Steady cocaine use linked to seizures

When moderately strong doses of cocaine are repeatedly given to rats, a considerable number of the animals develop lethal convulsions, according to scientists who spoke at an Alcohol, Drug Abuse and Mental Health Administration seminar last week in Washington, D.C.

"Our studies suggest that this 'kindling' process [in which convulsions are promoted by repeated consumption of the same dose] might easily mislead users into thinking they are taking a safe dose when, in fact, they are gradually lowering their brain's threshold for seizure and sudden death," said Robert Post of the National Institute of Mental Health, who reported the data along with colleague Susan Weiss.

The researchers first confirmed earlier reports that cocaine kindles seizures. About 40 percent of the rats they studied developed convulsions in the week after daily cocaine injections began. Either the first or second seizure resulted in death.

Cocaine is both an amphetamine-like stimulant and an anesthetic, says Post. To determine whether the anesthetic property kindled seizures, the researchers gave the rats equal doses of the local anesthetic lidocaine. Again, seizures rapidly developed, but the animals did not die. Post suggests that while the anesthetic properties trigger the seizures, cocaine's stimulant properties or interactions between stimulant and convulsive effects result in lethal convulsions.

The stimulating effects of cocaine on rats' behavior, such as hyperactivity and repetitive sniffing, were also increased by prior treatment with both lidocaine and amphetamine, notes Post, indicating that the drug's anesthetic and stimulant properties are both involved. Furthermore, a familiar environment significantly intensified behavioral responses to cocaine. Rats injected in the same test cage showed much more hyperactivity than rats given identical doses first in one test cage and then in another.

Individual responses to cocaine vary among both humans and rats, says Post, and not everyone develops an uncontrollable craving for the drug. But many people do not stop using cocaine once they start, and, he notes, "even if there is no dose escalation, one becomes more vulnerable to seizures over time. The point is, there's no safe dose." — *B. Bower*

Bee navigation: The eyes have it

Entomologists have long known that bees use polarized sunlight to navigate. Two Swiss scientists now say that a bee's navigational "map" lies embedded in special photoreceptors in its eyes. According to Samuel Rossel and Rüdiger Wehner of the University of Zurich, ". . . the array of receptors [in the bee's eyes] forms a template which the bee uses to scan and match the polarization patterns in the sky."

In the 1940s, Nobel laureate Karl von Frisch showed that bees have a simple yet elegant way of communicating the location of distant sources of food. When a foraging bee returns to the hive, she performs a "waggle dance" consisting of a short run ending in a loop that returns her to the beginning point of her run. The direction of her run indicates the direction of the food source with respect to the sun.

A sister bee observing this performance somehow remembers the size of the angle between the sun and the food indicated by the dancing bee. She flies out of the hive, makes a quick calculation of the position of the sun, and zips away at the same angle.

Bees have compound eyes made of almost 6,000 tiny lenses covering the openings of equally tiny tubes. Each tube contains eight light receptors that look like toothbrushes with the bristles facing each other at the lens end of the tube; the "handle" is the nerve going to the brain. The tubes located at the top of the bee's eye contain "toothbrushes" that specialize in detecting polarized ultraviolet light. Beginning at the back of the bee's compound eye and continuing around to the front, these specialized photoreceptors in each tube are arranged in a pattern that matches the direction of polarized sunlight.

Polarization results when the atmosphere scatters incoming sunlight and restricts the light's electrical field to a certain direction. When polarized sunlight enters a bee's eye, it stimulates the bristles, which in turn stimulate the photoreceptor "handles" that send a message to the bee's brain. Polarized sunlight with an electrical field direction that matches the direction of the bristles stimulates the bee's eye more than any other type of light.

In a complicated series of experiments described in the Sept. 11 NATURE, Rossel and Wehner showed that a bee flies in a circle until the special receptors in her eye detect the maximum stimulation from polarized light. The map in her eye tells her that, in this position, she is facing directly away from the sun. Remembering the orientation of her sister bee's waggle dance back at the hive, the bee veers off at the same angle to make a beeline for lunch.

— *T. Kleist*

New interferometer gets Sirius

Stars do not appear as disks in the images made by terrestrial telescopes, so astronomers cannot directly determine their sizes. Sometimes, however, the technique of interferometry — combining wave trains, or signals, received from the source at different points and measuring the differences between them — can yield information about stellar sizes. Now two Australian astronomers, John Davis and William J. Tango of the University of Sydney, report that they have determined the angular diameter of the star Sirius by a new interferometric technique, amplitude interferometry, that has not previously been used for stars of ordinary size. They say amplitude interferometry is more sensitive and applicable to more stars than techniques previously in use.

Classic interferometry works with differences in phase. Two wave trains received simultaneously from a single source at different observing stations will usually differ in phase, and the phase difference depends on the geometry of the source and the distance between the observing stations. Stars offer two other interferometric possibilities — intensity and amplitude. A star is a collection of billions of individual emitters, and the sum of their activity yields a signal that shows a complicated pattern of minute fluctuations in both intensity and amplitude of the waves. This pattern depends on the size of the star, so an interferometer built to work with intensity or amplitude could determine stellar sizes. Intensity interferometry has been pioneered in Australia, and the intensity interferometer at Narrabri, New South Wales, has measured a number of stars.

Amplitude interferometry is more delicate, and there were fears that atmospheric turbulence would destroy the correlations that make it work. But it does work, Davis and Tango report in the Sept. 18 NATURE. They measured the angular diameter of Sirius to be about 5.63 milliseconds of arc, agreeing well with the Narrabri measurement of 5.60. They say this is the first independent check of any of the Narrabri measurements, and it took only 2 percent of the observing time that the measurement of Sirius did with the Narrabri instrument. The angular diameter, the angle between lines of sight from the earth to opposite ends of the star's diameter, can be converted to kilometers if astronomers know the distance to the star.

Encouraged by this success, Sydney astronomers are planning to build a large amplitude interferometer, which will have 100 times the sensitivity of the intensity interferometer at Narrabri.

— *D. E. Thomsen*