Tool-use down the evolutionary ladder

Tool-use in animals is receiving more and more attention, especially following the reports of Jane van Lawick-Goodall (SN: 2/3/73, p. 71). Her discriptions of tool-use by chimpanzees and baboons point to evolutionary trends of increasing complexity, culminating in man. But tool-use begins lower on the evolutionary ladder than the primates. Charles Darwin described how the Galapagos woodpecker finch uses a cactus spine to probe insects from crevices in tree bark. Researchers at the University of Massachusetts in Amherst now report tool-use activity in blue jays.

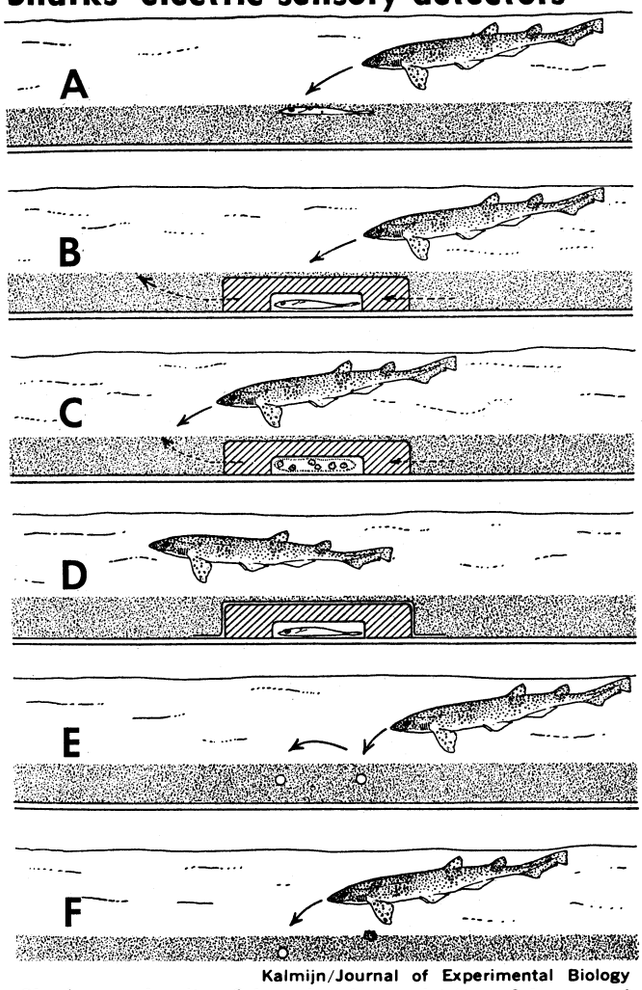
Thony B. Jones and Alan C. Kamil watched how a northern blue jay in their laboratory ripped a piece of newspaper from the floor of its cage and used it to rake in food pellets from outside the cage. Working with National Science Foundation support, the psychologists tested the blue jay under various conditions of food deprivation and found that the tool-use was not just a game, but definitely related to food-getting. On different occasions the bird was given and used a feather, a piece of straw, a paper clip and a plastic-bag tie to rake pellets near enough to be picked up through the wires of the cage. When the pellets were not available outside or inside the cage, they observed the bird in another possible type of tool-use. It dropped the paper in the water dish then swept it around the food dish to pick up food dust. The jay then either ate the small pieces of dust off the paper or ate the paper itself.

After Jones and Kamil observed this behavior, they watched eight other birds from the same laboratory colony. Five showed definite tool-use. Only one showed no sign of tool-use. They suggest that one bird probably learned the behavior serendipitously and the others learned by imitation. Jones and Kamil conclude in the June 8 SCIENCE that this type of tool-use may indicate a particular potential for behavioral adaptations by species like the blue jay. □

Kamil and Jones

Tool-using blue jay with paper rake.

Sharks' electric sensory detectors



Kalmijn/Journal of Experimental Biology

Sharks attack a live fish under the sand (A), a fish covered by agar (B) or the downstream smell of dead fish (C). They pass up electrically insulated fish (D), but attack electrodes (E) or pass up food for electrodes (F).

The ampullae of Lorenzini are tiny bladders found in the skin of all sharks and rays. They are connected to surface pores by long canals. Because these small sacs are full of nerve endings, scientists believed them to be some sort of sensory receptor. But none knew what they were sensitive to. In 1971, biophysicist A. J. Kalmijn reported in the JOURNAL OF EXPERIMENTAL BIOLOGY that sharks use the ampullae to detect prey buried in the sand. He found that the ampullae are excited by the electric field emitted by buried fish. In experiments, a shark detected and aimed attacks at a buried fish, even when it was covered by an agar plate that prevents mechanical, visual or chemical cues but allows an electric current to pass through. The shark also attacked buried electrodes carrying a current equivalent to that of a fish.

Theodore H. Bullock, a collaborator of Kalmijn at the Scripps Institution of Oceanography, has been studying electroreceptors since 1959. He reports in the May-June AMERICAN SCIENTIST that sharks, catfish and electric fish use electroreceptors in object detection and social communication.

Nearly all animals, including humans, emit into seawater direct-current fields as a result of different electric potentials between body fluids and ocean and between different parts of the body. Sharks, sensitive to the equivalent of one flashlight cell at 1,500 kilometers, are sensitive to all of these fields. A wound, for example, can double the voltage gradient from a person in seawater. A shark can detect this. In addition to such bioelectric fields, there is a world of inanimate fields induced by the motion of water, bodies of ore, earthquakes and atmospheric disturbances. During and prior to earthquakes in Japan, certain catfish there have shown behavior which, says Bullock, "is evidently dependent on changes in the electric current of the earth." The long canals of the ampullae, he explains, enable certain fish to sample electric fields at two widely spaced points. With this ability, he suggests, they not only detect prey but may be able to use electric fields as navigational aids and to communicate with each other. Bullock admits that these studies are in their infancy but says, "Like many basic questions of neurobiology, answers or clues from lower species may help us to understand the brains of higher forms."