

Sensory surprises in platypus, mantis

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.

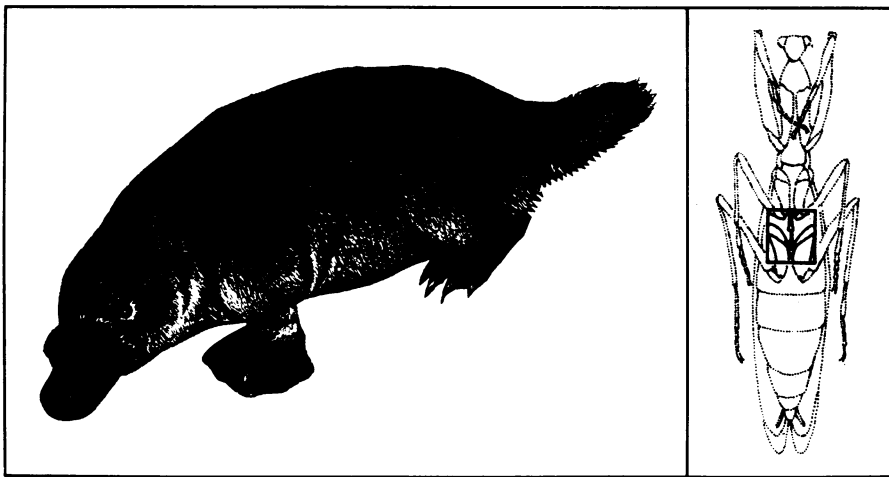
In the recent experiments, hungry platypuses were observed to explore underwater with their eyes, ears and nostrils closed. By swinging their bills rapidly back and forth, they detected direct and alternating electrical currents, which they used both to locate and avoid objects. For example, the platypuses 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



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.

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 localiz-

ing 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 hymenopteran 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

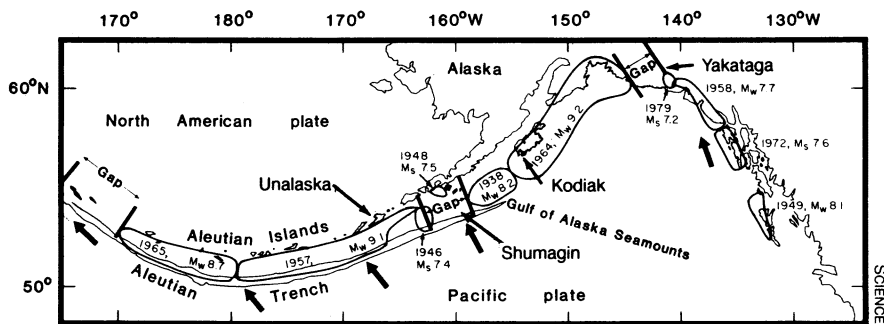
1903; and the Yakataga gap, which last ruptured in 1899. According to one line of thinking, the amount of strain building up along a fault is an indicator of how ripe that fault is for an earthquake. The theory holds that the relative motion of the plates steadily builds up strain along a locked fault 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

way in which the two plates slide past one another has changed fundamentally. Instead of sticking and then slipping as they had done before the last great earthquakes, the two blocks are now sliding continuously and stably, in a process called aseismic subduction. Because reliable strain measurements have been made for only a relatively short period of time, it's not possible to tell if the subduction along the gap is now permanently aseismic or if it is episodic, with long periods of aseismic subduction being punctuated by strain- and earthquake-generating stick-slip cycles.

Alternatively, says Savage, "our models of how strain accumulates may be wrong." It's possible that just before a large quake, the strain rate falls below a detectable level, he notes.

Last fall the state seismologist of Alaska, in conjunction with Klaus Jacob and other researchers at Lamont-Doherty Geological Observatory in Palisades, N.Y., issued an earthquake alert for the Shumagin gap because the occurrence rate of small earthquakes during the months May through October 1985 had increased from 30 to 80 percent above the average rate measured in previous years. Moreover, a sequence of magnitude 5 to 6.4 earthquakes had rattled the islands in October, and because the seismic pattern of this sequence was not typical, seismologists were concerned that these were precursory signals of a great earthquake. Now seismologists have to reconcile those seismic



Strain is building up along the Yakataga segment of the Aleutian island chain in a manner consistent with what scientists expect when plates collide and generate earthquakes. But at the Shumagin gap, for which an earthquake alert was issued last fall, scientists are puzzled by the lack of strain accumulation.

signals with Savage's strain results.

If aseismic slip is indeed occurring in the Shumagin gap, says Jacob, "then the activity we saw in October [could mean] that while most of it slips aseismically, there are patches that rupture seismically." Jacob, however, thinks permanent aseismic subduction, while possible, is the least likely explanation for the lack of strain. The alternative, and the most tantalizing of the ideas, he says, is that the patches are only the beginning of a larger rupture to come, and that, as Savage notes, the absence of strain is itself a precursor of a great quake.

"So right now we are in somewhat of a dilemma," says Jacob. "From a research point of view it's an extremely crucial time." Ironically, in spite of the Shumagin

gap's heavy instrumentation and puzzling behavior, Jacob worries that it may not be the best place for catching the precursory signals of a great quake. In the course of reanalyzing the seismic hazards in Alaska and parts of Canada, Jacob and his co-workers recently identified a 1,000-kilometer segment — stretching from Kodiak Island to Unalaska Island and including the 350-km-long Shumagin gap — that has a high probability of rupture. It is possible that a great earthquake and its precursory signs could start somewhere near Kodiak and outside of the Shumagin gap, which would be only minimally involved in the quake. "If that is the case," says Jacob, "we may miss our chance to do really good earthquake prediction."

— S. Weisburd

Miranda continued from p. 103

Having had barely three weeks to study the images, the researchers have agreed on no common explanation for the strange patterns. At a team meeting at JPL on Feb. 5, says Smith, the discussion of Miranda "just went around and around and around." According to assistant team-leader Soderblom, "We're back in the 19th century — all we're doing is classifying things."

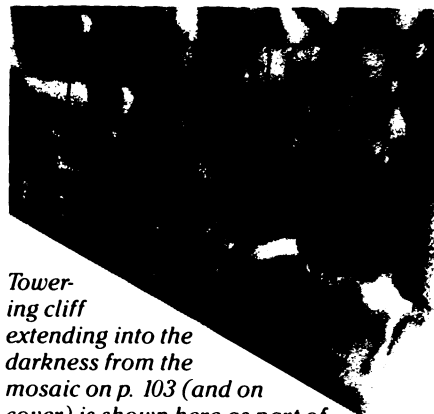
One of the most curious aspects of the "circi maximi," notes Smith, is that the terrain outside them seems so unaffected by their presence. Compared with the stark contrast between the circi and their intervening ordinariness, in fact, he says, even a spectacular like the chevron "is not so bothersome."

Some of the team members have observed that the three circi seem to suggest the same phenomenon with different degrees of evolution. The one containing the chevron could be the least refined, while the one in the lower left corner of the photomosaic may show the most worn appearance, though no one is going so far out on a limb as to assert one circi to be older than the other. Even the less-disturbed-looking "inter-circus plains," however, are anything but dull, bearing intricate patterns of intersecting

faults and fissures that one team-approved photo caption describes as "bewildering."

"Isn't it wonderful?" says Soderblom of Miranda's complexities. Says Smith, "It looks like a satellite designed by a committee."

— J. Eberhart



Towering cliff extending into the darkness from the mosaic on p. 103 (and on cover) is shown here as part of a very preliminary airbrush map being produced by the U.S. Geological Survey in Flagstaff, Ariz. Apparently one face of a huge, torn-open fracture that may be more than 10 miles deep, its dimensions are still being refined, but in Miranda's low gravity, says Torrence Johnson of JPL, "if you fell off that thing, it would probably take you 9 or 10 minutes to reach the bottom."

Bridge to freedom

There is something dramatic about crossing a bridge. This is especially true of the Glienicke Bridge between Potsdam and the Wannsee section of West Berlin, which has become the traditional place for prisoner exchanges between the Eastern and Western powers. On Feb. 11 mathematician Anatoly B. Shcharansky crossed the Glienicke Bridge, ending nine years of incarceration in the Soviet Union.

Shcharansky's treatment had symbolized the plight of the Soviet "refuseniks," people who had been refused permission to emigrate and then harassed in various ways for insisting on their desire to do so. Many of them have professional qualifications the Soviets deem sensitive to their national security. Shcharansky was sentenced in the Soviet Union on a charge of being a CIA agent, an accusation that the U.S. government denies. He insisted on his innocence in a telephone call to President Reagan the evening of his release: "As you know, I never was an American spy." After his release, Shcharansky met his wife, Avital, who had spent the last nine years fighting for his freedom, and the two went on to Tel Aviv. □