

rabbits. After a steady diet of cyclamates for three months, all experimental rats excreted cyclohexylamine in urine, he found. In the United States, the initial ban on cyclamates occurred after scientists discovered bladder tumors in rats being fed the artificial sweetener in massive doses.

In the case of guinea pigs, even after three months, "the ability to convert cyclamate to cyclohexylamine is not very marked," Dr. Williams reports. Of six rabbits studied, only one became a cyclamate converter, excreting about seven percent of his cyclamate intake as cyclohexylamine.

On the basis of these experiments, Dr. Williams concludes that cyclamate metabolism by gut bacteria is far from a universal phenomenon. □

#### NASA FUNDS

### Fighting the cuts

In a year when environment and world and domestic peace seem to be the magical words for winning votes, America's space agency has had not only to redirect its focus to earth-oriented orbital programs, but also to fight harder for what it does get.

This week, the long budget haul from requests to authorization to appropriations neared an end as the Senate debated the National Aeronautics and Space Administration's Senate appropriation bill of \$3.32 billion (SN: 5/2, p. 431). Three separate attempts to cut the committee's figure were defeated: The first was an amendment proposed by Sen. Walter Mondale (D-Minn.) to cut \$110 million for design and definition of the Space Shuttle/Station program, and the second, an amendment proposed by Sen. William W. Proxmire (D-Wis.) to reduce the appropriations to the House level of \$3.20 billion. Both failed by a small margin.

A third amendment, which came as an afterthought attempt by Sen. J. W. Fulbright (D.-Ark.), proposed to cut the NASA budget by 10 percent, or \$300 million. It failed by only five votes. The bill will go to a Senate/House committee where a compromise will be worked out.

The debate came on the heels of a House-Senate authorization conference which cut funds for NASA personnel and related costs by \$9 million. The total NASA/aerospace contractor work force has dwindled from a peak 410,000 in 1965 to less than 167,000 in 1970. An amendment proposed by Sen. Barry Goldwater (R-Ariz.) to restore the allocations cut for personnel was also defeated in the Senate. This action made it certain that further personnel cut-backs of 600 to 1,000 or more would take place. □

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#### COLD VOLCANO

### Explaining Moses Rock dike

In the rugged Colorado Plateau country of southeastern Utah there are some half dozen small areas littered with broken up rock of a type completely unrelated to the rocks of the surrounding countryside. The first geologists to study the sites, in the early 1900's, thought them to be glacial deposits.

But in 1954 a geologist identified the rocks as kimberlite, or blue ground, an unusual type of intrusive rock formed deep beneath the earth's surface. In South Africa, Siberia and Arkansas deep vertical channels, or pipes, of kimberlite contain rich fields of diamonds.

The kimberlite pipes of southeastern Utah have yielded no diamonds, so they have no economic importance. But they have considerable scientific significance because, it is now known, the bottom of the pipes extended through the earth's crust into the upper mantle.

Some of the rocks on the surface represent material from as deep as 200 kilometers. The pipes are, in effect, natural Moholes, channels through the boundary between the crust and the mantle.

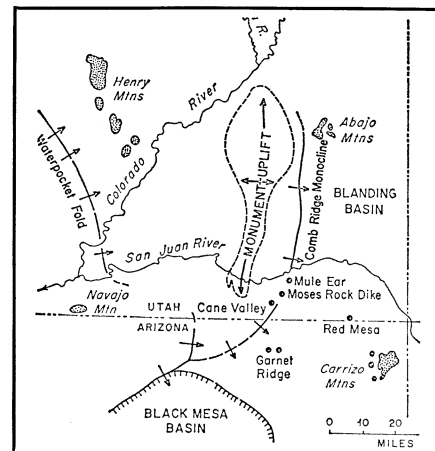
For the past six years a young geologist now at the Massachusetts Institute of Technology, Dr. Thomas R. McGetchin, has spent his summers studying one particular kimberlite pipe in Utah known as Moses Rock dike. The area of forced-up rock is about 1,000 feet wide and extends along the surface, in the shape of a hook, for about four miles.

His work is the first integrated study of a kimberlite pipe that explains the eruption mechanism, the nature of the rocks and the suggested means of producing enough water under pressure within the mantle to trigger the whole thing.

The blast forming the pipe about 30 million years ago was in a sense a cold, high-velocity volcano. With detailed studies of the surface rocks and use of a computer to test numerical solutions of flow problems, Dr. McGetchin has reconstructed the event.

It began some 200 kilometers below the surface, where temperatures are about 950 to 1,000 degrees C. and pressures are about 60,000 atmospheres. Under these conditions the rock is still solid. The eruption differs from ordinary volcanoes in that apparently no melting of rock was involved.

At that point in the mantle there was a large reservoir of water, and the water collected around tiny grains of olivine-rich rock. Even at those high temperatures and pressures water is much less dense than the rocks. It is so much lighter that there was a strong



T. R. McGetchin

*Utah's kimberlite: Up from the mantle.*

buoyancy effect, and a large fluid bubble was formed. Under the high pressure, this began propagating a crack, which quickly extended all the way up to the surface.

"Once the surface was breached," says Dr. McGetchin, "the fluid flow is analogous to an inverted rocket. But there are differences: The tube is long and rough, and the initial eruption is at extremely high pressure."

When the crack breaks through the surface, pressure decreases, flow increases, pressure on the walls decreases, the walls begin to fail and pieces of rock from the wall start to be introduced into the high-speed fluid stream.

Water is incompressible, but as the material approaches within about 25 kilometers of the surface, the entire system expands and the water begins to behave as a gas. As the water vapor expands, its temperature drops.

By the time the material reaches the surface it is traveling at 300 to 400 meters a second—three to four times the speed of sound in the medium. The rock fragments are at a temperature of about 600 degrees C. but the gas emerges at low temperatures of zero to minus 50 degrees C.

The transporting capacity of such a high-velocity fluid system is great. Sub-surface spherical blocks of rock as large as 10 meters in diameter were thrown out onto the surface.

Last week at the international symposium on the mantle in Flagstaff, Ariz., Dr. McGetchin led a field trip of earth scientists to the site of the kimberlite pipes and later presented a paper describing this emplacement mechanism.

The sequence of major events recorded in the igneous and tectonic history of the Colorado Plateau, he suggests, may be the result of the introduction or release of volatiles such as water, plus possibly heat, into a cool Colorado Plateau mantle that was below melting point temperatures. □