Insect lifestyle in rodent underground

The adult naked mole rat weighs up to 2 ounces and measures 3 to 5 inches, snout to tail tip. A queen rat can have litters of 10 to 30 pups, and the animal's can live more than 10 years.

Christopher Springmann, National Geo. Soc.

Avoid the rat-race of mammalian society and enjoy life with a "queen bee." A small burrowing African rodent recently has been found to do just that. In a style surprisingly similar to the social system of wasps and bees, the naked mole rats live a usually quiet and industrious life in a colony devoted to the breeding of a single dominant female.

"Their social behavior is one of the mammal finds of the century," says Richard D. Alexander of the University of Michigan in Ann Arbor.

Naked mole rats live in Kenya, Ethiopia and Somalia in underground colonies. Jennifer U.M. Jarvis of the University of Cape Town in South Africa began studying them a decade ago. More recently colonies of naked mole rats have been set up in two laboratories in the United States. The animals require high temperature and humidity and eat mostly root vegetables.

In each colony, in nature or in the lab, only one female and one or a few males breed. The majority of the naked mole rats are workers who keep the tunnels clear and forage for food.

"Naked mole rats are the only mammals with a caste that surrenders its breeding rights without constant friction and fighting," Alexander says. But when the colony loses its queen, there is sometimes mayhem, reports Paul W. Sherman, who maintains 90 naked mole rats in four colonies, each housed in 50 feet of clear acrylic drain pipes in his laboratory.

"There is intense fighting among both males and females," Sherman says. "Often would-be breeders, especially females, are killed. Things don't settle down until another female becomes dominant and starts breeding."

A major industry of the naked mole rat colony is the digging and moving of earth in a highly coordinated manner, Jarvis first reported. A mole rat at the blind end of a tunnel uses its oversize front teeth to chisel the earthen face, creating a pile of dirt. Then this mole rat scuttles backward through the tunnel, moving the pile of earth with its legs. At the opening, it gives up the pile to another animal, who kicks the dirt out of the tunnel. The first worker then returns to the blind end, crawling on tiptoe over other workers who are moving backwards with their own dirt piles.

"It's like a Caterpillar tractor tread of moving mole rats, pushing inexorably forward," Sherman says. "The single 'kicker' mole rat stays at the tunnel opening producing a little volcano with its continual stream of earth." Sherman says that in Africa such volcanoes are common in hard-packed soil, sometimes even appearing in the middle of asphalt roads. —*J.A. Miller*

Written on the wind: Tracing acid rain's elemental signature

The winds that sweep across the northeastern United States carry with them pollutant particles containing traces of practically every chemical element. These trace elements are becoming increasingly important for pinpointing the origin of pollutants like the sulfates and nitrates found in acid rain (SN: 7/30/83, p. 72).

The elemental composition of this windblown dust depends on where the dust is picked up. Because different regions of the country use different mixes of fuels, have different industries and require different levels of pollution control, particles picked up in these areas are likely to have distinctive elemental "signatures." These signatures can show up in particles deposited at sites hundreds of miles from the original sources.

In the last two or three years, several groups of researchers have started to use elemental tracer analysis to find out where the sulfates and nitrates that fall as acid rain originate. The technique shows considerable promise despite disagreements among scientists about how best to collect samples for analysis and about what kinds of conclusions are justified, given the skimpy data available. Evidence is growing that midwestern pollution sources contribute significantly to acid deposition in the Northeast.

In the Jan. 13 SCIENCE, Kenneth A. Rahn and Douglas H. Lowenthal of the University of Rhode Island in Narragansett outline their method for using ratios of selected trace elements to identify the origin of wind-carried particles. They look at the ratios of arsenic, antimony, zinc, indium, manganese and vanadium to selenium. First, they measure these ratios for particles collected within a given region to establish a regional signature. High levels of vanadium, for example, turn out to be associated with emissions from oil-fueled power plants, which are generally located along the East Coast, while selenium and arsenic levels are higher for midwestern, coal-fired plants. So far, Rahn's group has developed 12 regional signatures, six for North America and six in Europe for "Arctic haze" studies (SN: 1/29/83, p. 69). The characteristics of samples collected at more remote sites can then be compared with these regional signatures. The amount of sulfate present is linked statistically to the elements that make up the signature.

Based on results from daily samples taken in western Pennsylvania, High Point, N.J., Underhill, Vt., and at Narragansett, Rahn suggests that for sites in the Northeast, local sources roughly contribute as much sulfate as midwestern sources. Although this applies to particle deposition, Rahn says he expects a similar pattern to hold for acid precipitation.

Liaquat Husain of the New York State Department of Health in Albany has been applying a similar analytical technique at six sites within the state. Unlike Rahn's daily sampling schedule, samples were taken as often as every six hours, and Husain's data also take into account wind direction. Husain comes up with estimates that show, for example, that 70 percent of all sulfate reaching Whiteface Mountain in the Adirondacks comes from midwestern sources. Husain says, "The technique is useful, but you have to know where and when and how to apply it." He adds that he has recently extended his own tracer scheme so that it can specifically identify, in a mix of signatures, the contribution from a local power plant.

Robert K. Stevens of the Environmental Protection Agency's air pollution research center in Research Triangle Park, N.C., has also done extensive research on tracers and receptor modeling. In his own detailed studies, Stevens has recently shown that in the Shenandoah Valley in Virginia, both the sulfate and nitrate components in the air can be traced back to midwestern, coal-fired power plants. Stevens' paper, which will appear soon in ATMOSPHERIC ENVIRONMENT, is the first to show a definite link between power-plant nitrate emissions and acid nitrate deposition at a distant receptor site.

Stevens argues that too few data are available yet to distinguish clearly between local and distant sources of sulfate across a wide region. Elemental tracer studies, however, provide important clues, he says. With the extension of tracer analyses to include more elements and various organic compounds, and the addition of detailed meteorological data and microscopic techniques for identifying particular minerals, finding where a pollutant has come from by looking at what arrives looks very promising.

—*I. Peterson*