manner, an observation Dr. Drake calls "as hard to explain as the periodicity."

The pulses also differ in time of arrival at different frequencies, indicating a plasma cloud between earth and the radiating object. Although the initial radio emission at the pulsar occurs simultaneously on all frequencies, the intervening electrons slow down the radio waves, with the drag effect being greater at low frequencies.

On this basis, calculations show that three of the pulsars are roughly 300 light years away, although the distance is known only approximately and could be one-half or twice that, Dr. Drake says. These three lie very close to the plane of the Milky Way. The fourth, known as Pulsating Radio Source Number Three, shows only one pulse and no internal structure; it is about 100 light years away and is inclined nearly 60 degrees to the plane of the Milky Way.

The three pulsars with periods ranging from 1.18 to 1.33 seconds have diameters no larger than 12,000 kilometers, about the size of earth. The singly pulsed pulsar, with a period of one-fourth of a second, would have a diameter no larger than 4,200 kilometers; but that could be the size of a radiation source on a larger object.

Measurements of the delay in arrival time of a pulsar's radiation at different frequencies give a measure of the electron density in interstellar space, the speed of their travel being the same as that of light. This gives, for the first time, a method to determine the number of electrons in the line of sight between earth and another object without making any assumptions as to estimated factors, such as electron temperature. Any variation in the intervening electron density can be measured day-today, Dr. Drake noted, and this is now being done.

The value for the electron density obtained by pairing the lag in arrival times for widely differing frequencies is about a million times that typical for the earth's daytime ionosphere, thus ruling out a planetary ionosphere as the location of the retarding plasma.

Dr. Drake's co-workers include H. D. Craft Jr., D. L. Jauncey, J. M. Comella, G. A. Zeissig, E. J. Gundermann and B. S. Tanenbaum.

LSD vs. I.Q.

Trippers can't follow maps

LSD is one of the most potent drugs affecting perception. Despite that fact, little effort has been made to understand whether continuous LSD use alters vision, hearing or any other sensory function, leaving permanent changes in an individual's view of the world.

A leading authority on LSD has now found such a change in visual perception among 30 heavy drug users in Los Angeles who had trouble following directions on a road map test.

The test is given to measure spatial orientation. With map in hand, the subject must walk out a route, often complex, between cities marked as dots on the floor. Drug users would turn east when they should have turned west; north instead of south. None were on drugs during the tests, but the LSD users nevertheless did considerably worse than a non-drug group used as controls, report Drs. Sidney Cohen and Allan E. Edwards of the Veterans Administration Center in Los Angeles.

Curiously enough, drug users did as well as anyone else with a wooden map marked in braille relief. "The trouble has something to do with visual space," says Dr. Edwards. Normally such spatial impairment would be attributed to brain damage, but the drug users were not deficient in any other intellectual or perceptual function tested. Consequently, the investigators believe LSD causes a learned perceptual change. "If you take enough trips on LSD, you learn to look at space differently," comments Dr. Edwards.

Apparently because of this visual change, the heaviest drugs users—those who had taken LSD more than 100 times—also did worse on I.Q. tests. Intelligence scores were inversely related to the number of trips, says Dr. Edwards. There was roughly a 10-point drop between the 50-trip drug users and those who had used LSD up to 500 times. The heaviest users clustered below the drug group's mean I.Q., which was fairly high in any case.

Users and non-users alike came from an above-average social-economic class and included professors and lawyers. The groups were matched as closely as possible for age, sex, race and years of education.

Since the investigators do not have original I.Q's on their drug users, they cannot prove LSD caused the intelligence drop. But the other alternative—that less intelligent people take more LSD—does not stand up well. Everyone in the drug group had used LSD at least 50 times and often a variety of other drugs, including marijuana, psilocybin, dimethyltriptamine, barbiturates, amphetamines, methedrine, opiates and cocaine.

None of these drugs, unlike LSD, showed any correlation with altered visual perception or intelligence.

DUGWAY

Dead sheep and sick men

Amid the horror of thousands of dead sheep, apparently poisoned by a nerve chemical blown over their range from the Army's nearby Dugway Proving Ground (SN: 4/6, p. 327), there appeared to be at least some grounds for relief. No other animals were affected, said reports, though the pastures harbored many other species. Best of all was the news that no people had been affected.

Now there are signs that both of those optimistic beliefs may have been wrong.

Some 18 days after the first sheep deaths, a columnist reported that two veterinarians who had performed autopsies on the sheep had subsequently experienced nausea, headaches, dizziness and diarrhea. Such symptoms could be those of anticholinesterase poisoning, typical of the nerve chemical.

Several researchers involved in the sheep investigation branded the report "sensationalistic," and "without any foundation." The veterinarians had driven 140 miles and then worked all day long without rest, said one investigation. "It was snowing, it was raining, it was nasty and it was muddy. When they came in that night, they apparently said they were tired. That's all."

However, one of the doctors mentioned in the column, Dr. Lynn James of Utah State Agricultural College, admitted that he had had those symptoms, but said that they could just as easily be the result of the flu as nerve gas. "I could guess either way and be wrong," he said.

All this time the Army had been denying, although increasingly weakly, that its chemicals could definitely be blamed for the disaster. Soon afterward, however, Utah's Democratic Senator Frank E. Moss announced "proof positive" that the Army testing was responsible. Comparative tests by the U.S. Department of Agriculture, he said, had revealed that a chemical found in sheep tissue and in forage from the grazing site was the same nerve agent used by the Army in its experiments. The Public Health Service turned up identical traces in snow from the area, after examining samples at its Communicable Disease Center in Atlanta, Ga.

The Army, meanwhile, continued to raise the question of why anticholinesterase symptoms were found only in sheep, when there were horses, cattle and many other creatures in the same area. The main counter-response has been that sheep were the only chronic snow-eaters in the area, and that they took in the chemical that way. Such an

explanation may not be necessary, however. Dr. D. A. Osguthorpe, a veterinarian who is serving as a consultant to Utah Governor Calvin L. Rampton in the investigation, has collected a number of dead rabbits, rodents and birds, all of whom appear to have died just as the sheep did.

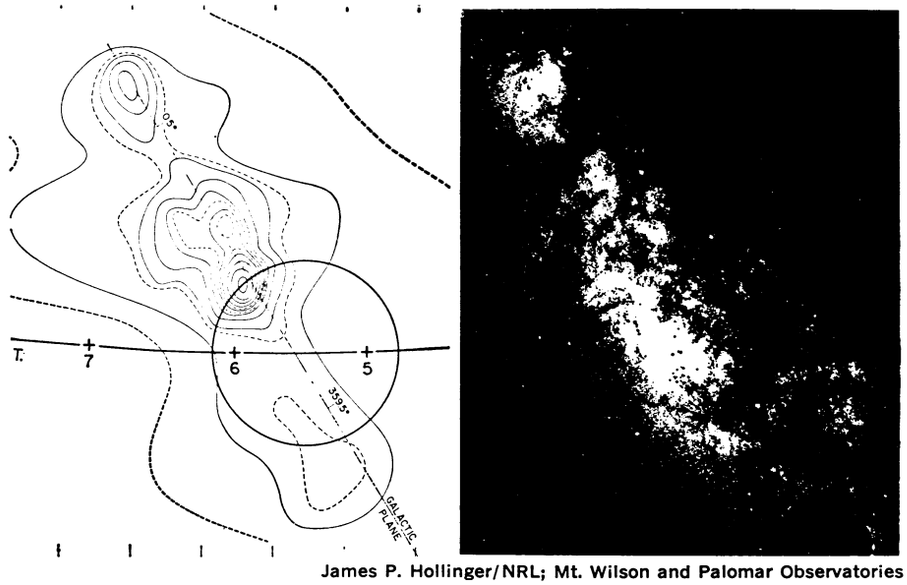
Most disturbing of all, however, are the reported comments of Dr. Kelly H. Gubler, chief of staff of Tooele Valley Hospital, which lies about 50 miles east of the proving ground. Though the Army claims that there have been no previous accidents involving Dugway's nerve chemicals, Dr. Gubler is quoted in the April 12 MEDICAL WORLD NEWS as saying, "I've treated workers in the past for an overdose of anticholinesterase agents, even though the Army denies they were contaminated at the proving ground."

The Army town of Dugway lies about halfway between the proving ground itself and the Skull Valley area where the majority of the sheep deaths occurred. Some 2,600 people live there, including 650 civilians, 450 soldiers and their 1,500 dependents. Many of the other 650 civilians who work in Dugway live in the town of Tooele. "We occasionally see patients who have gotten an anticholinesterase overdose at the proving ground," says Dr. Gubler in the NEWS article, "but will the Army admit it? Never."

Asked by telephone about how many such cases he had seen, Dr. Gubler said that "there was some misquotation in the story," but refused to clarify it or make any further comment.

In the article, Dr. Gubler described a particularly hair-raising case in which he treated a Dugway worker who was showing all the symptoms of anticholinesterase poisoning. "But the Army vehemently denied he had received an overdose. So vehemently, that even though I watched him go into convulsions, I referred the patient to a neurosurgeon for extensive work-ups. He suffered nervous system impairment and had to receive long-term treatment. But the Army continues to be secretive. As a result, we don't know the true incidence of human contamination at Dugway."

The Army still refuses to concede that its chemical has been conclusively implicated, and the nature of the chemical remains secret. All civilian and military personnel who work at the proving ground carry cards alerting health officials to contact the Army base immediately, day or night, in case of sickness. This would enable treatment to be carried out on the base if necessary, since qualified medical help is there; but it could also have the secondary purpose of enabling a tight security lid to be pulled down on accidents.



James P. Hollinger/NRL; Mt. Wilson and Palomar Observatories

Radio map of galactic center, showing moon's path; the area in visible light.

THE SECRET CENTER

Moon occultations and telescopes

The center of the earth's galaxy is a point of unique interest to astronomers; any attempt to describe or explain the structure, dynamics or evolution of the galaxy must contain information about conditions at and near the center.

Unfortunately, direct observation of the center by visible light is impossible. The solar system lies halfway between the center of the galaxy and the edge—about 25,000 or 30,000 light years from each. Interstellar dust limits our view in the galactic plane to only a few thousand light years. There was thus no hope of seeing the center until radio astronomy developed within the last 20 years.

Because their wavelengths are greater than the dimensions of the dust particles, radio waves are not absorbed by the dust. Radio signals from the center of the galaxy and even beyond are received.

Clouds of interstellar gas have been found near the center. Such clouds inhabit other parts of the galaxy also, and it is the sizes and motions of these clouds that gives information about galactic dynamics.

The gas clouds show up by absorbing part of the galactic background radiation, which is a mixture of signals from many sources that gives a continuous wideband spectrum. Sometimes certain sharply defined wavelengths are absorbed; these absorption lines identify the substances in the clouds. Both hydrogen and hydroxyl ions are known to be there.

From a shift of the frequencies from those measured at rest in the laboratory, the speed at which the gas moves can be measured.

Present radiotelescopes, however, do not have sufficient resolving power to obtain good enough data on position and extent of the gas clouds. To get around this problem, the technique of observing lunar occultations has been developed.

When the moon passes between the earth and a distant source it progressively cuts off the distant signal. Astronomers make a record of the times at which different signal components are extinguished. Knowing the position of the moon at those moments, they know with extremely high accuracy the direction each part of the distant signal was coming from.

The technique can be used only in the narrow band of the sky to which the motion of the moon and other bodies of the solar system is confined. Fortunately the galactic center is also there—in the constellation Sagittarius. Occultation studies are possible for about two years out of every 19; during that period the moon makes a monthly pass through Sagittarius.

We are now in such a period—it began last fall and will continue until 1970—and more than a dozen observatories all over the world are taking advantage of the opportunity, including Parkes, Australia; Berkeley, Calif.; the National Radio Astronomy Observatory in West Virginia; Jodrell Bank, England; Nancy, France, and Pulkovo, U.S.S.R. Each will be watching the occultations it can observe, and since the moon takes a slightly different path on each pass and each path looks different to widely spaced observers, the result of the effort should be information about a sizable area around the