

NOTES ON THE PSYCHOLOGY OF FISHES.

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LAST year Dr. C. O. Whitman of the University of Chicago delivered a very able lecture on "Animal Behavior," it being one of the biological lectures from the Marine Biological Laboratory, Woods Holl, Mass.¹ In the leading paragraph Dr. Whitman very truly points out the fact that "animal behavior, long an attractive theme with students of natural history, has in recent times become the center of interest to investigators in the field of psychogenesis. The study of habits, instincts, and intelligence in the lower animals was not for a long time considered to have any fundamental relation to the study of man's mental development. Biologists were left to cultivate the field alone, and psychologists only recently discovered how vast and essential were the interests to which their science could lay claim" (p. 286). This is as true a statement as has been made in the premises in question in any connection, and the person who has paid any attention to psychological literature during the last ten years is well aware of the fact that in the discussions that have been going on there on the subject of instinct and intelligence, the psychologist has been compelled over and over again to draw upon the observations made by the biologist upon the habits and physiology of animals in order to lay down the very base for his theories in regard to the afore-said faculties. Professor Whitman's recent researches have lent a powerful impulse to the interest taken in this subject, the more so from the fact that being a trained biologist himself, and possessed of a keen appreciation of the modern advances in psychology, he has been enabled to attack the question in the double capacity of naturalist and psychologist. So far as the writer's present information carries him, the researches of this observer have been chiefly devoted to the studying of the

¹ Boston, Ginn & Company, 1899.

habits and behavior of leeches (Clepsine), the large fresh-water amphibian *Necturus*, and to the various species of wild and domestic pigeons.

From these he draws very broad conclusions, so without entering upon a discussion of the theories touched upon in this meritorious memoir, for I have already done that elsewhere,¹ the present paper will take into consideration only such facts as concern the behavior of fishes. Moreover, what is here said will refer in particular but to the true bony fishes, or Teleostei, although, for aught that is known to the contrary, it is probably true of the entire group. Aside from some few well-known exceptions (*Amblyopsis* and congeners), that fishes possess excellent visual powers, even to the extent of keen discrimination between objects, there can scarcely be any manner of doubt. Therefore their appreciation of light and their sensitiveness to it follow as a natural consequence. Further, there is every reason to believe that fishes are so organized that they are extremely sensitive as to any disturbance of the element in which they live, when such disturbance is made within the range of the power of their nervous organization to appreciate it. Whether any fish is as sensitive in this respect as a leech (Clepsine) I think is an open question, for, as Whitman has shown, we have but to touch with extreme care with a point of a fine needle the surface of the water over a leech, when the latter is in a dish containing it, to see the animal suspend the act of respiration, *slightly* expand its body, and hug closer to the glass or china dish wherein it has been placed. This experiment must be performed with great caution, for any undue disturbance will effectually defeat the looked-for result. The very extreme sensitiveness of the creature is absolutely remarkable.

Coming now to the sensitiveness of fishes, I take occasion to quote in full a note that Professor Eigenmann furnished Dr. Whitman with for use in his paper on "Animal Behavior"; it runs as follows: "*Chologaster papilliferus*, a relative of the blindfishes living in springs, detects its prey by its tactile organs, not by its eyes. A crustacean may be crawling in

¹ R. W. Shufeldt, M. D. *Animal Behavior*. *Popular Science*, vol. xxxiv, No. 3, pp. 45, 46. New York, N. Y., March, 1900.

plain view without exciting any interest, unless it comes in close proximity to the head of the fish, when it is located with precision and secured. The action is a very strong contrast to that of a sunfish, which depends on its eyes to locate its prey. A Gammarus seen swimming rapidly through the water and approaching a Chologaster from behind and below was captured by an instantaneous movement of the Chologaster, when it came in contact with its head. The motion brought the head of the Chologaster in contact with the stem of a leaf, and

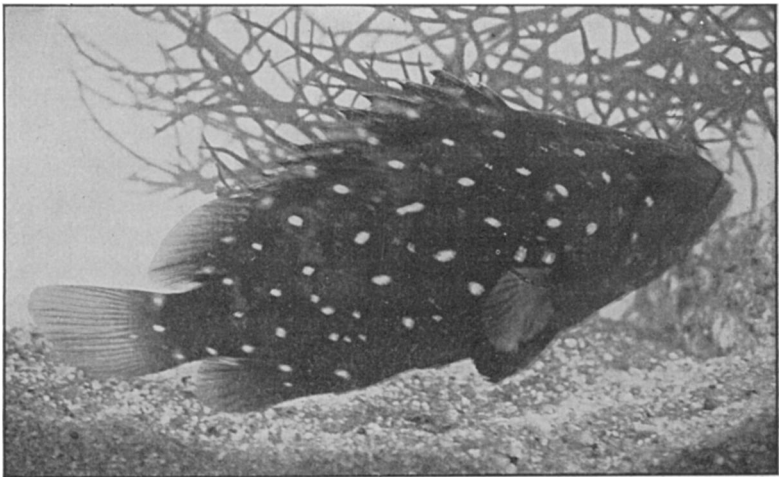


FIG. 1. — The Snowy Grouper (*Epinephelus niveatus*), juv. Photographed from life by R. W. Shufeldt.

instantly it tried to capture this also. Since the aquarium was well lighted, the leaf in plain sight, it must have been seen and avoided if the sense of sight, and not that of touch, were depended upon.

“In Amblyopsis, the largest of the blindfishes of the American caves, the batteries of tactile organs form ridges projecting beyond the general surface of the skin. Its prey, since it lives in the dark and its eyes are mere vestiges, is located entirely by its tactile organs. This is done with as great accuracy as could be done with the best of eyes in the light, but only when the prey is in close proximity to the head. Coarser vibrations in

the water are not perceived or are ignored, and apparently stationary objects are not perceived when the fish approaches them. If a rod is held in the hand, the fish always perceives it when within about half an inch of it, and backs water with its pectorals. If the head of a fish is approached with a rod, the direction from whence it comes is always perceived and the correct motion made to avoid it. This reaction is much more intense in the more active young than in the adult. One young about 10 mm. long determined with as great precision the direction from which a needle was coming as any fish with perfect eyes could possibly have done. It reacted properly to avoid the needle, and this without getting excited about it."

That fishes with perfect eyes depend entirely upon them in the detection and capture of their prey is easily proved by the difference in their behavior when feeding in perfectly clear or in muddy water. This experiment can be made in a large aquarium containing a number of hungry black bass, and turning a few small yellow perch loose among them. If the water be clear, short work is made of the victims, but their capture is made less and less certain the muddier the water happens to be. It is more than likely that some of the semi-blind deep-sea fishes, as, for example, *Mancalias shufeldtii*, are quite as sensitive to disturbances of a very delicate nature of the water in their immediate neighborhood as is *Amblyopsis* of the Mammoth Cave of Kentucky. On the other hand, the eyes of some of these fishes have come to be of enormous size in proportion to the size of their owners, and this to gain all the available light possible. Consequently, there is probably a compensating distinction in this regard among such fish as I have here noticed; in other words, the more perfect the sight the less need of a highly organized sensitive apparatus and *vice versa*.

But now comes another question in the behavior and psychology of fishes that will require a far greater knowledge on our part of the habits and history of these vertebrates, before biologists will arrive at anything like a unanimity of opinion regarding the matter, or the observations in the premises, and the observed facts are sufficiently numerous to insure the solution of the entire problem. It involves the whole question of

instinct and intelligence and some of the knottiest points in the entire range of biology. It has been observed in fishes that many of them have the habit of "pausing before the bait" prior to making a seizure with the jaws. This, according to Whitman, has its origin in *fear*, and he studied quite closely the corresponding, though somewhat different series of acts in *Necturus*. It is an *instinctive* timidity rather than a strategic approach of the fish not to alarm its prey and thus defeat capture. The long and careful series of experiments made by Professor Whitman in the case of numerous specimens of *Necturus*, both young and old, seem to prove very conclusively that their intensely shy behavior, when approaching their prey or food, is due to an innate timidity or really fear.

Young sunfishes (*Lepomis*) I have studied for many years at different times and places in aquaria, and I have observed the habit in the young of that species of "pausing before the bait," or really their food, prior to taking it. The same behavior obtains in the adult sunfishes, but in them it can be overcome by education to a large extent, for I have seen them *immediately* attack in numbers one's finger when placed in the water of the aquarium containing them; whereas, when the experiment was first tried, they evidently all stood in great fear of the object, however gently it was placed in the water. A study of the young and old of *Chætodon* in this connection and the method of some of the species of that genus of taking their prey would be interesting.

In speaking of the marked timidity of *Necturus* in the taking of its food or seizing its prey, Professor Whitman says: "If this series of acts represents an organic sequence, and if the behavior as a whole takes the form determined by the organization, as seems to me beyond reasonable doubt, we have an instinct the history of which may be coextensive with the evolution of the animal. We stand at the end of an interminable vista. The specific peculiarities of organization in *Necturus* form but an infinitesimal element of the problem. Scarcely a feature of the instinct belongs exclusively to *Necturus*. It is at least widely diffused among vertebrates, especially among fishes. The differences in the manner of execution among dif-

ferent forms, so far as I have observed, are of quite a superficial nature. The instinct evidently has its root in the general instinct of preying, which is doubtless coeval with animal organization" (p. 307).

In the adults of some species of fish it is very evident, in the matter of seizing their prey, that the elements of both *hesitation* and fear are entirely absent, as witness the bold rush of the pike to capture a minnow, or the manner in which a trout or a salmon instantly takes the *artificial fly*. Hundreds of similar cases could easily be cited.

This autumn the writer has been making photographs of living rare fishes at the building of the U. S. Fish Commission at Washington, D. C., and among them were some beautiful specimens of the young of the Snowy Grouper (*Epinephelus niveatus*) (see figure 1) and the Big-eye (*Pseudopriacanthus altus*). Both of these species exhibit a most remarkable behavior under certain conditions. The Snowy Grouper, for instance, when over-teased in any way, or sometimes without even that provocation, or when its food is presented to it, whether the act be voluntary or involuntary, passes through a peculiar fit or spasm, simulating all the symptoms of a dying fish. Not only this, but the specimen so behaving *changes in color* from the normal brownish-black to a pale leaden hue, and as the spasmodic stage of the attack subsides, the fish comes to lie perfectly motionless upon its side, or else floats on the bottom, belly upwards. It will remain in this condition for nearly half an hour, when signs of animation again make their appearance, and the individual gradually assumes its former normal condition and color. The Big-eye is another species exhibiting somewhat similar attacks under nearly like conditions, but this species, I am told, sometimes dies in one of its more violent spasms. It is a well-known fact that some species of large fishes that prey upon smaller species will not devour them unless captured when making an exciting attempt to escape and in full vigor of health. They will not touch a dead specimen, or even one in the act of dying. I have noticed this especially in the case of pickerel. Now this peculiar fit that seizes the young of the Snowy Grouper may be due to the result of an acute reaction caused by fear; but, on the

other hand, it may be something of the nature of "feigning death," and thus be useful to the form in nature. Possibly there may be some large form in the seas that preys upon young Snowy Groupers, and *prefers* to take them only in the excitement of actual chase, and ignores a dead or dying one. If this chance to be true, these peculiar "fits" of *Epinephelus* and *Pseudopriacanthus* are in favor of the preservation of the species. Indeed, we are hardly yet upon the threshold of our knowledge of the habits and *behavior* of fishes in nature, much less are we enabled to solve the problem in an untold number of cases, how in any special instance any special act in a fish's behavior first arose, and whether that act is wholly or only in part prompted by instinct. Whitman's "Animal Behavior" and similar memoirs will in the future have a beneficial result in stimulating investigation and research in such directions.