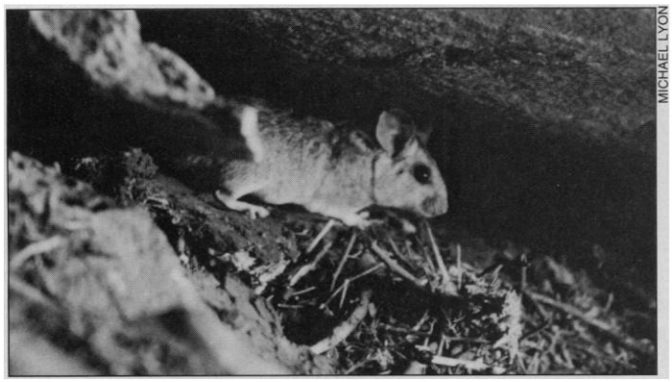
Pack Rats' Liquid Legacy



Midden in the making. *A desert pack rat adds to its nest.*

The lamentable housekeeping of desert pack rats is proving to be a boon for researchers seeking a record of Earth's exposure to cosmic rays. So says Pankaj Sharma, a radiochemist at the University of Rochester who has been analyzing an ancient pack rat "midden" or nest—an underground mass of sticks and other detritus, permeated with the animals' urine. At a meeting of the American Geophysical Union in San Francisco last month, Sharma reported that he and his colleagues have unearthed tentative confirmation that tens of thousands of years ago, Earth was subjected to a much stronger bombardment of cosmic rays than it is today, probably because its protective magnetic field was weaker.

The key is the rats' urine— specifically, the chloride salts it contains, says Sharma. Cosmic rays smashing into argon atoms in the atmosphere generate chlorine-36, a long-lived radioactive isotope. Falling to Earth in rain, the cosmic ray chlorine is taken up by plants, then passed on to plant-eating animals that excrete it in their urine in salt form.

Most animals don't preserve their urine for posterity, but the desert pack rat harbors its own waste so assiduously that middens tens of thousands of years old are caked with a substance said to have the texture of hardened molasses. Such middens have already proved to be rich troves for studies of ancient plant communities. So, says Sharma, he and his colleagues thought: Why not look at cosmic rays?

His colleague Fred Phillips of the New Mexico Institute of Mining and Technology proceeded to extract chlorides from various levels of a large midden excavated in western Nevada by Peter Wigand of the Desert Research Institute in Reno. When Sharma analyzed samples from one of the levels, dated at 21,000 years old, he found evidence that the cosmic ray flux then was 41% higher than it is today; chloride from a shallower level 12,000 years old, indicated a 28% higher flux.

Those results are in line with what other workers have concluded from studies of carbon-14, another element spawned by cosmic rays. And they bode well for the group's plans to broaden their cosmic ray survey to other middens and extend it further back, perhaps as far as 40,000 years.

taken out of action.

The search for a tenth planet was only a small part of the New Zealand station's activities. USNO also had to abandon plans to use the telescope for a major Southern Sky Survey, as well as ongoing work to provide an optical reference frame for interesting radio sources.

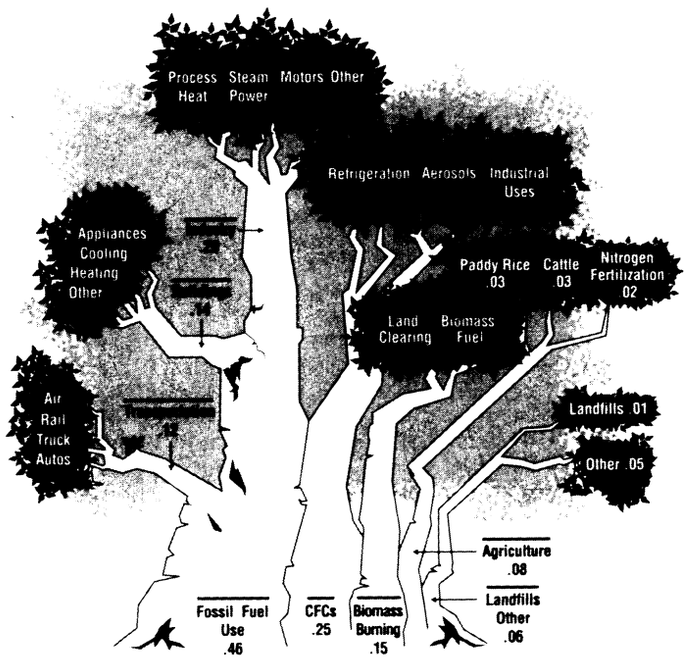
People vs. the Ecosystem

The causes of the earth's big environmental problems—deforestation, loss of biodiversity, pollution, climate change, and so forth—are all rooted in human behavior. Yet, as noted in a new book-length report* from the National Research Council (NRC), the social sciences have played only a peripheral role at best in environmental research programs such as those on global change. No government agency, other than the National Science Foundation (NSF), has the wherewithal to mount a significant social science research program. And existing research on human-environment interactions tends to be confined "within the boundaries of single disciplines."

The report's recipe for overcoming this neglect? You guessed it: a well-funded new research program. The NRC's Committee on the Human Dimensions of Global Change is urging the establishment of a "comprehensive national research program on the human dimensions of global change." The committee, chaired by Oran R. Young, chairman of the Institute of Arctic Studies at Dartmouth College, calls for the gradual phase-in of a program that would ultimately be funded at $45 million to $50 million a year. It would include the establishment of five new national interdisciplinary research centers, a new information network, a new fellowship program, and a variety of new research programs. That would include an increase in NSF's grants for research on human-environment interactions from $3.6 million to $11 million a year. But other agencies as well as private funding sources are called upon to get involved in all aspects of the program.

Doing it right will require interdisciplinary collaboration on an unprecedented scale. Says the report: "The need to understand global change may well become a powerful force for change in the existing structures of scientific disciplines."

*"Global Environmental Change: The Human Dimensions" is available for $29.95 plus $3 shipping from the National Academy Press, 2101 Constitution Ave. NW, Washington D.C. 20418.



A tree-structured representation of the relative contributions to greenhouse warming of human activities in the late 1980s.