ABILITY OF THE OYSTERCATCHER TO OPEN OYSTERS, AND ITS BEARING UPON THE HISTORY OF THE SPECIES.

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THE experiment, which is described in the present paper, was made with the object of determining the ability of the Oystercatcher (*Hæmatopus o. ostralegus*) to open oysters. The problem arose as a continuation of field-work on the Oystercatcher, and also as a result of the contradictory statements found in the literature of the subject. Of the success of the experiment there is ample evidence of a circumstantial nature. Unfortunately, owing to the persistent shyness of the birds, the actual opening of an oyster could not be observed. But I was able for over an hour to watch one bird make numerous attempts to open the shells.

In 1731 Catesby reported that, in his belief, the Oystercatcher, which he found in the estuaries of Carolina, fed "principally, if not altogether," upon the oyster and that the stomach of one bird which he examined contained "nothing but undigested oysters." Catesby's discovery was confirmed by Audubon (1835), who observed through a telescope the birds feeding upon the contents of oysters, and more recently by Fleisher (1920), who has furnished details from his observations sufficient to prove that the oyster is the principal food of the Oystercatcher on the shores of North Carolina. There the birds frequent the intertidal clumps of oysters, and open the smaller oysters on the edges of the clumps (Fleisher, *in litt.* See *Brit. Birds*, XIV., 215). No one in America, however, appears to have published anything on the mode of opening the shells, nor does anyone seem to have witnessed the act, with the exception of Audubon, who, it seems, was unfortunate enough only to see the birds feeding upon the contents of sun-dried and gaping shells.

The Oystercatcher, to which these observations refer, is a subspecies of *Hæmatopus ostralegus* (*H. o. palliatus*). In the time of Catesby, and for long afterwards, the American Oystercatcher was regarded as identical with the European form, which is now separated as *H. o. ostralegus*. Possibly, the assumed identity of these two forms was the cause, in part at least, of European writers including the oyster in their food-lists of the European Oystercatcher. But there is some evidence that the opening of oysters may have been witnessed

on the coasts of Europe. In any case the oyster did not begin to be mentioned by European writers until some time had elapsed after the appearance of Catesby's *Natural History*. Albin, the reprint of whose work is dated 1738, has no word of the oyster. Brisson, however, in 1760, quoted Catesby's observation, and left it to be understood that what applied in America also held good in Europe.

After Brisson, at least two European naturalists were able to add something new to the subject, but whether as the result of their own observations or not, I am unable to say. In 1766, Pennant asserted that on the coast of France the Oystercatcher had access to oysters at low water, and was able to force the valves apart with its beak. Latham (1785) held that the Oystercatcher opens up oysters only when they are gaping sufficiently to admit the tip of the bill. This assimilates to Audubon's view that the Oystercatcher removes the mollusc when the valves are gaping. But, as I understand Audubon's account, it means when the valves are gaping widely as the result of dessication by the sun's heat, so that the bird is not called upon to exert any force in separating the valves, nor even to separate them at all, while Latham implies that force has to be used after the beak is inserted between the valves. Latham's statement is probably a correct account of the process.

Vieillot (1803) included the oyster in the food of the Oystercatcher, and it is possible he had direct evidence of the fact, since he was well enough acquainted with the habits of the bird to know that, in suitable localities, it extracts *Pholades* from their borings.

On the German shores of the North Sea, Schilling (1822) made the interesting observation that Oystercatchers were overturning oysters in search of worms and crustaceans. He suggested that this habit might have had something to do with the origin of the supposed habit of feeding upon oysters. It is, however, fairly certain that most of the older authorities got their information from Catesby, and not from the sea beach.

Of the other species and subspecies of the Oystercatcher not much appears to be known regarding the food habits. According to Grinnell (1918), who reviews the available material, chiefly from stomach-contents, nothing from direct observation, *H. niger bachmani* of the Pacific coast of North America does not feed upon the oyster, the more so as accessible oysters are rare in, or absent from, the habitat of the bird.

Schilling's account shows that, in his time, oysters were still present in the littoral zone of the German coast of the North Sea. More than half a century later oysters were apparently still members of the littoral fauna near Heligoland, as Gätke (1891) wrote of Waders regularly visiting an oyster bed near the island. In Schilling's time oysters had ceased to occupy the littoral zone of the Baltic Sea. By the middle of the nineteenth century, whatever may have been the case when Pennant wrote, oysters were not to be found within tidal limits on the northern coast of France (Toussenel, 1859), when the principal food of the bird on this coast appeared to be species of *Anomia* and *Venus* (Gerbe, 1867). In Britain the oyster retreated below low-water-mark at a much earlier period, and it does not appear to have been plentiful within tidal limits since the early part of the Iron Age. Within historic times there is, possibly, evidence of retreat in actual process. Jeffreys (1863) gives the vertical range of the oyster as 0-45 fathoms, while recent authorities place the upper limit at three, or even as low as five, fathoms.

The oyster is one of those species which have been unable to resist climatic deterioration and other changes consequent upon the optimum climatic phase following the last glacial period, and it is possible that in that optimum phase—the period of the *Littorina* Sea—the oyster was an abundant littoral species within the geographic range of the Oystercatcher, and therefore accessible to it in plenty. This view is borne out by the following matter. At present, the oyster is plentiful within tidal limits only in low latitudes. Examples are *Ostrea virginica* on the coasts of Carolina, and *O. cucullatus* on those of New South Wales. As the latitude increases the oyster becomes more scarce. *O. virginica* shows this very well. In Carolina it is found in great abundance in the tidal estuaries, and there forms the staple food of the Oystercatcher. In New Jersey the oyster is much less common and, in the opinion of Blanchan (1899), it there gives way to the mussel as the principal food of the Oystercatcher.

The evidence, therefore, points to the conclusion that in former times the oyster was more widely distributed and more abundantly present in the littoral zone than is now the case, and would be available to the Oystercatcher in the whole, or almost the whole, of the latter's geographic range.

At the present time the type-form, *H. o. ostralegus*, appears to be more restricted in this respect than almost any other form of the genus. It is not improbable that formerly the principal food of the European Oystercatcher was the oyster

and that the mussel (*Mytilus edulis*) took the place of the oyster only when the latter ceased to exist in the littoral zone.

The view which I have given lies admittedly within the region of hypotheses. Yet, if it can be shown that, at the present time *H. o. ostralegus* is able to open oysters and, still more so, if it can be shown that it exhibits the same methods of doing so as it employs to open mussels, the theory would receive some factual support, and the principal objection, that the European Oystercatcher cannot open oysters, would be removed.

Through the kindness of the Director of the Scottish Zoological Park, I was enabled to make the test upon birds living in captivity in the Park. The oysters which were used in the experiment were all less than 7 cm. in length. A size-limit was necessary in the event of the test leading to a negative result, since Fleisher observed that the oysters opened by the American Oystercatcher were less than three inches (7.5 cm.) in length, and this dimension was never exceeded in mussels and other shellfish, which I found, after they had been opened by the European subspecies. Had larger shells been used, a negative result might have been due to size alone.

In the winter of 1920–1921 I had one bird under observation. It had been in the Park for six or seven years. For the experiment, the bird was removed from the large enclosure, where it was kept, to a small one in which it might be more easily observed. The oysters were exposed, among stones, in a pan containing a solution of Tidman's sea-salt made up to equal the specific gravity of sea-water. The pan with its contents was left in the bird's enclosure for several days without result. There was no indication that the Oystercatcher touched the shell-fish, or even went near the pan.

In the winter of 1921–1922 a new waders' aviary was completed. At the time the second test was made (January, 1922), the aviary contained, in addition to three Oystercatchers —the original bird and two birds of the year recently caught on the sea-shore, several species of Plover and soft-billed Waders, and also a Coot (*Fulica a. atra*) and a Purple Gallinule (*Porphyrio cæruleus*). There were no signs that any of these birds meddled with the oysters. This was hardly to be expected of the *Limicolæ*, but was a possibility in the case of the last two species named, to which I paid particular attention, without, however, detecting any sign of either bird visiting, or having visited, the oysters. Nor did the keepers

in their frequent visits to the aviary notice either of these birds at the oysters.

The new aviary contained a permanent stream of fresh water running over gravel set in cement between clay banks. The oysters were placed in the stream and left there, half a dozen or so being put out at intervals of several days, until the whole stock was exhausted. I may mention here that immersion in fresh water cannot be regarded as an objection to the experiment. It has long been known that oysters can live quite well in fresh water. In the course of the experiment none of the shellfish gaped widely, nor were any found dead. In all, twenty-seven oysters were exposed, and, of these, twenty-four were recovered shortly after they were opened. Of the remaining three, one was never found again, and the other two were only discovered long after they were opened and after they had been knocked about the aviary by the birds.

The average size of the twenty-four shells, which are in my possession, is 5.0×4.7 cm., the smallest shell being 3.4×3.6 cm., and the largest 6.2×6.2 cm. None of the shells were actually broken across; all bear evidence of having been opened by force. Entry was gained at some part of the posterior border of the shell (border furthest removed from the hinge of the shell). In seven, the whole of the posterior border was broken up; in thirteen, the point of entry was at the postero-dorsal or postero-ventral angle (the angles at the ends of the posterior border); in one both angles are equally damaged; in three, the shell was entered at the mid-point of the posterior border. Removal of shell-margin was sufficient in ten of the shells to leave a permanent gap in the closed shell, chiefly by loss of wedge-shaped pieces of shell, one piece being 12 mm. long, 5 mm. wide, and, along the line of fracture, 2 mm. in thickness. In the other shells smaller pieces had been broken away from the margins of the valves. All the shells, therefore, show definite evidence of having been opened by force; in not a single instance can it be said that the mollusc had been removed without the necessity of previously separating the valves. And, since the point of entry was confined to the posterior border, there being, in no case, injury to the dorsal and ventral borders or the hinge-line of the shell, adaptation of the Oystercatcher to the oyster was complete at the first attempt to open a shell. The condition of the shells proves that the bird acted as if it knew, without trial, that to force the beak between the posterior margins of the valves yields the greatest leverage with the least exertion.

This result disposes of an alternative solution of the problem that the Oystercatcher will open all kinds of shellfish of suitable size, because the bird is adapted to feed upon shellfish. In form and in apparatus for closing the valves, the oyster differs considerably from other kinds of bivalves that are opened by the Oystercatcher. This fact, together with the absence of "trial and error" search for the most suitable place of entry to the shells in the experiment, proves that personal or ancestral experience is involved in opening the oyster. And, since personal experience may safely be excluded from the birds used in the experiment, I am inclined to believe that reaction to the oyster is, in the European Oystercatcher, an inherited habit. The preference of the American Oystercatcher for oysters against mussels may be recalled in this connection.

One shell was opened within twelve hours of being put out; two were not found opened until the morning of the eighth day; six, including the first shell, were opened within two days; six more were found opened on the third morning; while the remaining ten were opened between the third and seventh days after they were placed in the stream.

Most of the opened shells were found lying free in the stream; some had been wedged into the vertical clay-banks of the stream; others were found lying open in a vertical position in the mud of the pool into which the stream flowed.

There is not much in the way of direct evidence to put forward that the Oystercatchers actually opened these shells. The evidence from the shells is, however, to my mind quite conclusive, since the shells were manifestly opened by force, and they bear the marks of damage that are typical of the Oystercatcher. The birds proved to be very shy of being observed at work, and no one appears to have witnessed the actual opening of an oyster. But, during the period in which unopened oysters remained in the stream, the birds were scarcely ever away from the spot, while, before and since the experiment, they visited the stream only on occasion. They also, at that time, showed increased activity and eagerness to a greater degree even than that shown during some tests with mussels that preceded the trials with oysters, and quite different from their ordinary placid behaviour as captive birds. For over an hour one morning I watched the old bird make between twenty and thirty efforts to open the shells, but in these it was not successful. It made periodical journeys up and down the stream to test each oyster in turn. Three different ways of trying to force open the shells were

observed: (1) The point of the bill was firmly applied to the margin of a shell, and the bill was then shaken vigorously from side to side through a narrow angle, while apparently firm pressure was maintained on the shell; (2) As the point of the bill was pressed on the margin of a shell, the head was lowered quickly to one side through a wide angle; and (3) A series of blows was delivered obliquely on to the margin of the shell, at one spot, with the point of the bill. The three methods were used in irregular order, and more than one of them were usually applied to each shell. The bird was greatly handicapped by the shells moving about under the pressure of the bill—a disadvantage which would not arise under natural conditions, since the oyster is commonly fixed to the substrate. I have given what I observed of this bird in some detail, because it furnishes convincing evidence of the determined efforts made by the bird to open the shells, and because the methods, which I saw being applied to the oyster, I have already seen applied to the mussel and to other shellfish (Dewar, 1908, 1913).

It is probable from these observations, and from the long time that elapsed before the shells were opened, that the Oystercatcher is unable to open oysters when the valves are tightly closed. The shell needs to gape a little before the bird can insert its beak between the margins of the valves. This is, I believe, the case for all other kinds of bivalves known to be opened by the European Oystercatcher, with the possible exception of some forms not yet studied, and with the exception of some examples of *Mytilus* and *Modiolus*, on the rare occasions when the bird has access to the ventral border, in which the byssal fissure provides a place of entry for the bill, even when the valves are closed, and of *Pholas* which cannot entirely close its valves. On this point, one of the keepers volunteered the information that he found one of the oysters gaping about an eighth of an inch (3 mm.) shortly before it was discovered to have been opened and emptied of its contents. While it is tolerably certain that the shells must have been gaping slightly before they were opened, there can be no doubt that the oysters, when they were opened by the birds, were not dead and relaxed, since the appearance of every shell proves that considerable force must have been used to separate the valves.

CONCLUSIONS.

The European Oystercatcher can open oysters. Latham's account of the process is probably correct. Adaptation of

Oystercatcher to oyster is initially complete. Hence, opening oysters is probably an inherited habit in the Oystercatcher. Formerly, the oyster was more abundant and more widely distributed in the littoral zone of temperate latitudes than now. The oyster then formed the principal food of the European Oystercatcher. Mussels were substituted for oysters when the latter became scarce in the littoral zone.

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