Sixth sense: The sexual sniff

In between taste and smell, many animals have another sensory system — a short-range chemical detector. Once considered just an accessory to olfaction, this system is now coming into its own. Although human adults have, at best, only vestiges of the organ, reptiles seem to use it in preference to smell. In a variety of mammals, the system is associated with reproductive functioning, so it can be considered a "sexual sniffer."

At the recent Symposium on Chemical Signals in Vertebrates and Aquatic Animals held in Syracuse, speakers described behaviors involving this specialized system and offered insights into how it functions. The organ in question is called the vomeronasal organ. (The vomer is a skull bone between the nose and the mouth.) It opens into the roof of the mouth or into the nose.

Tongue-flicking behavior characteristic of snakes transfers chemicals from the environment into the vomeronasal organ and helps the snake track its prey (see p. 394). If the organ's opening is sutured closed, or if the nerves are cut, tracking behavior stops until the sutures are removed, reports Gordon Burghardt of the University of Tennessee. If the vomeronasal system is blocked, courtship behavior is also abolished.

In mammals, the vomeronasal system is most clearly involved in receipt of sexual information. Guinea pigs, for instance, bob their heads and lick at a spot of guinea pig urine — with males spending more time bobbing and licking at urine from a female than from a male. If the urine is covered with a fine mesh to prevent direct contact, however, the guinea pig shows less response, says Gary Beauchamp of the Monell Chemical Senses Center in Philadelphia.

A characteristic grimace of some mammals, including deer, moose and cats, involves curling the upper lip, raising the head, opening the mouth and wrinkling the nose. This "Flehmen" response is thought to shuttle airborne chemicals into the vomeronasal organ. Gerda G. Verberne of the Netherlands devised a plug that fits in the organ's opening in the roof of a cat's mouth. With the plug in place, cats decrease the time they spend sniffing and exhibiting the Flehmen response.

The vomeronasal sensation of more exotic animals is also being studied. For instance, a Madagascan ring-tailed lemur makes markings using its genital scent gland. A male exhibits the Flehmen gape more frequently to the mark of a female than of a male, reports Charles Evans of Glasgow College in Scotland.

Techniques more sophisticated than blocking or destroying the vomeronasal organ are also being used to analyze how it functions. Researchers have assumed that large, nonvolatile molecules can enter the organ and an experiment with a fluorescent dye now provides supporting evidence. Beauchamp and colleagues let a guinea pig investigate urine mixed with rhodamine, a large dye molecule. When they viewed thin slices of the animal's vomeronasal organ under a fluorescence microscope, they found that it was brilliantly lit with the dye it had accumulated.

Instead of tongue-flicking or the Flehmen grimace, hamsters and probably other mammals have a pumping mechanism that sucks chemicals into the vomeronasal organ, reports Michael Meredith of the Worcester Foundation for Experimental Biology. The hamster organ is a long, narrow tube with a pore at one end opening into the nasal cavity. A network of veins is enclosed with the organ in its bony capsule. Meredith finds that if he stimulates a nerve coming into the capsule, those blood vessels constrict. The lumen of the organ then expands to fill the space, drawing in fluid through its duct. When the blood vessels relax and dilate, that fluid is forced back out into the nose. Meredith proposes that the pumping is not under voluntary control because an autonomic nerve is involved. He suggests the pumping may be a reflex following stimulation of the olfactory system.

A final question is the destination in the brain of the vomeronasal organ's information. Meredith reports that olfactory and vomeronasal input follow separate pathways and that the vomeronasal organ seems to have more direct input to the regions of the brain that regulate sexual behavior. □

Tropical effects on forecasts

Conventional thinking among the wizards who develop and run weather prediction models has been that, in forecasting ultra-long atmospheric waves (not the short-wave highs and lows we experience daily) in the northern hemisphere for the next week, it doesn't matter what's happening in Australia or South America. Because of that belief, meteorologists who make short-term predictions of large-scale circulation in the northern hemisphere atmosphere have had no qualms about relying on models that exclude all data from the southern hemisphere. Now, their complacency may be shaken by research presented at the recent American Geophysical Union meeting in Washington.

"I have convincing evidence," said Richard C. J. Somerville of the National Center for Atmospheric Research in Boulder, Colo., "that although the conventional wisdom may be true for medium-sized [weather] systems, the very biggest waves ... are affected dramatically and drastically within a day to two by the tropics."

These large-scale waves—only three to six occur around the globe—are crucial to long-range forecasting. The "information" stored and carried in such waves is ultimately passed on to the short atmospheric waves — the highs and lows that determine if it's rainy or sunny at any given spot on earth. Therefore, as Somerville says, any trick that will make forecasts of large-scale circulation better "is money in the bank" for better daily weather forecasting.

Somerville's contribution to the funds came about by comparing the long-range forecasting skill of several different prediction models. Using the actual conditions at Boulder as verification, he found that one model — which "looked" at the whole globe and used global data — produced strikingly accurate five-day forecasts. By contrast, a model that looked only at the northern hemisphere, but included some data from the southern hemisphere, produced accurate forecasts for only three days, and a hemispheric model that completely left out tropical data was good for only one to two days. What's more, Somerville's model contained no "physics" — no factors for clouds, solar radiation or latent heat — but produced better results than models that included such factors. "With the present state of data and physics, erroneous physics appear worse than no physics at all," he said.

Somerville's results could not have come at a better time for the meteorological community. The Global Weather Experiment (SN: 12/30/78, p. 440) — which is furiously collecting data from the tropics — "will have a larger impact than we thought on mid-latitude forecasting," says Somerville. In addition, the National Meteorological Center of the National Oceanic and Atmospheric Administration, which has been using a hemispheric prediction model, is testing a global model for use in the fall. "We couldn't imagine more significant or encouraging results," said John B. Hovermale of NOAA. □

Man flies Channel

On June 12, aboard a spidery, 55-pound craft named the Gossamer Albatross, 26-year-old California bicyclist Bryan Allen became the first human being to fly — not just glide or float — across the English Channel under his own power. The 22-mile journey from the English cliffs to a point about 15 miles south of Calais took just under three hours, with the pilot pedaling to drive the vehicle's propeller. Two years ago, Allen flew a similar craft called Gossamer Condor (designed, like the Albatross, by engineer Paul MacCready) around a pair of pylons on a California airstrip (SN: 9/3/77, p. 149), winning a prize offered by British industrialist Henry Kremer for human-powered flight. Kremer also posted an award for the channel crossing. □