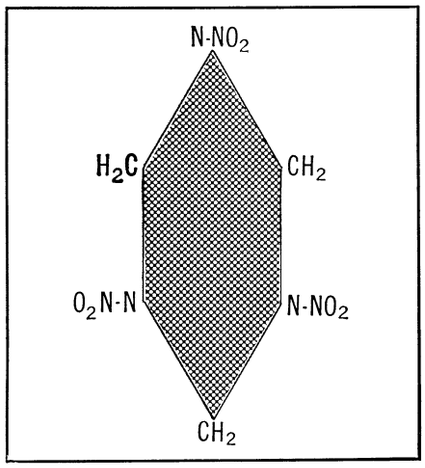
VIETNAM PROBLEM

Highs from an explosive

One of the headaches that has plagued Army authorities for years is the enthusiasm with which their recruits experiment with new drugs, mostly marijuana. Now the men have a new, military way to get high. In many cases, these soldiers become quite seriously ill.

Word has been passed around that eating or inhaling a plastic explosive known as C-4 will produce intoxication similar to that from ingesting ethyl alcohol. The result is that each military hospital in Vietnam has had patients ill from the effects of C-4. Two of them tried out the novel intoxicant their second day in Vietnam.



RDX: Explosive causes intoxication.

Composition C-4 is widely used for clearing land and destroying enemy bunkers. It is a putty-like material that explodes when detonated by an electric spark. It is comparatively safe to carry and store. Because it burns without exploding, it can be used for cooking fuel. In demolition kits and Claymore (antipersonnel) Mines, it is readily available, particularly to combat soldiers. But along with all these advantages, C-4 produces intoxication and, even in small quantities—about 25 grams—can cause a serious convulsive disorder in many individuals.

Generalized seizures, such as those that occur in attacks of epilepsy, bring the C-4 victims to the hospitals. These convulsions are frequent, sometimes almost continuous. They last one to two minutes. Between seizures, the men are stuporous or lethargic. For about a week they are disoriented and confused, with loss of memory and headaches. Impaired memory is the most lasting effect of the C-4 syndrome and the patient who took the largest amount, 180 grams, still had some memory difficulty when he left the hospital one month later. All patients suffered from some degree of renal failure and two men required the use of an artificial kidney for more than a week. Another C-4 victim needed mechanical assistance to breathe for awhile.

So far there have been no fatalities from eating or inhaling C-4. Dr. James H. Knepshield, now at the Walter Reed Army Medical Center in Washington, D.C., says this may be because care is more available in Vietnam. "They are at a hospital, receiving treatment, in 25 or 30 minutes."

No one knows the extent to which C-4 is used or tried, since physicians see only those men who become ill. Sometimes intoxication is accidental, due to cooking with C-4 in a bunker or closed building. One patient came to the hospital with seizures after he and three other field soldiers used C-4 to cook popcorn they had received from home. In fact, field manuals suggest the use of C-4 for cooking fuel when nothing else is available. Dr. Andre J. Ognibene, reporting in the July MEDICAL ANNALS OF THE DISTRICT OF COLUMBIA, says that present manuals which describe it as a relatively harmless compound are being modified to indicate harmful effects.

Doctors are not sure what is responsible for the intoxicating properties of C-4 and its effects on the central nervous system. The main component of C-4 is RDX (cyclotrimethylenetrinitramine), which is similar to TNT. Since RDX is highly insoluable in water, but reduced in ethanol, some clinicians in Vietnam thought that the worst reactions from C-4 occurred in men who were drinking. Five Army physicians tested RDX's solubility in beer, bourbon, gin, vodka, scotch, gastric juice and water, as well as combinations of these. It failed to dissolve in any of the liquids, indicating that liquor is not the reason for the adverse effects of C-4. The seriousness of C-4 intoxication seems instead to correlate with the amount ingested. The RDX did dissolve in cottonseed oil, which may mean that it is selectively absorbed by tissues with a high lipid content. This includes those tissues in the central nervous system and cell membranes in kidney tubules.

Revising the field manual and issuing warnings will reduce the accidental instances of C-4 intoxication and sickness, but, as Dr. William J. Stone of the Nashville, Tenn., Veterans Hospital points out, "Warnings have not reduced the use of marijuana, or even heroin and other drugs." For the most part C-4 intoxication is a special case of the worldwide problem of drug abuse, one that will not be immediately or easily solved. □

CYCLAMATES

Metabolism in the gut

Legally, the fate of cyclamates, now under a partial ban, is uncertain. Though totally barred from use in soft drinks, cyclamate foods are still being phased off the market and there is some question whether they will continue to enjoy the status of over-the-counter drugs. By fall, a newly established cyclamate review committee of the Food and Drug Administration will issue yet one more edict on the subject (SN: 7/4, p. 7).

Biologically, the fate of cyclamates is no more certain than it is legally, though continuing research is turning up some indications of what happens when the artificial sweeteners are ingested. Reports of work by Dr. R. T. Williams of St. Mary's Hospital Medical School in London were prepared for presentation at last week's conference on Drug Metabolism in Man sponsored by the New York Academy of Sciences.

When an individual ingests a drug or chemical, such as a food additive, his body will handle it in one of three ways. It may be excreted unchanged. It may undergo spontaneous reactions with substances in the body without the intervention of enzymes. Or it may be metabolized or broken down into other compounds.

Often, metabolism is performed by liver enzymes. It may also, Dr. Williams observes, be carried out by intestinal flora—bacteria in the gut. Such is the fate of cyclamates, sometimes.

With regard to the safety of cyclamates, metabolism is the crucial issue. If the chemical sweetners are excreted unchanged, there is no problem. But if they are converted metabolically to cyclohexylamine, some hazard exists. Cyclohexylamine clearly causes tumors in rats and is a suspected carcinogen in other species.

Dr. Williams gave three grams of cyclamate daily to three adult men who previously had been on a cyclamate-free diet. Initially, none of them metabolized cyclamates to cyclohexylamine. After about seven days, however, one of the three began converting up to 17 percent of his cyclamate dose. But after abstaining from cyclamates for a week, he lost the ability to convert to cyclohexylamine.

This history suggests, to Dr. Williams that intestinal *enterococci,* in effect, learn to metabolize cyclamates. It is not an inborn talent. The other two subjects, even after a steady diet of cyclamates for 30 days, failed to develop the capacity to metabolize even one percent of the cyclamate they ingested.

Dr. Williams, a biochemist, also studied cyclamate metabolism in three animal species—rats, guinea pigs and

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 cutbacks of 600 to 1,000 or more would take place. □

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.

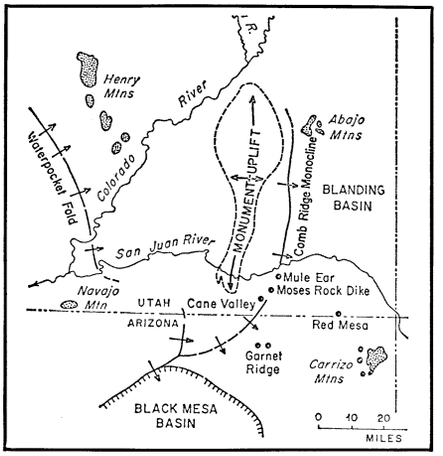
For the past six years a young geologist now at the Massachusetts Institute of Technology, Dr. Thomas R. McGetchin, has spent his summers studying one particular kimberlite pipe in Utah known as Moses Rock dike. The area of forced-up rock is about 1,000 feet wide and extends along the surface, in the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



T. R. McGetchin

Utah's kimberlite: Up from the mantle.

"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. Subsurface 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. □