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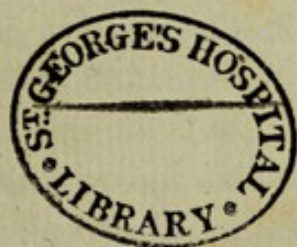
STRUCTURE AND OECONOMY

OF

W H A L E S.

By JOHN HUNTER, Esq. F. R. S.

From the PHILOSOPHICAL TRANSACTIONS.



OBSEVATIONS

STRUCTURE AND ECONOMY

H. A. J. E.

JOHN HUNTER, Esq. F.R.S.

From the Philosophical Transactions





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## OBSERVATIONS, &c.

Read at the ROYAL SOCIETY, June 28, 1787.

**T**HE 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

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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



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 oeconomy.

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 *Phyfeter 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.

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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 *Spermæceti* 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, Bottlenose, 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 supercedes 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,



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 useles 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 itself being small.

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

The tongue is flat, and but little projecting, as they neither have voice, nor require much action of this part, in applying the food between the teeth for the purpose of mastication, or deglutition, being nearly similar to fish in this respect, as well as in their progressive motion.

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

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

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

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



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

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bones,



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.

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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



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.

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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 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  
and



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-

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stallise,



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.

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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



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  
has



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 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 constitutes



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.

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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



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 carnivorous



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 stomach.



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



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 entirely 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, Raccoon, 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 kidneys 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 fulcus 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

G

branches



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



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 entirely 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,



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 fulci 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 fulci 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 fulcus, 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.

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These



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 opti-  
corum. 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 opti-  
corum, 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



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 oeconomy 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 bone.

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



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



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 axes; but forwards, near the cornea, the sclerotic coat turns quickly in, to meet the cornea, which makes this part of the cavity extremely flat, and renders the distance between the anterior part of the sclerotic

K

rotic



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 suppose 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 feminales* 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 *corpus*



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 fulcus. The skin and parts on each side of this fulcus 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 ostiæ; 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



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.

EXPLANATION OF THE PLATE. The figure represents the common shape of the animal, and shows a principal part, namely the mouth, through the whole length of the body, and collecting the smaller lateral ducts, which are made up of these small tubes. Some of these lateral branches enter the common trunk in the division 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 trunk which include the nipple, are composed of parts which in texture resemble the common adipose membrane, which is probably to admit of the elongation or projection of the



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

L London



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.

## P L A T E   X X .

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.

## P L A T E   X X I .

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 fulcus, in which the left nipple lies, spread open, and the nipple itself exposed to view.

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

Fig. 4. A fulcus near to the nipple, which is spread open to shew the inside. This fulcus, 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 fulcus on the opposite side, closed up.

P L A T E 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 furrounds 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.

P L A T E 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



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, laminae 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.

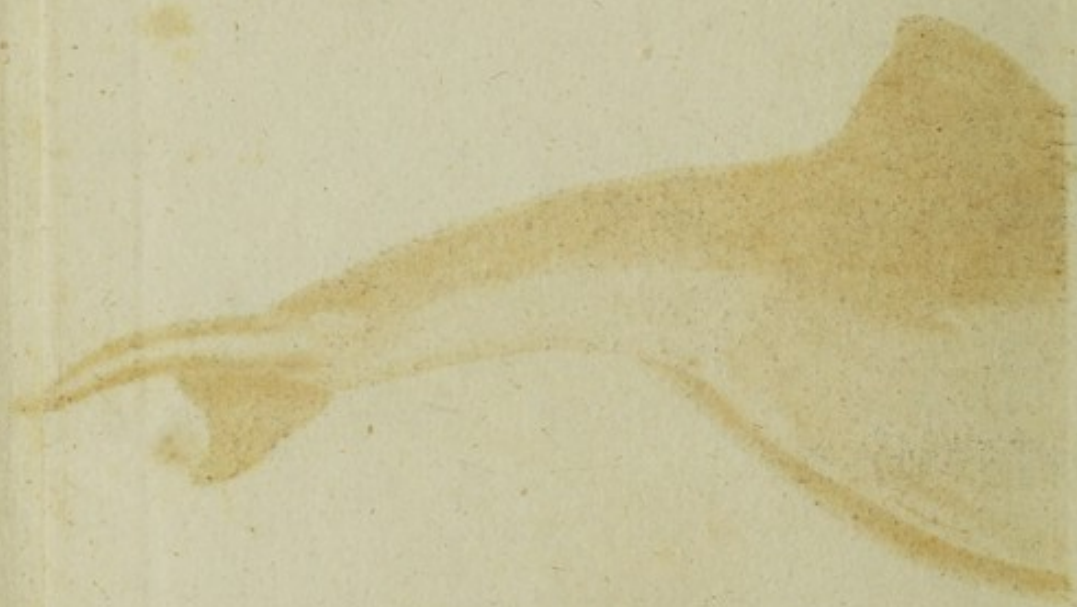


Fig. 1. A perpendicular section of several plates of whalebone in their natural situation in the gum; their inner edges or shortest terminations, are removed, and the cut edges of the plates seen from the inside of the mouth.





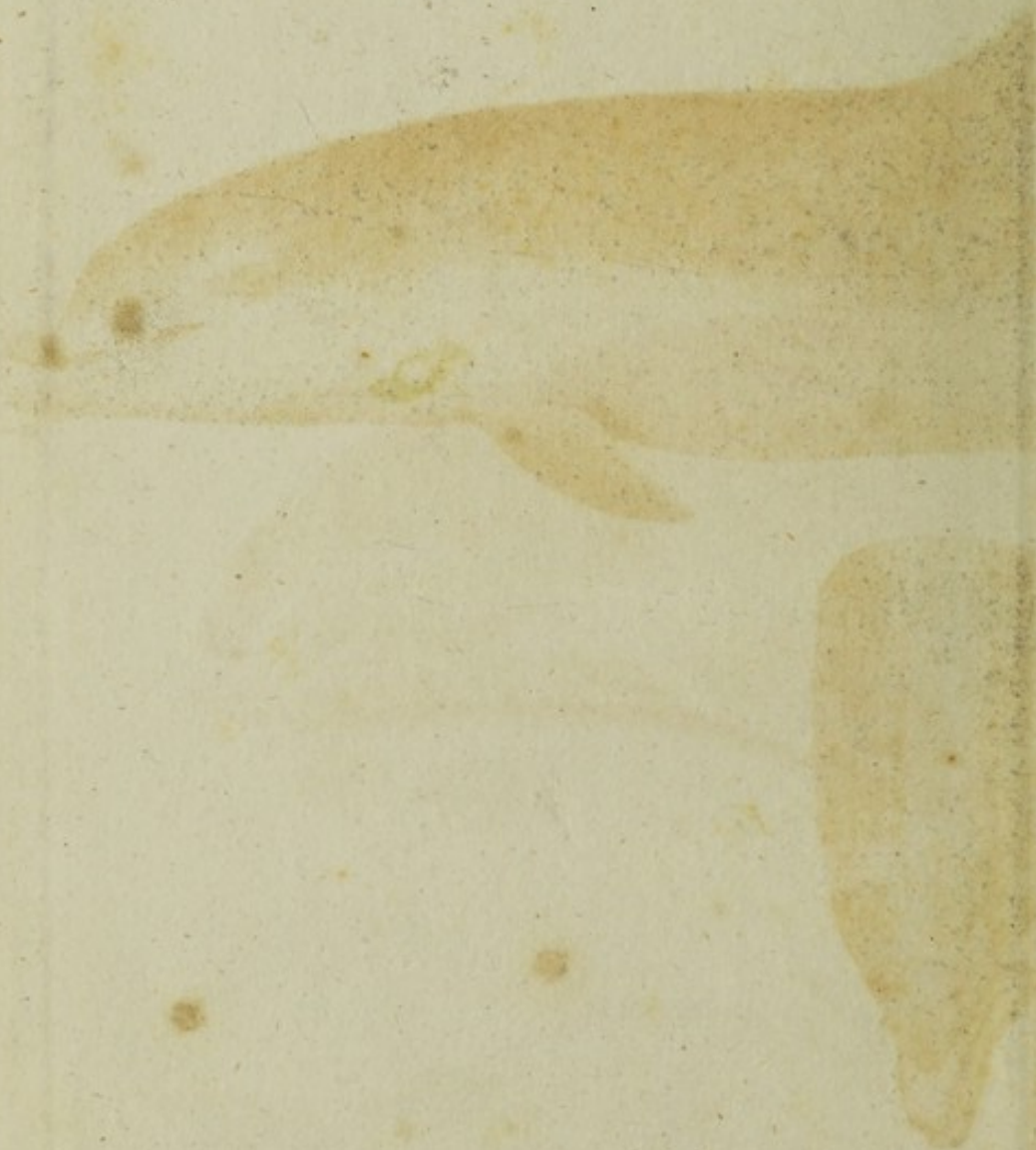














*Fig. 1.*



*Fig. 2.*



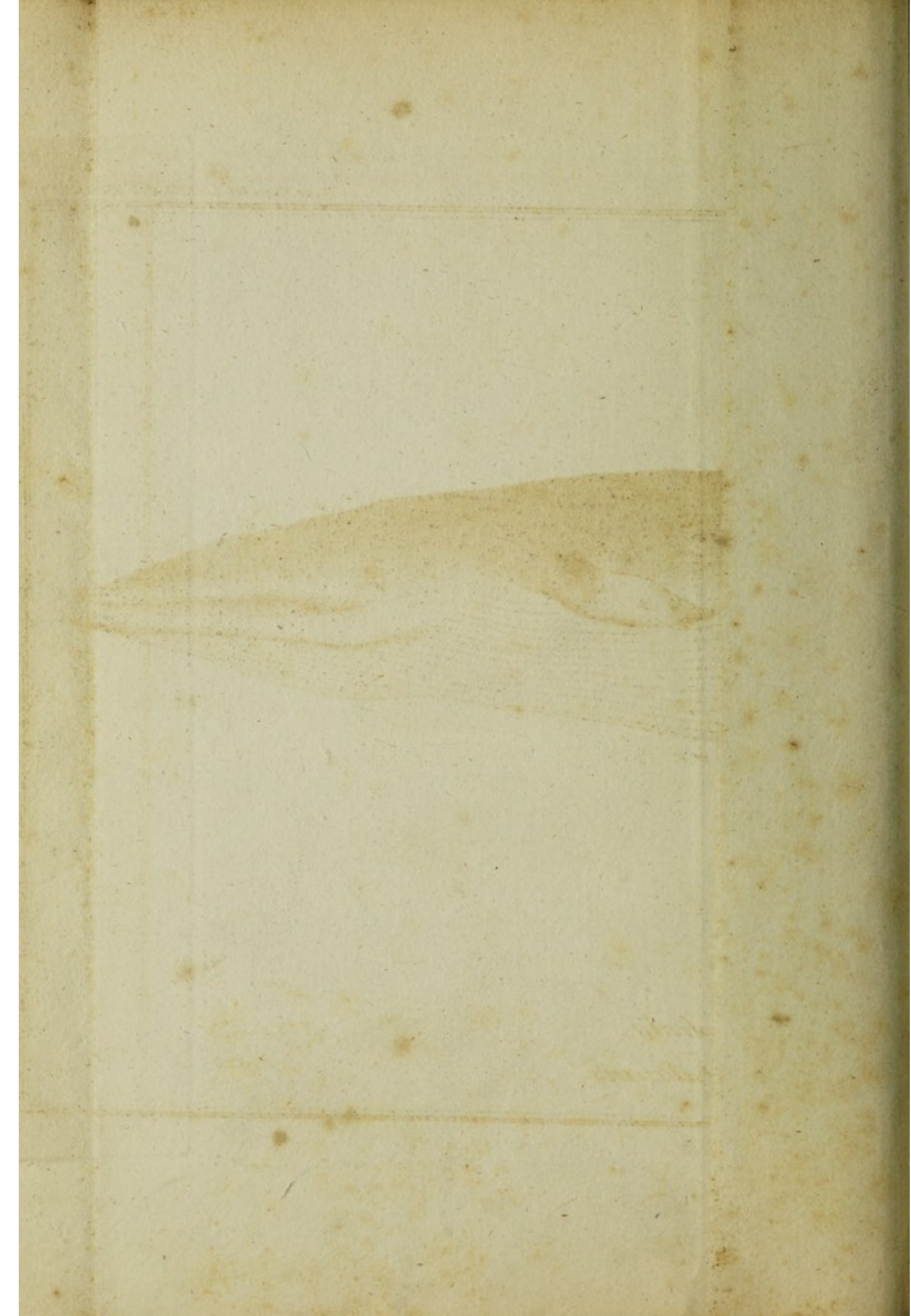














Whole Length..... $\frac{27}{17}$  6  
 Upper Jaw from Eye to Eye.....1 : 8  
 Lower Jaw.....2 : 6  
 Within the Whalebone.....0 : 10 $\frac{1}{2}$   
 Greatest length of Whalebone...0 : 5

Fig. 1.



Fig. 2.

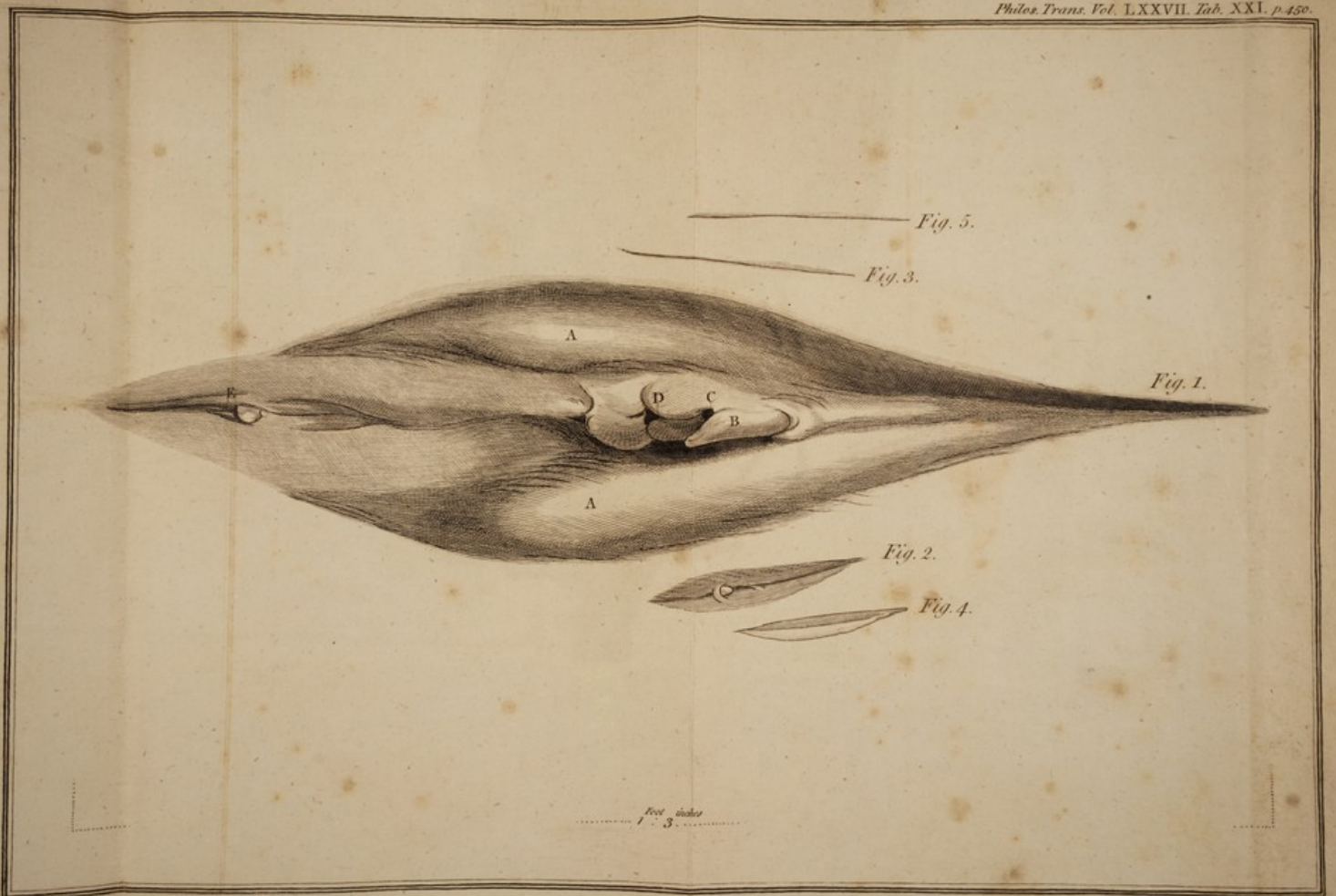


*Balæna Rostrata.*  
*Fabricius.*















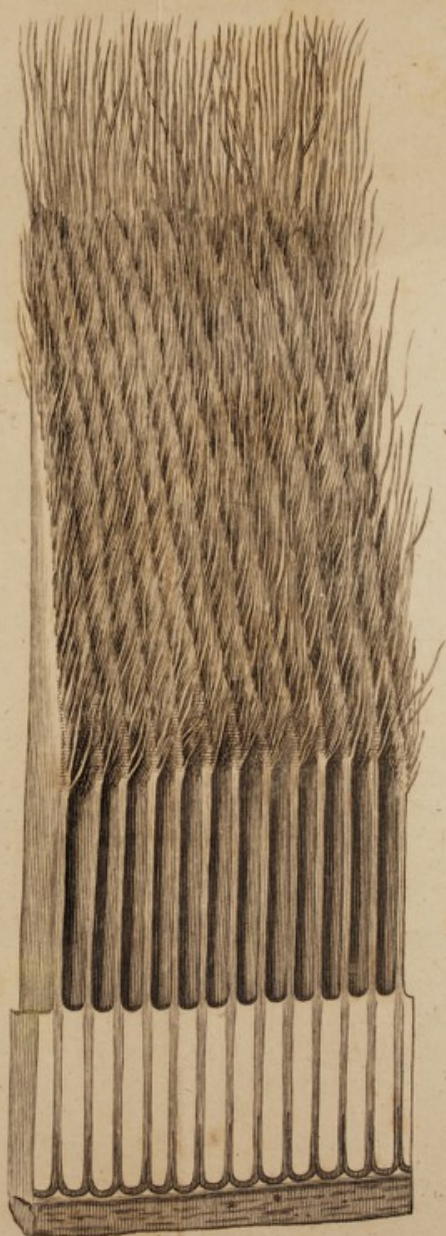








*Fig. 1.*



*Fig. 2.*

