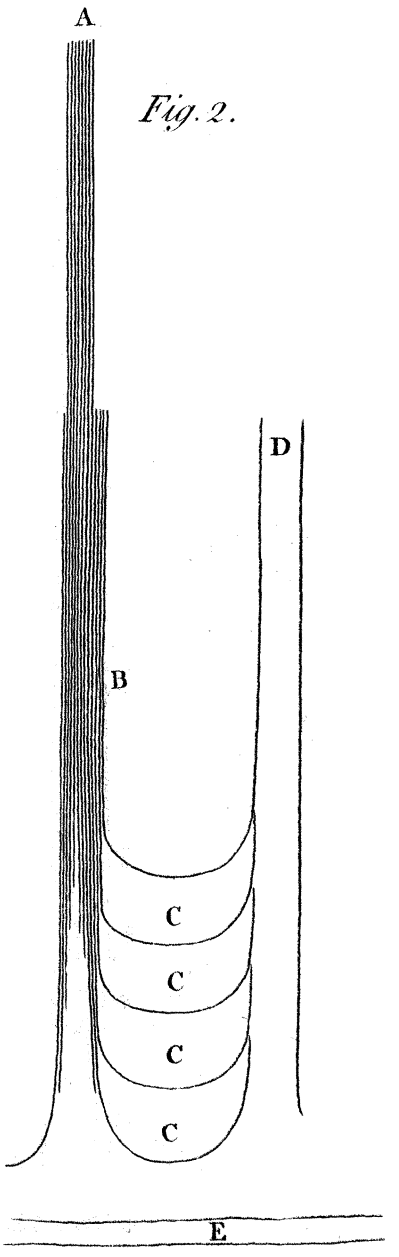


EXPLANATION OF THE PLATES.

PLATE XVI.

This fiſh is called a Grampus: it was caught in the mouth of the river Thames, in the year 1759, and brought up to Weſtminſter Bridge in a barge. It was twenty-four feet long.

PLATE XVII.

Another ſpecies of Grampus, which was caught in the river Thames, fifteen years ago. It was eighteen feet long.

PLATE XVIII.

Fig. 1. A ſpecies of Bottle-noſe Whale; the Delphinus Delphis of LINNÆUS. It was caught upon the ſea-coaſt, near Berkeley, where it had been ſeen for ſeveral days, following its mother, and was taken along with the old one, and ſent up to me whole, for examination, by Mr. JENNER, Surgeon, at Berkeley. The old one was eleven feet long.

Fig. 2. The head of the ſame Whale as fig. 1. to ſhew the ſhape of the blow-hole, which is tranſverſe, and almoſt ſemi-circular.

PLATE XIX.

The Bottle-noſe Whale deſcribed by DALE. It is ſimilar to that of Plate XVIII. in its general form, but has only two ſmall pointed teeth in the fore part of the upper jaw, and is rather lighter coloured on the belly. It was caught above

London Bridge in the year 1783, and became the property of the late Mr. Alderman PUGH, who very politely allowed me to examine its ſtructure, and to take away the bones. It was twenty-one feet long.

PLATE XX.

Fig. 1. The Balæna Roſtrata of FABRICIUS, or Piked Whale. It was caught upon the Dogger Bank. It had met with ſome accident between the two lower jaws under the tongue, in which part a conſiderable collection of air had taken place, ſo as to raiſe up the tongue and its attachments into a round body in the mouth, projecting even beyond the jaws. This rendered the head ſpecifically lighter than the water, ſo that it could not ſink, and therefore was eaſily caught.

It was ſeventeen feet long, and was brought to St. George's Fields, where I purchaſed it. The dorſal fin having been cut off cloſe to the back, is therefore only marked by a dotted line.

Fig. 2. A view of the tail, to ſhew its breadth.

PLATE XXI.

Includes the external parts of generation, with the relative ſituation of the anus and the nipples, of the Balæna Roſtrata.

Fig. 1. The labia pudendi ſpread open, expoſing the meatus urinarius, vagina, and anus, which in a natural ſtate are all concealed, there only appearing a long ſlit, the two edges of which are in contact.

AA. The labia pudendi.

B. The clitoris.

C. The meatus urinarius.

D. The

D. The opening of the vagina.

E. The anus.

Fig. 2. The ſulcus, in which the left nipple lies, ſpread open, and the nipple itſelf expoſed to view,

Fig. 3. The ſulcus of the right nipple, in a natural ſtate, only appearing like a line.

Fig. 4. A ſulcus near to the nipple, which is ſpread open to ſhew the inſide. This ſulcus, I conceive, gives a freedom to the motion of the ſkin of theſe parts, ſo as to allow the nipple to be more freely expoſed.

Fig. 5. The ſame ſulcus on the oppoſite ſide, cloſed up.

PLATE XXII.

A ſide view of one of the plates of whalebone of the Balæna Roſtrata.

A. The part of the plate which projects beyond the gum.

B. The portion which is ſunk into the gum.

CC. A white ſubſtance, which ſurrounds the whalebone, forming there a projecting bead, and alſo paſſing between the plates, to form their external lamellæ.

DD. The part analogous to the gum.

E. A fleſhy ſubſtance, covering the jaw bone, and on which the inner lamella of the plate is formed.

F. The termination of the plate of whalebone in a kind of hair.

PLATE XXIII.

Fig. 1. A perpendicular ſection of ſeveral plates of whalebone in their natural ſituation in the gum; their inner edges, or ſhorteſt terminations, are removed, and the cut edges of the plates ſeen from the inſide of the mouth.

The upper part ſhews the rough ſurface formed by the hairy termination of each plate of whalebone.

The middle part ſhews the diſtance the plates of whalebone are from each other.

The lower part ſhews the white ſubſtance in which they grow, and alſo the baſis on which they ſtand.

Fig. 2. An outline conſiderably magnified, to ſhew the mode of growth of the plates, and of the white intermediate ſubſtance.

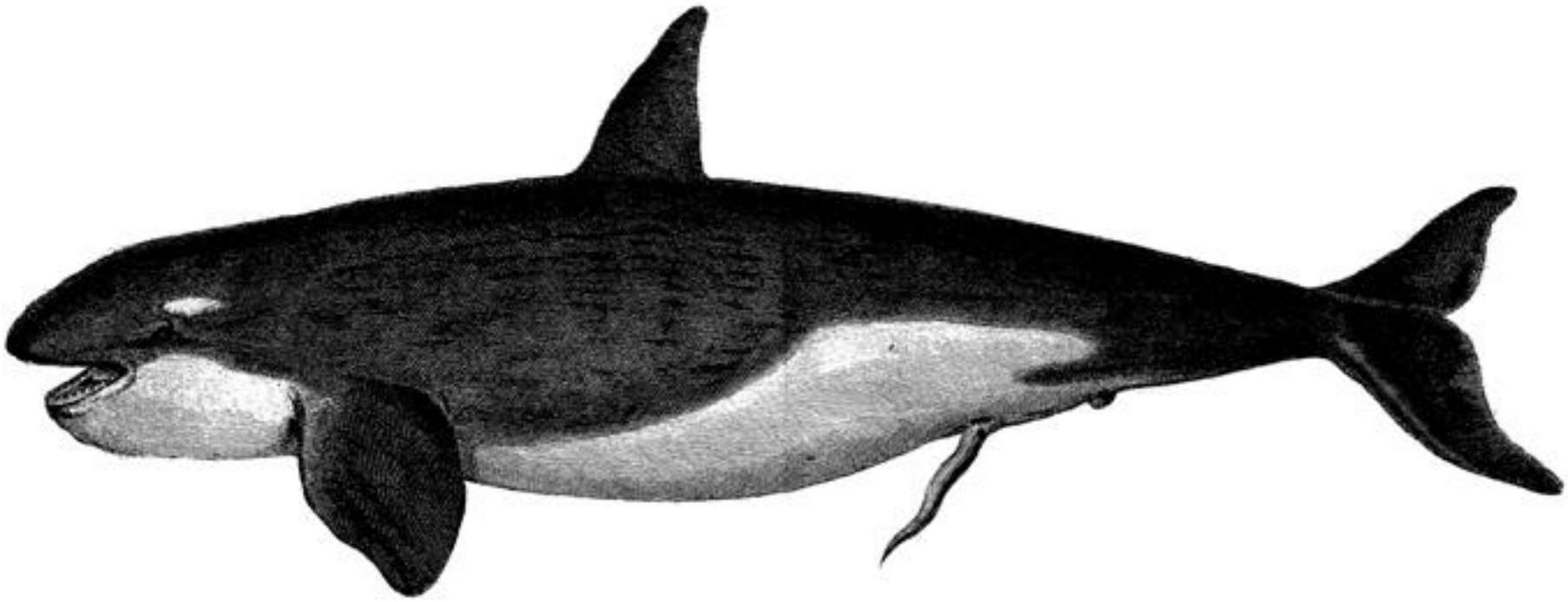
A. The middle layer of the plate, which is formed upon a pulp or cone that paſſes up in the centre of the plate. The termination of this layer forms the hair.

B. One of the outer layers, which grows, or is formed, from the intermediate white ſubſtance.

CCCC. The intermediate white ſubſtance, laminæ of which are continued along the middle layer, and form the ſubſtance of the plate of whalebone.

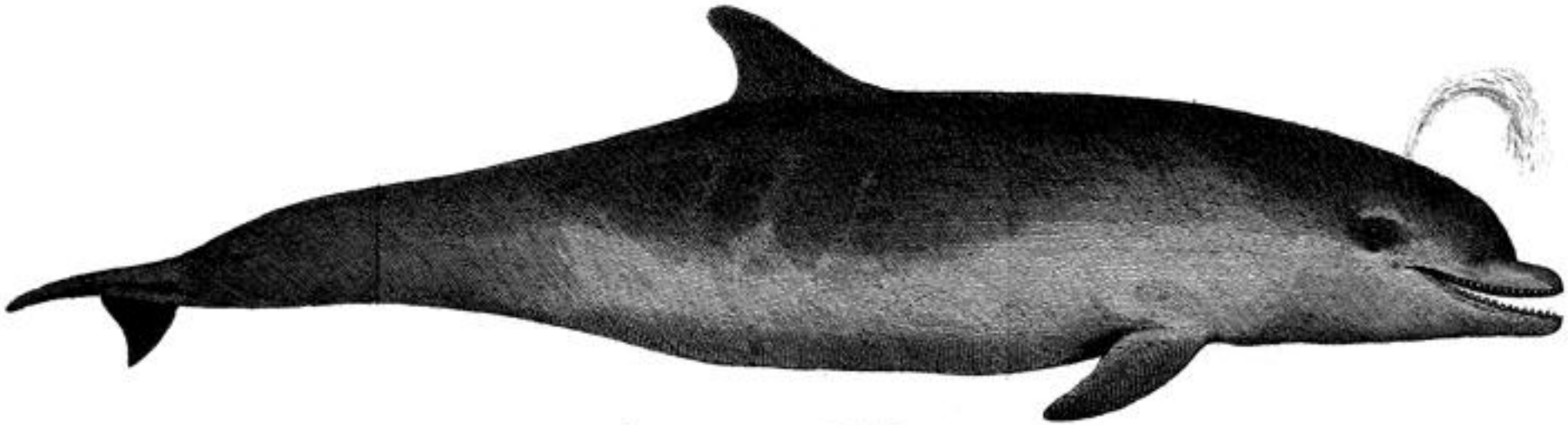
D. The outline of another plate of whalebone.

E. The baſis on which the plates are formed, which adheres to the jaw bone.



Bell. d. *Basire Sc.*

Fig. 1.



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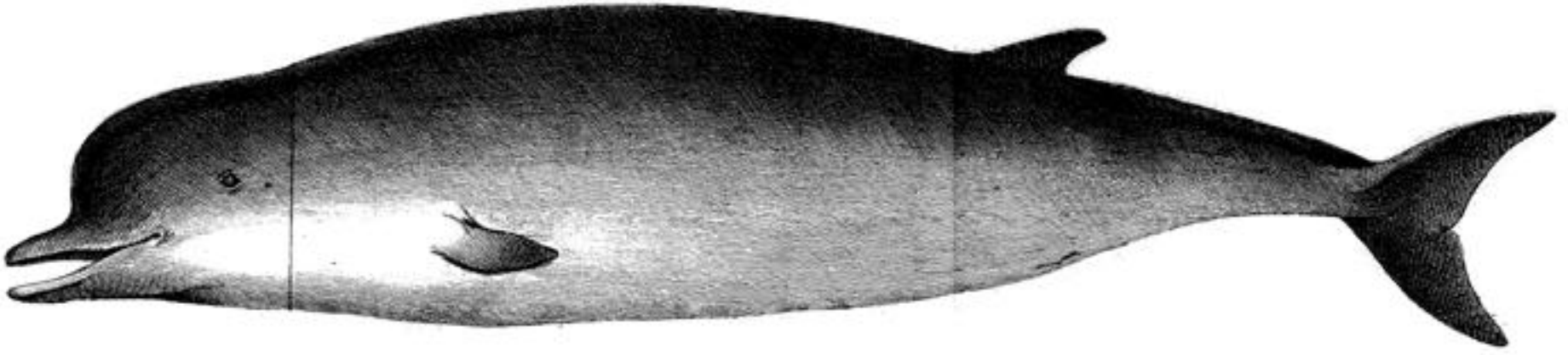
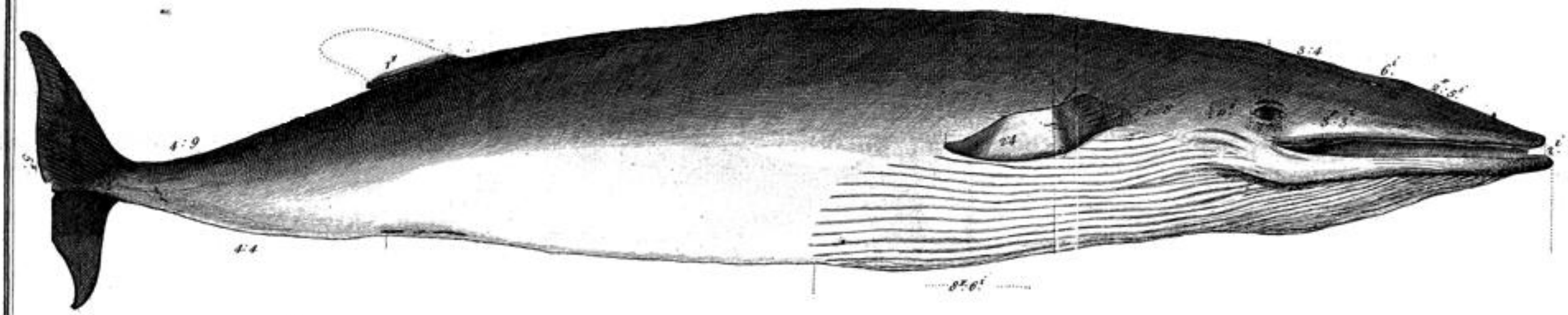


Bell. d.

Basire Sc.

	F.	I.
Whole Length	17	0
Upper Jaw from Eye to Eye	1	8
Lower Jaw	2	6
Within the Whalebone	0	10½
Greatest length of Whalebone	0	5

Fig. 1.



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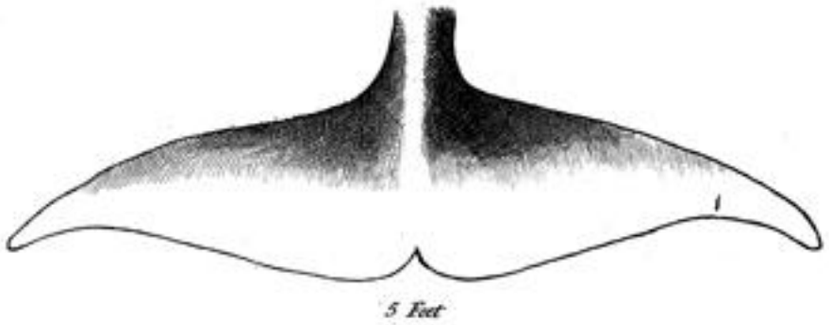

Balæna Rostrata.
Fabricius.

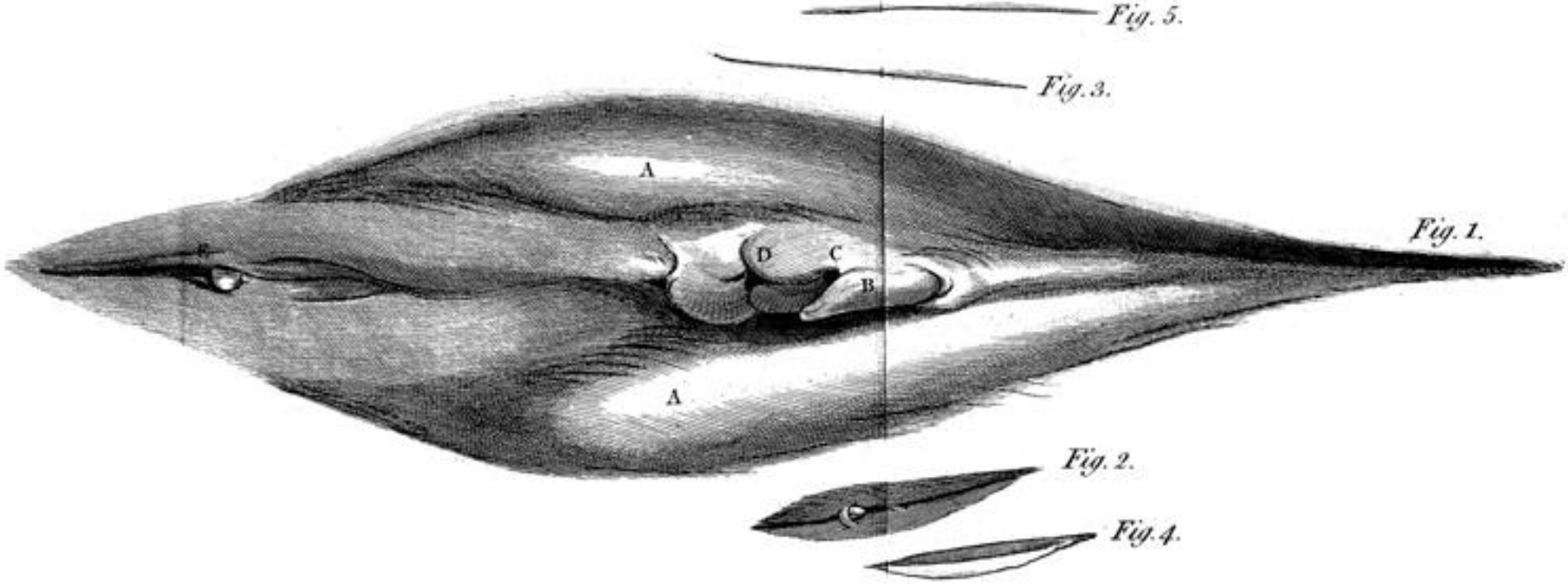
Fig. 5.
Fig. 3.
A
D
C
B
A
Fig. 1.
Fig. 2.
Fig. 4.
feet inches
1 3