ZOOLOGY

The Maligned Octopus

The octopus is not really a vicious monster, but a shy, retiring creature and the most intelligent of invertebrates. Camouflage helps it to avoid capture.

By MARJORIE VAN DE WATER

➤ THE OCTOPUS is known to us chiefly from fantastic tales that picture it as a horrible monster clutching entire ships in its powerful arms and dragging hapless sailors down to a watery grave. It is the octopus, or his close relative the squid, that has inspired the tall tales of sea serpents that are still being reported by newspapers when news is scarce.

Scientists give us a very different picture of this invertebrate creature of the sea. The octopus is described as shy or retiring. He is said to be less likely to attack you and tear you limb from limb than is your own pet dog.

The class of marine creatures of which the octopus is one—the cephalopods (footed head)—is described as the most highly organized and most intelligent of the invertebrates.

The octopus is said to have a larger and better-functioning brain than any other invertebrate and one scientist even suggested that the octopus ranks higher in learning capacity than some of the lower vertebrates.

Has Keen Eye

It has a highly developed eye.

Now a psychologist has taken advantage of this keen eye and the learning ability of the octopus to find out what forms the creature can discriminate readily and which are likely to be confused. From this information, Dr. N. S. Sutherland, of the Institute of Experimental Psychology, Oxford, England, has reasoned what the mechanism of the octopus nervous system must be.

By rewarding the octopus with food at a vertical rectangle and by punishing him with a mild electric shock at a horizontal rectangle, the octopus was trained to attack the vertical and to shy away from the horizontal shape. Reversing the procedure, other octopuses were trained to attack the horizontal and shy away from the vertical.

Scores on this test of discrimination were correct 81% of the trials. The octopuses were even better at learning to distinguish a square from a triangle. The score on this test was 85%.

They are not so clever at distinguishing a circle from a diamond (score 74%). They were poor at telling a T right side up from one upside down. And they failed entirely to distinguish a rectangle that tilted obliquely to the right from one tilted to the left.

From these strengths and weaknesses of discrimination, Dr. Sutherland deduces how perception takes place in the octopus.

First, to answer the question, why is it so easy for the octopus to learn to tell horizontal from vertical figures?

How Distinction Is Made

When the octopus is in movement, his motion is horizontal and his head is held in a fixed orientation by organs called statocysts. But when he is stationary, head movements are usually in a vertical direction.

The excitation produced by an object on the retina of an octopus eye, Dr. Sutherland reasons, is relayed to an array of nerve cells representing a projection of the retina on the optic lobes.

These nerve cells must be arranged in rows and columns. As the octopus swims past a vertical figure, there is no excitation of the cells until he reaches the tall figure. Then there is a sudden burst. The amount of firing from the column cells represents the height of the figure.

The firing of the cells connected with the rows, on the other hand, represents the width of the figure. In the case of the vertical rectangle, this would be a very weak burst.

The nerve pattern, then, for a vertical rectangle would be strong output from columns, with weak output from rows.

Compare this with the pattern for a horizontal rectangle. Here the output is weak for the columns and strong for the rows.

Thus the vertical and horizontal rectangles would look very different to the octopus. The octopus would make its discrimination between the two forms by comparing the size of the output for columns and rows.

If the octopus really does see by this quantitative system suggested by Dr. Sutherland, it explains why such forms as a T right side up and a T upside down could not be readily distinguished. The quantity of nerve cell output would be very similar in both cases. And rectangles tilted in opposite directions would "look" almost identical to the octopus.

"It seems probable," Dr. Sutherland comments, "from the evidence we have that something like the system proposed here may operate in human beings. But in the humans it would almost certainly be only one classifying system operating among several others."

In the octopus, it is enough to account for how this "footed head" is able to learn to seek food at an object of one form and to avoid punishment at another that looks different to it. It explains, too, why the octopus is able to earn an 85% score in the case of horizontal and vertical rectangles, but gets only a 50% or chance score when required to distinguish between the tilted rectangles.

An American psychologist has matched the wits of the octopus against those of the minnow. Dr. Paul N. Schiller of the Yerkes Laboratories of Primate Biology in Orange Park, Fla., found that the octopus as well as the minnow can learn to detour around a glass jar barrier to get at food.

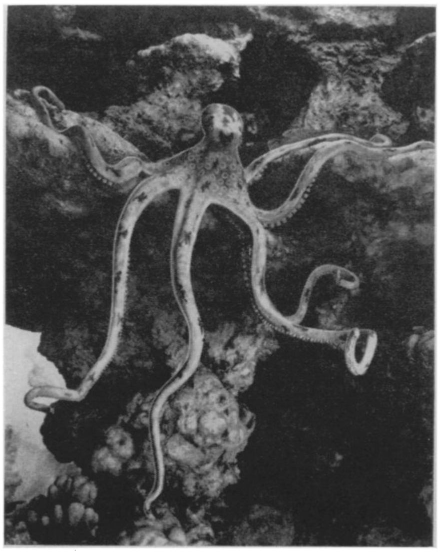
The octopus, however, uses a different method. He reaches out with his long arms (or feet) in different directions until one of them contacts the food. When one arm has found the food, he sends out other arms in the same direction. Then he follows the majority of his arms around the jar to get to the food.

Having learned that the jar is associated with food, the octopus then explores this strange object further. He embraces it. He explores both the inside and the outside. He tilts and lifts it.

Oriental Delicacy

As an article of food, the octopus is repulsive to most Americans. But it is considered a great delicacy by Oriental peoples. Fishermen take advantage of one trait of the octopus to capture it for food.

Far from being a belligerent terror of the



SHY CREATURE — The octopus, scientists find, is no more likely to attack you than your own pet dog. He has a fondness for hiding in holes in rocks and in pottery jars.

deep, the octopus is a shy, retiring creature. He likes to hide in hollows in the rock along the shore.

Fishermen interested in mass capture of octopuses have developed an ingenious system. They lower hollow earthenware pots to the bottom by means of cords. The octopuses enter the pots and make themselves at home. Then the fishermen pull up the pots. The octopus seems reluctant to leave the cosy pot, so the fishermen can pull the pot to the surface before the octopus makes his getaway.

Dr. Paul Bartsch, curator of Marine Invertebrates at the U. S. National Museum, quotes another story to show how the same retiring, shy trait of the octopus has been made use of to capture, not the octopus, but archaeological treasure from the bottom of the sea.

Many years ago, a ship carrying a very valuable cargo of porcelains from Korea was wrecked off Japan, taking the precious pottery to the bottom.

In recent years, fishermen in the vicinity hit upon a way of recovering the pots. They tie strings to octopuses and lower them to the bottom. The octopuses creep into the pots and hang on to them while the fishermen pull them to the surface.

Thus is archaeology indebted to the octopus.

Prototype of Jet Propulsion

The cephalopod is the prototype of jet propulsion.

Water is taken into the mantle cavity between the free edge of the mantle and the body. When the creature is at rest, the water can wash out again through the same opening. But when he wants to move, that opening is closed and the water is driven out with great force through a siphon. This drives the animal backwards through the water at considerable speed.

The octopus and his relatives among the cephalopods have an unusual defense against enemies. A glandular sac produces a dark fluid which the animal can discharge at will.

When the animal is pursued, he can throw out this "ink" as a "smoke-screen" which hides him while he makes good his escape. One scientist has suggested that the ink may serve as decoy or camouflage rather than screen. The ink pool is about the size of an octopus and assumes about the same shape and the enemy may be led to pursue this false octopus while the real one gets away.

This octopus "ink" has its use in printing and photography. It is the sepia that gives the admired brown tone to illustrations.

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A four-pound *plastic relief map,* showing South America as it might be seen through a flyer's eyes, is now available.

Adoption of *dry pelleted diets* as standard rations by all state fish hatcheries in Michigan increased trout production (in pounds) by 60%.

AERONAUTICS

To Fly Higher, Faster

➤ AN AIRPLANE that will fly higher and faster than man has ever ventured before is being built for the National Advisory Committee for Aeronautics. The research craft is called the X-15.

Details of its design and expected performance are secret, but it will be used to gather information on the problem of re-entering the earth's atmosphere and the heating effects then encountered. It will also be used to obtain data on the heating, stability and control of airplanes operating at extreme speeds and altitudes.

These few items on the X-15 were revealed in hearings by the House Subcommittee on Appropriations in Washington. The research airplane is being built by North American Aviation Corporation for the Air Force, to specifications made jointly by the Air Force, Navy and NACA.

Information recorded using the X-15 will be applied to designing hypersonic airplanes and missiles. It is expected to fly in the 7,000 mile-an-hour range.

Highest speed yet attained by a piloted airplane is "well above" two and a half times the speed of sound, which is about 760 miles an hour at sea level. Unofficial reports indicate the plane, the NACA's Bell X-2, reached 2,100 miles an hour at an altitude of 126,000 feet before it crashed last Sept. 27.

Dr. James H. Doolittle, chairman of the NACA, told the committee the reasons for its crash were known, but his explanation of them was taken out of the record for security purposes. The hearings do reveal, however, that instrument records from the plane were salvaged, including one of the "most striking movies" Dr. Doolittle has ever seen.

Photographed by a camera inside the cockpit, he said, were the instrumentation, the pilot's head and his reactions during the entire final flight of the X-2.

In spite of the risk, however, pilots and not electronic equipment will have to be used to fly research airplanes. The reason is that an automatic pilot cannot be installed until it is known what the airplane is going to do.

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