THE JOURNAL OF MENTAL SCIENCE.

[*Published by Authority of the Medico-Psychological Association of Great Britain and Ireland.*]

No. 185. NEW SERIES, No. 149. APRIL, 1898. VOL. XLIV.

PART I.—ORIGINAL ARTICLES.

Note on the Memory of Fishes. By W. C. McINTOSH, M.D., LL.D., F.R.S., Professor of Natural History in the University of St. Andrews.*

THOSE who have watched a larval cod about 4 mm. in length nimbly avoiding the forceps following it for capture are in a fair way to estimate the brain-functions of an adult measuring three feet. Still more is this appreciation of such functions strengthened by the behaviour of a large grey skate in its endeavour to escape over a trawl-beam more than fifty feet long which had been arrested in its rise—just above the surface of the sea—by a temporary block in the machinery. The dexterity with which it skimmed to and fro along the beam to find where it dipped sufficiently during the movements of the ship to enable it to glide over was a study, and relief was felt when at last its intelligent perseverance was rewarded. The observation of a group of salmon on a spawning-bed, and the acquired skill of young trout in passing up a model of a salmon-ladder, are corroborative of both intelligence and memory. Moreover, if those who have given a green cod of six or eight inches a particular kind of "scale-back" (a kind of worm), and noticed, firstly, how eagerly it seized it, then tested it in its pharyngeal region, and soon ejected it, never again taking that species into its mouth, would be slow to deny that fishes, and even very young fishes, have a memory. It is well known that fishes prefer certain kinds of bait to others, probably because they retain the pleasant sensations of former occasions. Thus it is that anemones are a fatal bait for cod, lob-worms and certain Nereids for plaice, the toothsome mussel for most marine fishes, and the stripe of silvery skin (like a young rockling

* In a letter to Dr. Urquhart.

https://doi.org/10.1192/bjp.44.185.231 Published online by Cambridge University Press

or mackerel-midge) so eagerly sought by the mackerel. Muddy water, again, obscures the nature of bait, and misleads both observation and memory, so that a lure which would not so readily capture in clear water is now effective, because no suspicions are roused. On the other hand, the presence of phosphorescent organisms on a mackerel- or herring-net is said to prevent a successful haul.

In confinement the young of both cod and green cod recognise a figure approaching the tank in which they are fed, and so with flounders, dabs, gunnels, viviparous blennies, sea scorpions, and other forms. Their expressions are those of eager expectation as they glide forward, and some keep an eye on the surface of the water, and with a swift rush secure the food before the others have time to reach mid-water if they happen to rest on the bottom of the tank. There can be little doubt they remember what happened on former occasions. Similar actions are observed when the keeper approaches the trout in the ponds at Howieton. In swimming about in a tank with large anemones in full expansion, fishes, especially the smaller forms, avoid the dangerous tentacles of the "sea flowers," of which they have unpleasant experiences. Again, if adult cod are kept for breeding purposes in a large enclosure, and an attempt is made to capture them by a ring-net, they soon crowd, as Captain Danevig found, into the most remote corner, and thus, after the first examples, are difficult to secure. Functional differences, indeed, between this species and the green cod are noticed when only about three inches in length, for as they glide in company through the mazes of the tangles and other sea-weeds in the tidal pools, the former is much more shy and sensitive than the latter. The recollection of danger is further manifested by the shanny when it is approached as it creeps under the sea-weeds on a rock uncovered by the tide. It instantly leaps into its pool, and seeks shelter in a miniature cavern or recess under the sea-weeds.

Bearing these manifestations in mind, it does not appear improbable that when much harassed by trawls, by nets, or by lines, shoals of certain fishes gain experience which renders them less easily captured, and perhaps causes them to leave their wonted sites in the ocean for a time and roam elsewhere.

In nest-making and in the care of the eggs and young, memory is apparently present in certain fishes. The skill of the fifteen-spined stickleback, for example, is remarkable,

https://doi.org/10.1192/bjp.44.185.231 Published online by Cambridge University Press

and its recollection of the spots where the sea-weeds best suited for its purpose are located is evident. The threads which the male secretes for binding the nest together are placed in no haphazard way, but are interlaced with the sea-weeds with some intelligence. The accuracy with which the male lump-sucker finds his particular mass of adherent eggs —of which he is the faithful guardian even to the rendering up of his life—is well known. Devotion which impels fishes to be almost left high and dry at low water, so that only a runlet bathes one side of the gills, is of no common type, and it is unfortunate that they so often fall a prey to the carrion crows and rooks which come to feed on the eggs they protect. If the male be removed to a distance from the eggs it will even flounder through shallow water till its snout impinges against its charges (the eggs).* It would be difficult for the male *Arius* to retain the large eggs in his gill-chamber if he did not always recollect they were there; indeed, he is somewhat more acute than those higher forms who search everywhere for their spectacles which are *in situ* on their noses.

The habits of the climbing perch, of the flying-fish, of the electrical fishes, and other forms indicate the same traces of memory. It is probably more than blind instinct which enables the three-spined stickleback to use its formidable spines in attack, or which enables the picked dog-fish and the "fire-flare" to inflict serious wounds with their weapons. The claspers of the male skate would not cut so readily if the animal, when seized, did not thrust the knife-edge out. The sword-fish knows the use of its spear-like snout, just as the saw-fish manipulates from experience its snout with the double row of tooth-like spines.

In connection with the fact that certain fishes return to a fresh lure while the old hook is fixed in the jaw, their sensibility has been the subject of remark. Thus sharks will return to their prey even when severely wounded, not perhaps from want of memory but from courage and voracity. The latter may also present nice discrimination in regard to hooks and lines. A porbeagle shark will pass along a fisherman's line, biting off the snoods with their attached haddocks to the number of a dozen or more, as if trained to the pursuit. Nor do the hooks appear to give inconvenience after the digestion of the fishes, being probably ejected by the mouth. It seems to have no unpleasant associations with this method of feeding. On the other hand, an adult porpoise, which has

* *Ann. Nat. Hist.*, August, 1886, pp. 81—84.

https://doi.org/10.1192/bjp.44.185.231 Published online by Cambridge University Press

a brain more richly constituted than most mammals, trying the experiment for the first time, may be held by a single hook and captured, for its teeth are of less service in the case than those of the shark. A saithe (green cod) will chase haddocks as they are drawn to the surface by the lines so closely that fishermen will strike them with the "clip" (a kind of gaff), and it has happened that the hook of the gaff has parted from the handle and remained in the fish, which, nothing daunted, was captured by another gaff as it eagerly pursued the haddocks, and the broken instrument recovered. Gulls, indeed, show little more discrimination in regard to hooks and bait than fishes.

It would appear, however, that the voracity of sharks does not blunt their appreciation (and recollection) of a choice repast; for instance, when they fall in with a group of "green-bones" (*Belone*), as in the case of a male thresher or fox-shark, the stomach of which was filled with them; yet in our country the "green-bone" is by no means a common fish, a single example, as a rule, falling under the notice of zoologists at a time, though it enters the estuaries of certain rivers in numbers.

The extreme hardihood of certain fishes after injury must be borne in mind when doubts are thrown on their memories. Thus a full-grown female picked dog-fish was captured in the stake-nets for salmon some years ago with its stomach distended with food. In dissecting the apparently dead animal in the laboratory the heart pulsated actively, though it and the pericardium were covered with old and recent lymph, caused by the irritation of a large cod-hook, the point of which projected into the pericardium, and against which the heart seemed to impinge during contraction. An eel will live for a year or two with a hook projecting through the gut into the abdomen, and the glutinous hag (*Myxine*) is also hardy under similar circumstances.

Remarkable structures, it is true, are occasionally found in the stomachs of fishes, though perhaps not always swallowed at sea. Such things, however, occur so rarely in the life of the fish that experience is of little importance.

With regard to the absence of the cortex of the brain in fishes, this is probably only a question of degree—easily understood by referring to the descriptions and figures of the brain in the salmon and the wolf-fish.* Besides, who has proved that the function of memory depends on the brain-cortex of the human

* *Trans. Roy. Soc. Edin.*, vol. xxxv, part iii.

https://doi.org/10.1192/bjp.44.185.231 Published online by Cambridge University Press

subject? I have seen many a curious case in the pathological room, the history of which would not have led us to this conclusion.

The Systematic Collection of Anthropological Data in Asylums. By Edwin Goodall, M.D., Joint Counties Asylum, Carmarthen.*

It is not my purpose on the present occasion to relate a series of observations. I merely desire to ask your attention to a field of work hitherto little cultivated, either abroad or in this country, especially the latter. I have not, indeed, come across any account from which it is to be gathered that anthropological methods—which are what I now refer to—have been adopted systematically in any asylum for any length of time, although of late such have been in use in certain asylums of America, and also of Italy. In respect of France and Central Europe I have no certain information; but I have not seen any notice in the journals of the speciality of the employment of these methods in the asylums of those countries. That the grosser stigmata of degeneration have been observed in the course of ordinary clinical work in asylums for some time, we are all aware. It is common to hear at clinical examinations that a particular case has a "narrow" or "sloping" forehead, a "flat" occiput; possibly we are at times more venturesome, and describe the head as "dolico-" or "brachy-cephalic" (our remarks thereby acquiring a certain *nuance* of scientific gravity). Or perhaps the palate is noted to be "arched" or "Gothic," "semi-V-shaped" or "semi-saddle-shaped;" or the chin to be "receding;" or, employing a dramatic generalisation, we pronounce the patient to be of a "simian" type. I need not illustrate further, my object being simply to bring to mind the fact that it has for long been thought worth while to record conditions ascribed to imperfections of development. I pass to the representation that if it is worth while to record such conditions at all, it is proper that there should be some system whereby they may be recorded. There are pathological forms, as you are aware, in many asylums, on which systematic records of autopsies are kept; and if at

* Read by Dr. Bullen for the author at the Autumn Meeting of the South-Western Division, 1897.

https://doi.org/10.1192/bjp.44.185.231 Published online by Cambridge University Press