

IX. *On the Gizzards of Grazing Birds.* By Everard Home,
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Read April 4, 1810.

IN the course of my enquiries into the various modes in which the food in different animals is prepared for digestion, many circumstances have been met with, which tend to shew, that grass is the substance of all others, on which animals feed, that requires the most preparation ; and that ruminating animals are fitted by nature in an eminent degree, for extracting the greatest possible quantity of nourishment from this species of food.

If we examine the means employed by quadrupeds of this description, it will appear, that the grass in the first instance is broken short off from the ground and swallowed ; then macerated with the mass that had previously undergone some preparation in the first stomach, and afterwards a part of the whole of this mixture, before it is digested, is brought back into the mouth, there masticated in a particular manner ; not as in the elephant and horse, or those nearest allied to them, but by being obliquely cut into smaller portions and then mixed up with the saliva into pellets, which are conveyed through the third stomach into the fourth, for the purpose of digestion. This is a mode of preparation peculiar to ruminants, no other quadruped being provided with all the same means.

Finding so marked a peculiarity in all the organs connected

with digestion, in those animals who naturally live wholly on grass, I was led to consider that as some birds graze, there must in them be peculiarities in the form of their gizzards, to fit them for digesting this particular kind of food, by which they may readily be distinguished from the gizzards of other birds.

With this view, I examined the gizzards of the goose and swan, who are both in the habit of grazing, (though geese more constantly so,) and compared their structure with that of the turkey, a bird nearly of the same size, whose food is of a different kind.

To make this comparison more correct and satisfactory, a goose's and a turkey's gizzard were moderately filled with plaister of Paris, and then boiled; by this means the cavity was kept open, and the course of the muscular fibres very readily traced.

In the turkey, the external surface was first attentively examined, viewing that side which is anterior in the living bird, and on which the two muscles and middle tendon are most distinct, there being no other part to obstruct the view; while on the opposite side there is the opening of the pylorus, and the bag formed by the lower portion of the gizzard beyond the circumference of the muscles.

In this view, the muscle on the left side is distinctly larger than that on the right, as will be seen in the annexed drawing. This appears on reflection to be a great advantage in producing the necessary motion; for if the two muscles were of equal strength, they must keep up a greater degree of exertion than is necessary; while in the present case, the principal effect is produced by the left side, and a smaller force is used by the right, to bring the parts back again.

The muscles when dissected, are found to be composed of fasciculi of fibres, connected together by a loose cellular membrane, so as to appear like so many separate muscles lying parallel to each other. They all arise from the anterior strong flat tendon, and are inserted into that on the posterior surface ; as they are very numerous and require a large surface of insertion, part of them, on a superficial examination, appear to be lost on the internal membrane of the gizzard.

These muscles by their alternate action produce two effects ; the one a constant friction on the contents of the cavity, the other a pressure upon them. This last arises from the swell of the muscle inwards, which readily explains all the instances which have been given by SPALLANZANI and others, of the force of the gizzard upon substances introduced into it ; which force is found, by their experiments, always to act in an oblique direction.

The internal cavity, when opened in this distended state, is of an oval form ; the long diameter in the line of the body : its capacity nearly equal to the size of a pullet's egg, and there are, laterally, ridges in the horny coat, in the long direction of the oval.

When the horny coat is examined in its internal structure, the fibres of which it is formed, are not found in a direction perpendicular to the ligamentous substance behind it, but in the upper portion of the cavity they have a direction obliquely downwards, and in the lower portion obliquely upwards.

From this form of cavity it is evident, that no part of the sides are ever intended to be brought in contact ; and that the food is triturated by being mixed with hard bodies, and acted on by the powerful muscles which form the gizzard.

In the goose, the gizzard differs very much in its external form, from that of the turkey; being oval in its transverse direction, and having the lateral edges very thin; this arises from the fasciculi of fibres of both muscles being more numerous than in the turkey. The disproportion between the left muscle and the right, is still greater than in the turkey, and when the cavity is opened it is flat, divided into two equal portions; that on the right side convex above, forming a projection into the cavity, and concave below, forming a hollow. On the left side there is a corresponding surface, only that the concavity is above, answering to the convex part opposite; and a convexity below, fitted to the opposing concavity.

The horny covering of these surfaces is very strong, much more so than in the turkey, and when the structure is examined, the direction of its fibres is oblique; on the right side from above downwards, and on the left side from below upwards.

In the swan, the gizzard is altogether larger than in the goose, and more flattened at the external edge, so that the muscular fibres are shorter; on its internal cavity the appearances are nearly the same, but there is a less strongly marked ridge and concavity, and the surface of the oval portion, in which these are met with, is smaller in size. The substance of that part of the gizzard appears to be less dense, but the cuticular covering is thicker, and its fibrous texture more conspicuous. The direction of the fibres is exactly the same as in the goose.

From this construction of cavity it is evident, that these two corresponding surfaces are intended to move on one another,

with little more than the food between them; the hard substances interposed, being only of a small size, so as not to interfere with their regular correspondence with each other.

In these gizzards there is not the rotatory motion mentioned in the turkey, but a regular sliding motion, begun by the strong muscle forcing one side of the horny substance over the surface of the other; and it is brought back by the action of the weaker.

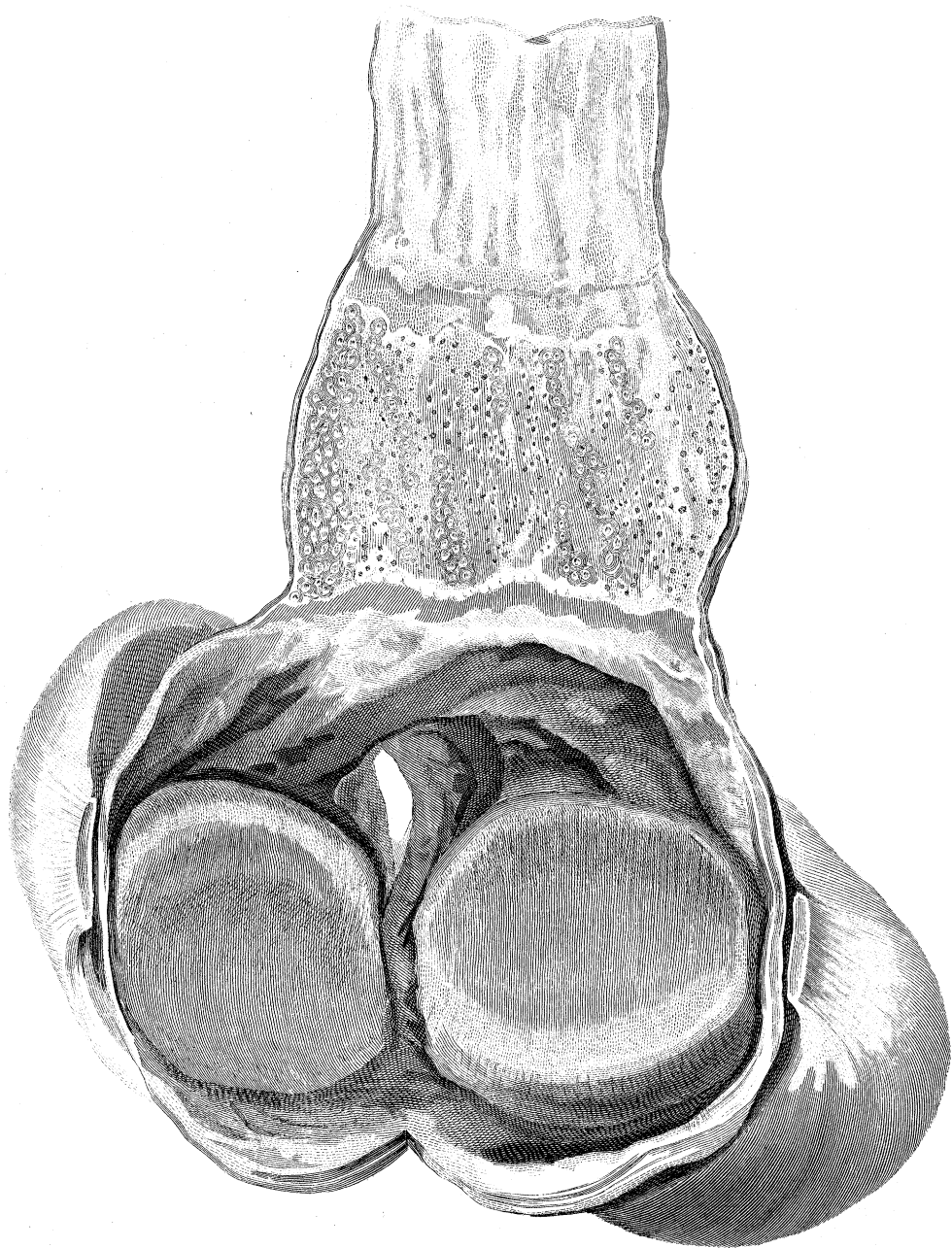
This motion bears so great a resemblance to that of the grinding teeth of ruminating animals, in which the teeth of the under jaw slide upwards, within those of the upper, pressing the food between them, and fitting it by this peculiar kind of trituration for being digested; that it is fair to conclude, it is for the same purpose, more especially, when we only find it in those birds that graze.

The gizzard of the goose is evidently fitted for a harsher kind of grass than that of the swan, and we find that the goose prefers the common grass of the fields, while the swan is partial to the soft weed found in ponds and rivers, and only grazes occasionally.

The bill of the goose breaks off the grass short from the ground, nearly in the same manner as the fore teeth of ruminants. In like manner as ruminants have only teeth in the under jaw, so has the goose small pointed cuticular teeth in the lower portion of the bill, which, when the bill is closed, fit into grooves in the upper one, so that the grass inclosed in the space between the teeth and grooves, is nipped off.

There is a swell in the lower part of the oesophagus in these birds, which is peculiar to them: this answers the purpose of a reservoir, in which the grass is retained, macerated,

Fig. 2.



and mixed with the secretions poured out by the glandular surfaces surrounding it, in this respect corresponding to the first and second stomach of ruminating animals, in which the grass is prepared for mastication.

These facts, as they account for the goose and swan living upon a species of food not fitted for birds in general, proves that in this class of animals, a peculiar conformation of the digestive organs is required, as well as in quadrupeds, when they are intended by nature to live intirely upon grass.

This fact being ascertained, is not without its importance in elucidating this branch of physiological inquiry.

EXPLANATION OF THE PLATE.

Fig. 1. The gizzard of a turkey laid open on its anterior part, to shew the form of the internal cavity, which is oval, and the grinding surfaces uniformly concave.

Fig. 2. The gizzard of a swan exposed in the same way ; the grinding surfaces have an oval form, but in an opposite direction to those of the turkey, and each of them is made up of a ridge and a hollow in the direction of the oval, which are adapted to those of the opposite side, the ridge of the one fitting the hollow of the other.