

SCIENCE NEWS OF THE WEEK

Punching Holes in the Sky

On May 14, 1973, the day the Skylab workshop was launched from Florida by the last of the huge Saturn V rockets, researchers at the Air Force Geophysics Laboratory in Massachusetts were working on what seemed to be a completely unrelated task. They were monitoring transmissions from the ATS-III satellite as an indicator of the number of ions and free electrons in the ionosphere, through which the signals were passing on their way to the ground. Even when, shortly after the launching, the number abruptly dropped by about 60 percent, no one was immediately aware of any obvious link between the two events.

It took a year, says Michael Mendillo of Boston University, to figure out the "Skylab effect." The combustion products of the hydrogen and oxygen propellants in the rocket's second stage, spewing out within the ionosphere, had reacted with the ionosphere's positively charged O^+ ions to form the positive molecular ions H_2O^+ and OH^+ . These in turn reacted with the local free electrons (which are negatively charged), thereby becoming neutral and effectively taking the electrons out of circulation. The result, at least in terms of free electrons: an artificially produced "hole" in the ionosphere, lasting for more than an hour and extending for hundreds of kilometers. As viewed from Massachusetts, the ATS-III signal path simply happened to pass through the hole. In previous Saturn V launchings, the second-stage engines had been fired below the level of the ionosphere, so the effect had not appeared.

It was a newly discovered process, says Mendillo, involving fundamental processes of the ionosphere. But besides suggesting a new area of basic research, the effect seemed to have some real applications. Mendillo and Michael D. Papagiannis, also of BU, proposed that sounding rockets with haloes of water could be used to create such holes deliberately, in order to temporarily increase the ionosphere's transparency to the wavelengths used in low-frequency radioastronomy.

Arecibo, over which holes will be blown.



Cornell Univ.

Study of the holes may also prove important in evaluating the possible environmental effects of the proposed solar power satellites (see p. 256), whose in-orbit construction could require launching great numbers of rockets that would release large quantities of water into the upper atmosphere or ionosphere. Morris Pongratz and Gordon Smith of the Los Alamos Scientific Laboratory in New Mexico suggest that data on the holes could even be relevant to long-range climate studies. It has been proposed that earth's passage through the spiral arms of the galaxy may be connected with the triggering of ice ages (SN: 7/12/75, p. 23), and some theorists feel that the enhanced molecular hydrogen in the spiral arms could lead to ionospheric depletions similar to the Skylab effect.

The first attempt at deliberately generating an ionospheric hole was less than a resounding success. A sounding rocket launched from Alaska in 1976 carried a can of water with an explosive device to release the water into the ionosphere. Unfortunately, says Mendillo, the rocket (for which the hole project was only a secondary objective) was launched at night, "when there is not much ionosphere anyway," and the explosive detonated at too low an altitude. There were also telemetry problems and other difficulties.

This week, however, researchers at the meeting of the American Geophysical Union in Miami Beach reported on two successful attempts, together known as Project Lagopedo (Spanish for ptarmigan, a feather-footed bird). A pair of sounding rockets were launched last Sept. 1 and 11 from the Hawaiian island of Kauai, carrying payloads of water and carbon dioxide. The vapors were deployed 262 and 283 kilometers (respectively) above the earth, well within the ionosphere, and each firing produced a "hole" about 50 kilometers across, heavily monitored both from the ground and from the rockets themselves.

A far more elaborate plan, Mendillo told the meeting, is now being planned for as early as 1981, to be conducted from the Spacelab research module aboard the space shuttle. As many as six holes will be created by the exhaust from the small engines of the shuttle's orbital maneuvering system, which will be fired at locations in orbit above five research facilities.

A firing over the huge Arecibo antenna in Puerto Rico (at about 18°N) will yield data on ionospheric depletion effects at low mid-latitudes. Higher-latitude effects will be studied with the aid of a hole over the 150-foot steerable dish at Millstone Hill, Mass., at about 41°N. Researchers at a facility at Roberval, Quebec, will study whether the holes can create a "preferen-

tial path" different from the earth's magnetic field lines for atmospheric "whistlers," while a dipole array at Jicamarca, Peru, will look for signs of ionospheric irregularities that show up as a "twinkle" in radio signals, similar to the optical twinkle of stars caused by thermal instabilities in the atmosphere. Finally, the possibilities of low-frequency radioastronomy, particularly below about 3 megahertz, will be studied using a "hole" over the large Llanherne/Reber antennas at Horbart, Tasmania.

The ambitious effort is scheduled for the second Spacelab flight, Mendillo says, which is tentatively expected to take place on the fourteenth or fifteenth mission of the space shuttle. □

Lipoproteins: A delicate balance

Women, Greenland Eskimos and marathon runners have at least two things in common — decreased risks of heart disease and high plasma levels of high density lipoproteins (HDL). Evidence is accumulating that the two may be related.

Cholesterol, a known felon in heart disease, circulates in the bloodstream bound to lipoproteins, conjugated compounds of lipids and proteins. These come in two basic types: high density (more protein than lipid) and low density (more lipid than protein). The latter type is divided into low density lipoproteins (LDL) and very low density lipoproteins (VLDL).

Certain species, such as the rat, that are resistant to atherosclerosis, primarily have HDL. Other species (pigs, most monkeys and, unfortunately, humans) circulate most of their cholesterol attached to low density lipoproteins and are prone to heart disease. However, even though humans for the most part have LDL, increased levels of high density lipoproteins may protect them against heart disease. Large epidemiological studies indicate that the more LDL present, the greater risk of atherosclerotic heart disease; increased amounts of HDL lower the risk.

Although it is still not clear whether HDL levels prevent the onset of atherosclerosis in humans or animals, researchers are intensely interested in why people with high density lipoproteins are resistant to disease and what alters the levels of the lipoproteins.

In atherosclerosis, cholesterol accumulates in the arterial walls. Apparently, low density lipoproteins with their bound cholesterol infiltrate the cells of the walls. The cholesterol keeps collecting and eventually coalesces into larger and larger

SCIENCE NEWS, VOL. 113, NO. 16

patches that narrow the blood vessel. Scientists hypothesize that high density lipoproteins are beneficial because they can lure the cholesterol out of the arterial walls and deliver it to the only organ in the body that can degrade it, the liver.

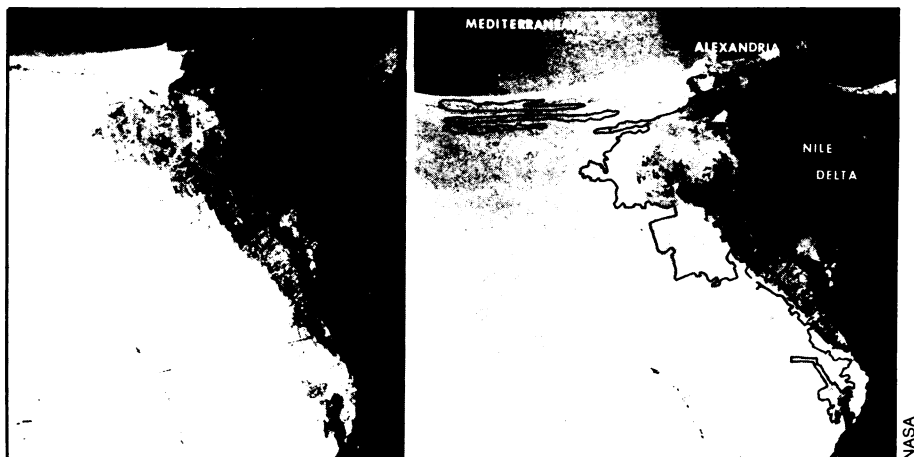
Most supporting data for this mechanism have come from studies of isolated tissue culture cells (SN: 2/4/78, p. 72). Now an *in vivo* study reported in the April 7 SCIENCE has found that the liver of a woman selectively used the cholesterol bound to high density lipoproteins rather than that bound to low density lipoproteins. Charles C. Schwartz and colleagues in the departments of medicine and surgery at the Veterans Administration Hospital in Richmond, Va., intravenously injected radioactive labeled HDL and LDL and sampled blood and bile frequently for the next 11 hours. (The bile was easily obtained because the woman had had her gall bladder removed and the bile duct had been connected to the body surface.) Three days later they repeated the experiment, switching the radioactive labels on the HDL and the LDL. In both experiments the free cholesterol from high density lipoproteins was more rapidly incorporated into biliary cholesterol than was the free cholesterol from low density lipoproteins. The control tissue, red blood cells, preferred cholesterol from HDL more than that from LDL also, but the difference was quite small in comparison to the liver.

Obviously, one patient does not a theory make, but this observation does support the hypothesis that HDL delivers its load of cholesterol to the liver where it is metabolized and destroyed.

Why do premenopausal women, Swedish skiers and Greenland Eskimos have elevated levels of HDL? Why are levels depressed when cholesterol or triglyceride levels are high, or when a person is obese or diabetic? Why are the levels of HDL high when the levels of LDL are low, and vice-versa? Answers to these questions are not yet to be had.

Studies have been hampered because the high density lipoproteins in most animal models have proved resistant to manipulation. Last week at the annual meeting of the Federation of American Societies for Experimental Biology in Atlantic City, N.J., J. L. Hojnacki, Robert J. Nicolosi and Kenneth C. Hayes of the Harvard School of Public Health reported that they had found a model that responded to increased dietary cholesterol by elevating the levels of high density lipoprotein rather than the low density lipoprotein levels. Cebus monkeys, unlike most others, have a majority (80 percent) of high density lipoproteins and are very resistant to atherosclerosis. The researchers hope that this model will reveal what regulates HDL levels and that the findings can be extended to manipulate the HDL levels in humans in order to decrease the risk of atherosclerotic heart disease. □

Greening the Egyptian desert



The above photo (left) of the Egyptian desert, taken from orbit during the July 1975 Apollo-Soyuz space-rendezvous mission, may seem unexceptional enough — until it is compared with a photo of the same region (right) taken 10 years before during the flight of Gemini 5. In the intervening decade, says Farouk El-Baz of the Smithsonian Institution, Egypt has reclaimed about 686 square kilometers of desert for vegetation. Also outlined on the Gemini photo are areas identified as fertile and with reclamation potential. This, says El-Baz, is important to a country whose land is only about 4 percent fertile.

Genius and parental loss

“Anna O.,” a patient of Sigmund Freud’s, lapsed into the hysterical symptoms of headaches, paralysis and anesthesia in her limbs during her father’s terminal illness and after his eventual death. She later discovered, through psychotherapy, that her symptoms were linked to the trauma of her father’s death. Anna O. went on to become the first social worker in Germany, founded a periodical and started several institutes.

In published reports of the case, “trauma and symptom were linked, but trauma and creative productivity and occupational achievement were not linked,” says J. Marvin Eisenstadt of East Plains Mental Health Center in Hicksville, N.Y. This was part of the psychologist’s motivation in undertaking perhaps the most ambitious study yet purporting to connect the relatively early loss of a parent with genius development.

Reporting in the March AMERICAN PSYCHOLOGIST, Eisenstadt presents a series of statistical comparisons that he says support the genius-parental loss link. His basic population of “eminent” individuals consists of 573 persons who were given at least one column of space in the 1963 *Encyclopedia Britannica* and those with one column or more in the 1964 *Encyclopedia Americana*.

The backgrounds of those persons reveal that one-fourth had lost at least one parent by age 10; 34.5 percent by age 15; 45 percent by age 20; and 52 percent by age 25. In comparison, an analysis of the 1921 census of England and Wales shows that just 12.4 percent of the general population

there lost a parent by age 9; and only 16.6 percent by age 14. And data from the Metropolitan and Icelandic life insurance companies (covering periods during the first third of the 20th century) indicate that considerably more eminent people lose a parent by their mid-teens than do the rest of the population.

Eisenstadt further contrasts the genius group with juvenile delinquents and psychiatric hospital patients. He finds that it “appears that the rate of orphanhood among the eminent is even greater than that among delinquents given over to courts and state institutions for care.” However, the incidence of parental loss and orphanhood among certain psychotic, severely depressed or suicidal patients is *comparable* to that of the geniuses, he reports.

Despite “the lack of true control groups,” Eisenstadt says the data point to an apparent link between parental loss and genius. In addition, he presents a theory that “neatly explains... similarities between the genius and the psychotic.”

Basically, he suggests that although the potential genius and the psychotic both may lose a parent at an early age, the genius then undergoes a “creative mourning process” — a form of overcompensation that drives the person to the heights of achievement and creativity. For another person, though, the bereavement reaction “can have the effect of stunting personality growth and producing the concomitant antisocial acts, destruction of social relationships and even the taking of one’s own life,” Eisenstadt says. □