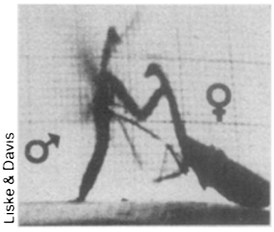
Biology

Julie Ann Miller reports from Anaheim, Calif., at the annual meeting of the Society for Neuroscience

Mantis mates without decapitation



Liske & Davis

Ritual, rather than cannibalism, is the rule among praying mantises, contrary to the popular belief — dating from the 18th century — that females decapitate the males as the standard preamble to copulation. Eckehard Liske of the Zoological Institute of West Germany's Technical University and W. Jackson Davis of the University of California at Santa Cruz have videotaped and analyzed dozens of matings between Chinese praying mantises. They found no decapitations, but a previously unreported and intricate courtship ritual. During a typical courtship, they observed, a male praying mantis shows at least nine behavioral components, including visual fixation, antennal oscillation, an extremely slow approach toward the female, repetitive flexing of the abdomen and a "flying leap" toward his intended mate. The female responds with her own pattern of courtship behavior.

The scientists suggest that this ritual is designed to inhibit aggression between the courting animals. Liske speculates that previous reports of decapitation may have been based on cases where the courtship ritual failed, perhaps due to the conditions of captivity disrupting the elaborate natural behavior.

Receptor analysis in living brains

Communication among brain cells is mainly a matter of chemical transmitter release and reception. The supply of transmitter and the number of transmitter-binding, or receptor, molecules present at nerve cell junctions is often a key to brain disorders. A number of laboratories have recently demonstrated the feasibility of looking at the distribution of specific receptors in the living brain. The researchers use radioactively labeled drugs and a technique called positron emission tomography, or PET (SN: 6/25/83, p. 406). Now Kirk A. Frey of the University of Michigan in Ann Arbor reports an unexpected finding on the kinetics of drug-to-receptor binding that may increase the power of the technique.

"We are teasing out the mechanisms underlying the drug-transmitter binding," Frey says. "We need a well-characterized reaction before we can begin clinical applications." Frey predicts that this work will lead to quantitative measures of human receptors in the next year.

To examine a type of receptor (called muscarinic) that binds the transmitter acetylcholine, Frey and colleagues have compared the binding of a radioactively labeled drug in isolated brain tissue and in the brains of living rats. They found that it takes four hours for the living brain to reach the equilibrium that corresponds to the drug binding observed in the isolated tissue. Because four hours is too long a period for patients to be exposed to high concentrations of the drug, the investigators examined shorter time periods. They found that the equilibrium is not approached uniformly across the brain: Areas with relatively little acetylcholine-based nerve cell communication bind the drug more rapidly than those with dense innervation by acetylcholine-releasing nerve cells.

"It is intriguing that not all receptors behave *in vivo* as a unitary pool," Frey says. He suggests two explanations. The first is that the observations reflect differences in the location of receptors—the more slowly tagged receptors being those active in nerve cell communication and the more rapidly tagged receptors being inactive, for example those in the membrane at locations that do not face junctions with acetylcholine-releasing nerve cells or those being transported within the cell.

The second — and, Frey says, more exciting — possibility is that transmitter naturally present in the junction between nerve cells competes with the drug for receptor binding sites. Therefore active junctions, containing transmitter, would bind the drug more slowly than areas without transmitter present. Frey says this situation would allow researchers, with appropriate analysis of the kinetics of the drug-receptor binding, to use the PET technique to observe both of two clinically important conditions: the number of receptors and the adequacy of transmitter release.

An active voice for glia

Glial cells, which have been considered to be the silent support cells of the brain, can under certain conditions become electrically excitable and behave like nerve cells, reports Brian A. MacVicar of the University of Calgary in Alberta.

The most numerous cells in the brain, glial cells form an extensive interconnecting network surrounding nerve cells. This network has been thought to provide brain nerve cells with metabolic and physical support, but never to initiate electrical signals. Now MacVicar reports that he has observed in glial cells in laboratory culture the occurrence of action potentials — the self-propagating electrical changes that are characteristic of nerve, muscle and endocrine cells. The glial action potentials occurred in response to injections of electrical current and also occurred spontaneously and rhythmically in some glial cells.

Glial action potentials are due to a calcium channel that changes permeability according to the electrical potential difference across the membrane, MacVicar says. He observed the activity of this channel by inhibiting the glial cell membrane's high natural potassium permeability, which normally masks other electrical characteristics.

MacVicar is now investigating whether glial cells under typical brain conditions are also electrically excitable. "A new function may be added to the postulated actions of glial cells," he says. "It may be possible for glial cells to cause widespread excitation of neurons." MacVicar proposes that an influx of calcium through the glial cell voltage-dependent channel may cause an efflux of potassium, which could excite adjacent neurons. He concludes, "Hypothetically, abnormal functioning of such a system could underlie hyperexcitability disorders such as seizures and epilepsy."

It's all in the antennae

When a male sphinx moth sniffs out a female, nerve cells in his antennae respond to a pheromone released by her abdomen. The antennal cells in turn activate nerve cells in the olfactory center of his brain, and this activity initiates male mating behavior. Scientists have grafted precursors of the male antennae onto the heads of female caterpillars and then have allowed the caterpillars to metamorphose into adults. The grafted nerve cells grow into the female's brain and make connections with cells in the olfactory center (SN: 4/23/83, p. 268).

In recent experiments, using a wind tunnel to simulate conditions in the field, the investigators find that female moths with male antennae actually exhibit male-like behavior. They fly into a pheromone-carrying wind current with the zigzagging pattern characteristic of a male moth. They hover around samples of pheromone suspended in the tunnel, and occasionally attempt to make abdominal contact with them. Anne M. Schneiderman and John G. Hildebrand of Columbia University in New York and Margaret M. Brennan and James H. Tumlinson of the USDA Agricultural Research Station in Gainesville, Fla., where the wind tunnel is located, conclude, "Thus, the grafted male cells that grow into the brains of operated females make connections with certain nerve cells and, amazingly enough, influence their activity to the extent that the females display some atypical female, but typical male, mating behaviors."