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XXIII. *Observations upon Animals, commonly called Amphibious by Authors. Presented by Dr. Parsons, F. R. S.*

Read June 26, 1766. **T**HE following remarks, which I have the honour to lay before this learned Society, were occasioned by a conversation that passed between me and a gentleman well acquainted with natural history, however mistaken in the subject before us. His opinion was, that amphibious animals lived more in the water than on the land: but I believe the contrary will appear by the sequel of this treatise.

If we consider the words ἀμφί and βίωσις, from which the term amphibious is derived; we should understand that animals, having this title, should be capable of living as well by land or in the air, as by water, or of dwelling in either constantly at will; but it will be difficult to find any animal that can fulfil this definition, as being equally qualified for either; and in classing creatures of this kind, authors are much divided and sometimes mistaken.

Now if any natural historian should deduce his distinction of this class, from the structure or characteristic of any part of the animal, I think he would be a little out of the way; because the term comprehends nothing but what regards its living in both air and water at discretion; however, since the word

amphibious is adopted by the writers of the history of animals, let us retain it still, and examine some of this class, and, by considering their natural œconomy respectively, endeavour to range them according to that standard in the following manner. They are such as :

1. Enjoy their chief functions by land, but occasionally go into the water.

2. Such as chiefly inhabit the water, but occasionally go a shore. Of the latter there are but very few species. And although none of the winged tribe are to be ranged under this class, yet as many of them remain long upon the water, in search of their proper food, we shall enumerate some peculiar advantages, which have been allowed to several of them by the bountiful wisdom of the Creator, in order to render them the more able to obtain it; and this will make one curious part of my present purpose, not generally known.

The dispute mentioned between my friend and me, turned upon the class of the phocæ, which consists of a very numerous tribe of different species: I shall therefore endeavour to shew that none of them can live chiefly in the waters, but that their chief enjoyment of the functions of life is on shore.

These animals are really quadrupeds; but, as their chief food is fish, they are under a necessity of going out to sea to hunt their prey, and to great distances from shore; taking care that, how ever great the distance, rocks or small islands are at hand, as resting places when they are tired, or their bodies become too much macerated in the water; and they return to the places of their usual resort to sleep, copulate, and bring

bring forth their young, for the following reasons, viz. It is well known that the only essential difference (as to the general structure of the heart) between amphibious and meer land animals, or such as never go into the water, is that in the former the oval hole remains always open. Now, in such as are without this hole, if they were to be immersed in water for but a little time, respiration would cease, and the animal must die; because a great part of the mass of blood passes from the heart, by the pulmonary artery, through the lungs, and by the pulmonary veins returns to the heart; while the aorta is carrying the greater part of the mass to the head and extremities, &c.

Now the blood passes through the lungs in a continual uninterrupted stream, while respiration is gentle and moderate; but when it is violent, then the circulation is interrupted, for inspiration and expiration are now carried to their extent; and in this state the blood cannot pass through the lungs either during the total inspiration or total expiration of the air in breathing; for in the former case the inflation compresses the returning veins, and in the latter, by the collapse of the lungs, these veins are interrupted also, so that it is only between these two violent actions that the blood can pass: and hence it is that the lives of animals are shortened, and their health impaired, when they are subjected to frequent violent respiration; and thus it is that in animals who have once breathed, they must continue to respire ever after; for life is at an end when that ceases.

There are three necessary and principal uses of respiration in all land animals, and in these kinds that are counted amphibious; the first is that of promoting

the circulation of the blood through the whole body and extremities ; in real fishes, the force of the heart is alone capable of sending the blood to every part, as they are not furnished with limbs or extremities ; but in the others mentioned, being all furnished with extremities, respiration is an assistant force to the arteries in sending blood to the extremities, which, being so remote from the heart, have need of such assistance ; otherwise the circulation would be very languid in these parts ; thus we see, that in persons subject to asthmatic complaints, the circulation grows languid, the legs grow cold and oedematous, and other parts suffer by the defect in respiration.

A second use of breathing is that, in inspiration, the variety of particles of different qualities, which float always in the air, might be drawn into the lungs, to be insinuated into the mass of blood, being highly necessary to temperate and cool the agitated mass, and to contribute refined pabulum to the finer parts of it, which, meeting with the daily supply of chyle, serves to assimilate and more intimately mix the mass, and render its constitution the fitter for supporting the life of the animal. Therefore it is, that valetudinarians, by changing foul or unwholesome air for a free, good, open air, often recover from lingering diseases.

And a third principal use of respiration is, to promote the exhibition of a voice in animals ; which all those that live on the land do according to their specific natures.

From these considerations it appears, beyond contradiction, that the phocæ of every kind are under an absolute necessity of making the land their principal residence ; but there is another very convincing argument

argument why they reside on shore the greatest part of their time, and that is, that the flesh of these creatures is analogous to that of other land animals; and therefore, by over-long maceration, added to the fatigue of their chasing their prey, they would suffer such a relaxation as would destroy them. It is well known that animals, which have lain long under water, are reduced to a very lax and even putrid state; and the phoca must bask in the air on shore; for while the solids are at rest, they acquire their former degree of tension, and the vigour of the animal is restored; and while he has an uninterrupted placid respiration, his blood is refreshed by the new supply of air, as I have explained it above, and he is rendered fit for his next cruise: for action wastes the most exalted fluids of the body, more or less, according to its duration and violence; and the restorative rest must continue a longer or shorter time, according to the quantity of the previous fatigue.

Let us now examine by what power these animals are capable of remaining longer under water than land animals.

All these have the oval hole open, between the right and left auricles of the heart, and, in many, the canalis arteriosus also: and while the phoca remains under water, which he may continue an hour or two more or less, his respiration is stopped, and the blood, not finding the passage through the pulmonary artery free, rushes through the hole from the right to the left auricle, and partly through the arterial canal, being a short passage to the aorta, and thence to every part of the body, maintaining the circulation: but, upon rising
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to come ashore, the blood finds its passage again through the lungs the moment he respire.

Thus the fœtus in utero, during his confinement, having the lungs compressed, and consequently the pulmonary arteries and veins impervious, has the circulation of the blood carried on through the oval hole and the arterial canal; now so far the phoca in the water and the fœtus in utero are analogous; but they differ in other material circumstances: one is, that the fœtus, having never respired, remains sufficiently nourished by the maternal blood circulating through him, and continues to grow till the time of his birth, without any want of respiration during nine months confinement; the phoca, having respired the moment of his birth, cannot live very long without it, for the reasons given before; and this hole and canal would be closed in them, as it is in land animals, if the dam did not, very soon after the birth of the cub, carry him into the water to teach him, so very frequently; by which practice these passages are kept open during life; otherwise they would not be capable of attaining the food designed for them by providence.

Another difference is, that the phoca, as I said before, would be relaxed by maceration in remaining too long in the water; whereas the fœtus in utero suffers no injury from continuing its full number of months in the fluid he swims in: the reason is; that water is a powerful solvent, and penetrates the pores of the skins of land animals, and in time can dissolve them; whereas the liquor amnii is an insipid soft fluid, impregnated with particles more or less mucilaginous, and utterly incapable of making the least alteration in the cutis of the fœtus.

Otters, beavers, and some kinds of rats, go occasionally into the waters for their prey, but cannot remain very long under water; I have often gone to shoot otters, and watched all their motions; I have seen one of them go softly from a bank into the river, and dive down, and in about two minutes rise, at ten or fifteen yards from the place he went in, with a midling salmon in his mouth, which he brought on shore; I shot him, and saved the fish whole. Now, as all fœtuses have these passages open, if a whelp of a true water-spaniel was, immediately after its birth, served as the phoca does her cubs, immersed in water, to stop respiration for a little time every day, I make no doubt but the hole and canal would be kept open, and the dog be made capable of remaining as long under water as the phoca.

Frogs, how capable soever of remaining in the water, yet cannot avoid living on land, for they respire; and if, as I have often done, a frog be thrown into a river, he makes to the shore as fast as he can.

The lizard kind, such as may be called water lizards, or *lacertæ aquaticæ*, all are obliged to come to land and deposit their eggs, rest, and sleep; even the crocodiles, who dwell much in rivers, sleep and lay their eggs on shore; and, while in the water, are compelled to rise to the surface to breathe; yet, from the texture of his scaly covering, he is capable of remaining in the water longer by far than any species of the phocæ, whose skin is analogous to that of a horse or cow.

The hippopotamus, who wades into the lakes or rivers, is a quadruped, and remains under the water a considerable

considerable time; yet his chief residence is upon land, and he must come on shore for respiration.

The testudo, or sea-tortoise, though he goes out to sea, and is often found far from land; yet, being a respiring animal, cannot remain long under water. He has indeed a power of rendering himself specifically heavier or lighter than the water, and therefore can let himself down to avoid an enemy or a storm; yet he is under a necessity of rising frequently to breathe, for reasons given before: and his most usual situation, while at sea, is upon the surface of the water, feeding upon the various substances that float in great abundance every where about him; these animals sleep securely upon the surface, but not under water, and can remain longer at sea than any others of this class, except the crocodile, because, as it is with the latter, his covering is not in danger of being too much macerated; yet they must go on shore to copulate and lay their eggs.

The consideration of these is sufficient to inform us of the nature of the first order of the class of amphibious animals; let us now see what is to be said of the second in our division of them, which are such as chiefly inhabit the waters, but occasionally go on shore.

These are but of two kinds: the eels and water-serpents, or snakes of every kind. It is their form that qualifies them for loco-motion on land, and they know their way back to the water at will; for by their structure they have a strong peristaltic motion, by which they can go forward at a pretty good rate, whereas, all other kinds of fish, whether vertical or horizontal, are incapable of a voluntary loco-motion on

shore ; and therefore, as soon as such fish are brought out of the water, after having flounced a while, they lye motionless, and soon die.

Let us now examine into the reason why these vermicular fish, the eel and serpent kinds, can live a considerable time on land, and the vertical and horizontal kinds die almost immediately, when taken out of the water : and, in this research, we shall come to know what analogy there is between land animals and those of the waters. All land animals have lungs, and can live no longer than while these are inflated by the ambient air, and alternately compressed for its expulsion ; that is, while respiration is duly carried on, by a regular inspiration and expiration of air.

In like manner, the fish in general have, instead of lungs, gills, or branchiæ ; and, as in land animals, the lungs have a large portion of the mass of blood circulating through them, which must be stopped if the air has not a free ingress and egress into and from them ; so, in fish, there is a great share of blood vessels that pass through the branchiæ, and a great portion of their blood circulates through them, which must in like manner be totally stopped, if the branchiæ are not kept perpetually wet with water ; so that, as the air is to the lungs, in land animals, a constant assistant to the circulation, so is the water to the branchiæ of those of the rivers and seas ; for when these are out of the water, the branchiæ very soon grow crisp and dry, the blood vessels are shrunk, and the blood is obstructed in its passage ; so, when the former are immersed in water, or otherwise prevented having respiration, the circulation ceases, and the animal dies.

Again, as land animals would be destroyed by too much maceration in water, so fishes would, on the other hand, be ruined by too much exsiccation; the latter being, from their general structure and constitution, made fit to bear, and live in, the water; the former, by their constitution and forms, to breathe, and dwell, in the air.

But it may be asked, why eels and water snakes are capable of living longer in the air than the other kinds of fish? this is answered, by considering the providential care of the great Creator for these and every one of his creatures: for, since they were capable of locomotion by their form, which they need not be if they were never to go on shore, it seemed necessary that they should be rendered capable of living a considerable time on shore, otherwise their locomotion would be vain. How is this provided for? why in a most convenient manner; for this order of fishes have their branchiæ well covered from the external drying air, and are also furnished with a slimy mucus, which hinders their becoming crisp and dry for many hours, and their very skins always emit a mucous liquor, which keeps them supple and moist for a long time; whereas the branchiæ of other kinds of fish are much exposed to the air, and want the slimy matter to keep them moist. Now, if, when any of these is brought out of the water, it was laid in a vessel without water, he might be kept alive a considerable time, by only keeping the gills and surface of the skin constantly wet, even without any water to swim in.

Before I dismiss the first part of my discourse, I must beg your patience, while I mention something that relates to a family among the fish kinds, which is
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of a middle nature between the phocæ, and the real fishes of the sea, in one peculiar respect. This is the class of the phocenæ, or porpeffes, of which there are several species; and these have lungs, and therefore are forced to come up to the surface to breathe at very short intervals; but, when brought on shore, have no progressive loco-motion. So that, having lungs, they resemble the phocæ, and, in every other respect, the real fishes of the sea.

Blasius, in his *Anatome Animalium*, page 288, gives an account of one of these taken and brought on shore alive; the people let him lye, to see how long he could live out of the water; and he continued alive only about seven or eight hours, and exhibited a kind of hissing voice.

From what has been said, it will, I hope, appear rational, that these are the only two orders, that can properly be deduced from the class of Amphibious animals; and that the genus's of either order are very few in the animal world.