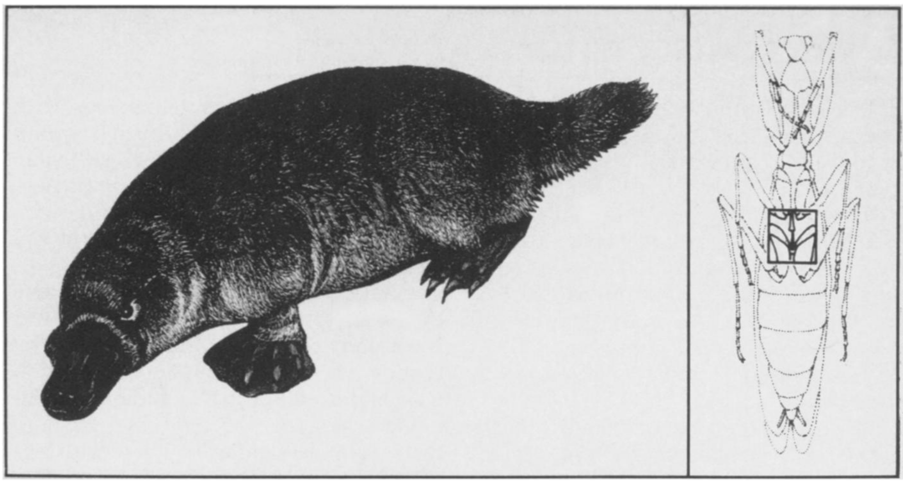
Sensory surprises in platypus, mantis



Mantis: Margaret C. Nelson, Cornell Univ./SCIENCE

Incomparable sensations: Platypus bill detects electrical signals emitted by the muscles of its prey, and praying mantis detects ultrasound with a deep, tear-shaped groove (in box) on the midline of its thorax.

In the realm of the senses, animals continue to amaze scientists. No longer impressed by a dog's ability to hear high-pitched whistles or a cat's ability to see in dim light, researchers have gone on to document far more unexpected animal perceptions in such animals as the platypus and praying mantis.

Take the bill of the duck-billed platypus. It serves as an antenna to pick up weak electrical signals, scientists report in the Jan. 30 NATURE. This is the first report of electroreception in mammals, say Henning Scheich of the Technical University of Darmstadt, West Germany, Anna Guppy of the Australian National University in Canberra City and their colleagues.

In the recent experiments, hungry platypuses were observed to explore underwater with their eyes, ears and nostrils closed. By swinging their bills rapidly back and forth, they detected direct and alternating electrical currents, which they used both to locate and avoid objects. For example, the platypuses would swim down to and try to bite active batteries, but not inactive ones. The scientists propose that the platypus, which feeds on live crustaceans, frogs and small fishes, naturally uses its bill to detect the electric field generated by the muscles of moving prey.

Some fish and amphibians are known to sense electrical currents, but the platypus appears to use a distinctly different, independently evolved type of electroreceptor. These receptors may be located in the ducts of mucous skin glands, which would prevent them from drying out when the platypus is out of the water, the scientists suggest.

The praying mantis provides another sensory surprise — a single "ear" that is a groove in the underside of its thorax. Long thought to be deaf, the insect possesses a "sensitive and specialized acoustic sense," David D. Yager and Ronald R. Hoy of Cornell University report in the Feb. 14 SCIENCE.

What the mantis hears is ultrasonic frequencies, perhaps wings rubbing abdomen during courtship or the sonar signals of insect-eating bats. The sensitivity to ultrasound is shared by some other insects that detect sound with more conventional organs. But all other insects that hear have two "ears," widely separated on the body. Their auditory organs are on the forelegs, on the back of the thorax or on the abdomen.

The first evidence for hearing in the mantis was nerve signals recorded after stimulation with sound. To locate the "ear" responsible, the scientists used a process of elimination. They removed a mantis's legs and coated various parts of its body with a heavy layer of petroleum jelly or melted wax. Nerve recordings show that the mantis does respond to sound when it has no legs, and also when most of its thorax is covered. Only a drop of wax in the deep thoracic groove renders the nerve insensitive to sound.

The "ear" of the mantis consists of a thinned region of cuticle folded into a groove shaped like an elongated teardrop. Under each wall of the groove is a large air sac, connected to the insect's respiratory system. A small neural structure, thought to carry auditory information from the vibrating cuticle to the central nervous system, is located near the top of the sac.

Because animals obtain information about the location of a sound by comparing the input of their two ears, the scientists reasoned that the "cyclopean ear" of the mantis would not be useful in localizing sound. Their data concur: The location of a sound appeared to make no difference in the activity recorded from the nerve.

Although Yager and Hoy do not yet know what role detection of ultrasonic signals plays in the natural lives of mantises, some preliminary experiments do provide a hint. The scientists are interested in learning "who hears" among the 1,700 mantis species of the world, Yager says. When the researchers provided "batlike" ultrasound pulses to an Asian hymenopodid mantis in flight, it responded by extending its forelegs and flexing its abdomen. This response caused an abrupt and dramatic deviation in the flight path. Yager and Hoy conclude, "The mantis thus has independently evolved not only a novel ear but possibly a complex nocturnal predator avoidance system." — *J.A. Miller*

Alaskan great quake: Ready or not?

The Aleutian islands of Alaska have more than adequately demonstrated a propensity for earthquakes. Since 1938, great earthquakes — with magnitudes exceeding 8 — have rattled different segments of the island chain as a result of the Pacific plate subducting, or sliding beneath, the North American plate. But there are three "gaps" or segments along the Aleutian subduction boundary where no great earthquakes have occurred since the turn of the century; these gaps have been targeted as the most likely Aleutian sites of great earthquakes in the near future by a number of seismologists. Now, however, a group of researchers at the U.S. Geological Survey in Menlo Park, Calif., argues that one Aleutian gap is far from ready to rupture.

Geophysicists Jim Savage, Mike Lisowski and Will Prescott have measured the strain accumulating since 1980 at two Aleutian gaps: the Shumagin gap, which ruptured in 1788, 1847 and possibly 1903; and the Yakataga gap, which last ruptured in 1899. According to one line of thinking, the amount of strain building up along a fault is an indicator of how ripe that fault is for an earthquake. The theory holds that the relative motion of the plates steadily builds up strain along a locked fault until the strain reaches a critical level and the fault slips, suddenly releasing all the strain in the form of an earthquake. Then strain begins to build up again and the stick-slip cycle continues. At the Yakataga gap, Savage's group measured an accumulation of strain consistent with the rate at which the North American and Pacific plates are converging. But at the Shumagin gap, they detected no buildup of strain, the researchers report in the Feb. 7 SCIENCE. "This finding appears to be inconsistent with the imminent occurrence of a great earthquake in that area," says Savage.

One explanation for the lack of strain, according to the researchers, is that the