Male-female contrasts: The vole story

A stout rodent known as the vole has provided scientists with a peek at how sex differences may evolve in behavior and brain structure.

The hippocampus — an inner-brain structure critical to processing spatial information — takes up a significantly greater portion of the total brain in the polygamous male meadow vole than in the monogamous male pine vole, report biologist Lucia F. Jacobs of the University of Pittsburgh and her colleagues. Females of both species show a hippocampal size closely matching that of the faithful male pine vole, they add.

Breeding male meadow voles range over large areas in search of sexually receptive mates, while male pine voles and females of both species stick close to home. The polygamous males also perform better in laboratory mazes testing different types of spatial ability. These voles apparently evolved superior spatial skills—and larger hippocampi to regulate those skills — in order to navigate efficiently throughout their surroundings during breeding season, the researchers assert in the August PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES (Vol.87, No.16).

Sex differences in hippocampal size related to spatial ability should occur in a wide variety of mammals, they theorize, since males in most mammalian species practice polygamy. Indeed, says Jacobs, anthropological research indicates that in most human societies, men engage in polygamy and range over larger territories than women. Men consistently score higher than women on tests of spatial ability, but scientists have not studied human sex differences in relative hippocampal size.

However, researchers have found differences in hippocampal size and spatial ability that favor male laboratory rats, the descendants of polygamous rodents. Hippocampal size also varies across related species with different spatial capacities. Bird species that store food in thousands of locations throughout a home range, for instance, possess markedly larger hippocampi relative to total brain size than non-food-storing bird species.

Hippocampal size contrasts show up more strongly between vole sexes in the same polygamous species than between vole species, Jacobs says. She and her coworkers studied the brains of 10 male and 10 female voles in each of the two species. All the voles came from wild populations.

"So far, we've looked at the hippocampus in a simple way, measuring its size relative to the overall brain," Jacobs says. In follow-up studies, they will attempt to determine whether specific parts of the hippocampus enlarge disproportionately in polygamous male voles.

Spatial abilities stem from several brain areas, although the hippocampus appears crucial for navigating a complex environment, Jacobs adds.

For now, the findings support a rarely tested principle of brain organization formulated in 1973 by neurologist Harry J. Jerison of the University of California, Los Angeles, the researchers say. Jerison proposed that the mass of brain tissue controlling a particular function corresponds to the amount of information processing required to perform that function. Applied to the new data on voles, his theory suggests that greater environmental demands on spatial navigation among polygamous male voles lead to larger hippocampi.

Environmental pressures may also lead to the enlargement of as-yet-unspecified brain regions in female voles, Jacobs notes. Since females need more calories than males for lactation and child care, brain regions regulating memory for the location and contents of food-storage sites may show a female-specific size advantage, she suggests. — *B. Bower*

Male fragrance attracts moth mates

Two years ago, entomologist Peter J. Landolt noticed something strange about the mating behavior of the cabbage looper moth, *Trichoplusia ni*. The caged insects hung upside down, vibrated their wings, raised their abdomens and partially exposed their genitalia in the familiar stance associated with the release of sex pheromone — a perfume irresistible to loopers of the opposite sex. Many female moths, including cabbage loopers, secrete such chemical lures.

But in this case the pheromone producers were males.

Landolt and chemist Robert R. Heath at the USDA's Insect Attractants, Behavior and Basic Biology Research Laboratory in Gainesville, Fla., have now isolated and identified a sex pheromone produced by male cabbage loopers — the first direct evidence, they say, that male moths of any species secrete a scented lure to announce their presence to potential mates.

Landolt and Heath say the finding suggests a better moth trap for limiting populations of this pest, whose larvae devour the leaves of cabbage, broccoli and other cruciferous vegetables. The discovery also highlights the male looper's unusual role in the insect mating game, the scientists note in the Aug. 31 SCIENCE.

Female cabbage loopers seek out males for breeding — a reversal of standard sex roles among insects, says Landolt. The females must also scout for suitable egg-laying sites. In the laboratory, Landolt and Heath found that male loopers often mark plants appropriate for egg-laying with a telltale pheromone scent. Thus, female cabbage loopers hit the jackpot when they follow their noses, finding both home and hubby with a minimal expenditure of time and energy.

Landolt calls sexual communication among looper moths "a two-way street" that likely evolved to ensure successful mating. The male pheromone consists of a mixture of a rare form of linalool—a sweet-smelling oil otherwise found only in coriander seeds—and cresols, a component of coal tar. Female loopers emit a chemically distinct male-attracting odor, the researchers find.

Males far outnumber females in this species, and efforts to reduce cabbage looper populations by luring males to traps sprayed with female sex pheromone have proved ineffective, leaving a large percentage of males still available for mating. Landolt and Heath suggest that traps baited with the newly isolated male pheromone may work better by targeting the smaller population of females. — *R. Cowen*

A chemical glance at short-lived elements

The chemical elements lawrencium, rutherfordium and hahnium hardly contribute to the stuff of everyday life. Synthesized one atom at a time by bombarding heavy nuclei with ions, these highly radioactive elements generally survive just a few seconds before decaying into other atomic isotopes.

Darleane C. Hoffman of the Lawrence Berkeley (Calif.) Laboratory and her coworkers, including collaborators in West Germany and Switzerland, have taken up the challenge of determining the chemical properties of these short-lived elements. Such studies enable researchers to see where the elements fit into the periodic table and whether they follow the trends in chemical behavior evident among lighter elements along the table's rows and columns. The researchers also look for evidence of new isotopes, in which the number of neutrons present in a nucleus differs from known varieties, and for traces of spontaneous fission, in which a newly synthesized nucleus immediately splits into two pieces.

Hoffman's team has been focusing on hahnium, or element 105. From its assigned position in the periodic table, hahnium ought to behave like its stable neighbor tantalum. However, recent ex-

periments show that hahnium has a number of chemical properties resembling those of protactinium, a naturally occurring element situated beside uranium in the so-called actinide series. Protactinium is a dangerous, highly toxic material that requires precautions similar to those used when handling plutonium.

"Like plutonium, hahnium seems to have very nasty properties," Hoffman says. "There are many challenges in these studies of the heaviest elements." She described the results of her team's investigations at last week's American Chemical Society meeting in Washington, D.C.

The researchers synthesize hahnium by firing oxygen ions into a target consisting of berkelium-249. The resulting isotope, hahnium-262, has a half-life of 35 seconds, allowing only a tantalizingly brief interval in which to dissolve the isotope in water to study its chemistry in solution, or to react it with bromine to study its properties as a gas.

Like tantalum ions, hahnium ions in nitric acid stick to glass. However, whereas the organic solvent methyl isobutyl ketone readily extracts tantalum from solution, it fails to pull out hahnium. This result, along with hahnium's response to other solvents and the behavior of hahnium bromide in the gas phase, seems to put the element nearer to the protactinium camp than the tantalum group.

The findings support the notion that subtle quantum-mechanical and relativistic effects play an important role in establishing hahnium's electron arrangement, which determines the element's chemical properties. Such special effects are usually negligible in lighter elements.

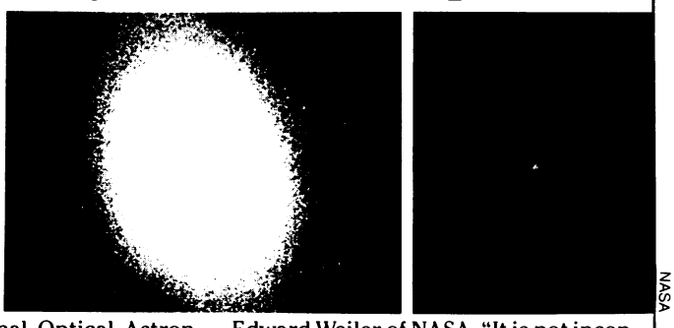
"The nuclear and chemical properties of these [heavy] elements go hand in hand," Hoffman says. "They're hard to separate."

Hoffman would like to extend her chemical investigations to elements with a higher atomic number (a larger number of protons) than hahnium, but the half-lives of known isotopes of elements 106, 107, 108 and 109 — sighted but not yet named — are 0.8 second or less, often much less. That severely limits the time available for studying their chemistry.

However, researchers continue to search for heavy-element isotopes with significantly longer half-lives. The synthesis in 1986 of two relatively long-lived isotopes, lawrencium-261 and lawrencium-262, furnishes grounds for hope. These isotopes have half-lives 100 to 500 times longer than predicted by theory — sufficiently long to permit detailed studies of the chemical properties of lawrencium, the last member of the actinide series.

Lawrencium-262 also decays into nobelium-262, an isotope of element 102 containing more neutrons than any other known atomic nucleus. — *I. Peterson*

Within a galaxy and outside a supernova



NASA

Astronomers got more than they expected when they turned the Hubble Space Telescope on the galaxy NGC 7457, about 40 million light-years away. "We thought it would be a boring, ordinary galaxy," says Tod R. Lauer of the National Optical Astronomy Observatories in Tucson, Ariz.

Instead, Hubble's wide-field and planetary camera found a galactic center packed with about 400 times more stars than predicted from Earth observations. The left image shows NGC 7457's center, while the right image, with contrast adjusted, reveals a huge concentration of stars at the galaxy's heart.

The finding, announced last week, suggests that the centers of many "normal" galaxies may contain far more stars than previously believed. It also raises the question of whether the crowd of stars in NGC 7457 results from the gravitational attraction of a black hole at its center.

"We're not claiming that this is a black hole," says Hubble program scientist Edward Weiler of NASA. "It is not inconsistent with a black hole, however."

Hubble's faint-object camera, provided by the European Space Agency, also photographed a bright ring or shell of gas surrounding supernova 1987A. Both ground-based and satellite observations had indicated the existence of the material, a slowly moving remnant of the hydrogen-rich envelope ejected by the star during its red supergiant stage, some 10,000 years before it exploded.

A few hours after the cataclysmic blast, ultraviolet radiation from the supernova heated the gas and set it aglow. Within a few decades, astronomers say, fast-moving debris from the explosion will completely engulf the gas. — *J. Eberhart*

Energy studies proposed to cool greenhouse

To confront the threat of a greenhouse warming, the federal government should substantially increase its support for research into energy conservation and the use of renewable energy resources such as solar power and wind, a panel of experts concludes in a report issued last week.

The National Research Council panel suggests boosting these efforts by an additional $300 million, which amounts to about 20 percent of the current budget for energy-related research and development. It recommends obtaining such funds from money earmarked for research into magnetic fusion and fossil-fuels development.

The panel also suggests that the government consider a more intensive, multibillion-dollar effort in energy research, which the nation could adopt if concerns about greenhouse-gas emissions grow in the future. These funds would go toward developing emissions-reducing technologies not economically viable at present.

As a first step, though, the panel recommends pursuing energy research that will both reduce emissions and address some unrelated concerns such as national security. Enhancing studies on conservation and renewable energy would not only help cut emissions but also reduce U.S. dependency on foreign fuels, notes panel chairman David L. Morrison of the MITRE Corp. in McLean, Va.

During the 1980s, while oil prices dropped considerably, federal funding for renewable-energy R&D declined by 89 percent, and support for conservation programs dropped by 61 percent. "Current funding for alternative-energy R&D in the United States is not sufficient to address the problem of achieving major reduction in greenhouse-gas emissions," the panel concludes.

While many conservation groups welcome the recommendations, the new report has drawn criticism from some energy analysts. "Advocating more research is not, in my view, the primary way to reduce greenhouse-gas emissions," says James MacKenzie, a senior associate at the World Resources Institute in Washington, D.C. MacKenzie contends that the government must ensure that industry and the public adopt energy-efficient, low-pollution technologies. "There's a lot available now. We're incorporating some of it now, but we could be doing much better."

MacKenzie also warns against spending too much on federal research without stimulating research by private companies. — *R. Monastersky*