of civil engineering at Ohio University. If one chain broke, unequal stresses could have pulled over the towers.

The chances of finding that this did happen are not good. Even if investigators discover that pins are missing from their eyeholes, the probability is greater that they fell out as a result of the collapse than as its cause.

Another possible cause, says Dr. Shermer, is that stress due to the bridge loading may have found a flaw or caused a crack in one of the bars and finally brought about a rupture.

He discounts overloading of the structure as a possible cause, however, even though the bridge was crowded with Christmas traffic, including a bumper-to-bumper line of heavy trucks. As with other long bridges, the dead weight of the bridge itself is a more important factor than the weight of the traffic passing over it. Dr. Shermer figures that an overload would have dropped a portion of the deck and the offending traffic into the river but left the rest standing.

Corrosion is a third possibility, especially if it occurred at a critical point such as the base of a tower. But corrosion should have been discovered during inspections or repaintings.

The reports of the investigating commissions, when they come in some months from now, may or may not disclose the reason for the disaster. Investigators are giving no promises of when they will report, since dredging up bridge pieces from the bottom of the Ohio River is a chancy business.

New engineering and inspection standards probably will emerge, with the Federal Government taking a bigger role in making sure that states keep up their inspection procedures.

Meanwhile, people in the Ohio Valley are just a little nervous about other bridges that have similar steel bars in their construction, especially the Silver Bridge's twin, 75 miles upstream. <>

SOURCE ONE

'Neutron star' demoted

When it was first discovered (SN: 3/16 p. 255), what is now called Pulsating Radio Source One was described, perhaps whimsically, as a possible signal from some extraterrestrial intelligence. Then more seriously, it could have been the first observed neutron star. Now, as data on the strange, regularly pulsating object is evaluated, it seems to be a still-strange but less exotic hot, white dwarf.

At least that is the theory—developed by Dr. Kip Thorne and graduate student James Ipser of the California Institute of Technology—gaining currency among astrophysicists.

Dr. A. G. W. Cameron of Yeshiva University, New York, says the source is "definitely not a neutron star," and endorses the Thorne and Ipser findings. Dr. Cameron is working on some details of the theory, such as how the energy of a shock wave becomes channeled into radiation in the radio frequency range.

Dr. Allan R. Sandage of Mt. Wilson and Palomar Observatories says his strong belief is that it is not a neutron star but a white dwarf, citing Dr. Thorne's calculations as additional substantiation.

What Ipser and Dr. Thorne have done is to show—"fairly conclusively," they believe—that the source cannot be a pulsating neutron star for one simple reason: to vary its radiation at such a rapid rate—every 1.33 seconds—would require a very low density and low mass, and to form a neutron star of such characteristics requires an inexplicable input of energy.

They have also pulled together some theories concerning white dwarfs. In 1950, Profs. Paul Ledoux and E. Sauvinier-Goffin investigated the energy source of white dwarf stars. Their conclusion was that a hydrogen-fueled white dwarf would be explosive with an uncontrolled thermonuclear reaction instead of the controlled fusion with which most stars burn.

Dr. Thorne believes that unburned hydrogen in the outer envelope could set the star pulsating when it sinks toward the core and burns explosively as the earlier model dictates. Dr. Thorne and another graduate student, David Meltzer, when they were at Princeton University several years ago, calculated the kinds of pulsations that might occur if the hydrogen surrounding a white dwarf burned explosively.

They found that any pulsation driven by an explosion in the envelope would be coupled to the first harmonic, not the fundamental mode. This means that when the surface is expanding, the center will be compressing. The periods they calculated for this pulsation are of the right magnitude for the source observed by the British radio astronomers —one-half a second to 20 seconds.

Dr. Thorne believes he has arrived at "a very attractive, self-consistent picture" for a rapidly varying radio source, but stresses that this is far from proof. He urges more calculations and more observations, pointing out that a rotating neutron star might turn out to be a correct identification. Details of his theory will appear in the April ASTROPHYSICAL JOURNAL (LETTERS).

Though many other astrophysicists agree with this model, there are exceptions. Dr. Herbert Friedman of the Naval Research Laboratory believes Pulsating Radio Source One is two objects, a white dwarf and a more normal star revolving around each other.

Dr. Friedman readily admits he does not know how such a combination would form, but then, he notes, no one really has a satisfactory explanation of how binary stars ordinarily form.

To determine whether or not Pulsating Radio Source One has a variable output in light waves as well as radio, Dr. Sandage with two co-workers will train the 200-inch Hale telescope on it for two nights in mid-April. He estimates the giant instrument will catch about 500 photons a second from the 18th magnitude source, while the noise level of the sky background is about 4,000 counts per second. The photon-by-photon count should show any pulsation in visible light.

Dr. William Liller, Harvard College Observatory, has searched Harvard's collection of photographs for information on the past history of the object. He examined at least one and on the average four plates taken of the area each year from 1897 to 1952. His survey shows the source was never brighter than magnitude 17.

Pulsating Radio Source One varied less than half a magnitude in brightness between 1950 and 1967, Dr. Sidney van den Bergh of the David Dunlap Observatory in Ontario has found by comparing two plates taken with the 48-inch Schmidt telescope on Palomar.

Both Drs. Liller and van den Bergh have estimated the annual proper motion of the object, a guide to its distance. They find it is somewhat more than 100 light years away, if the British identification of the visible object is correct (SN: 3/23, p. 281).

COSMIC RAYS

The search for transuranics

Primary cosmic rays arrive at the top of earth's atmosphere after long journeys through interstellar space. Where they come from, how long they have been on the way, how they got accelerated and how much interstellar hydrogen they may have encountered are all significant clues to conditions in the galaxy. The information must be read out of the picture the primaries present on arrival.

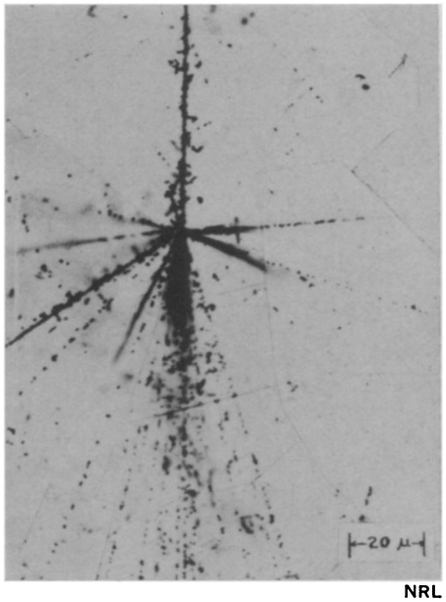
Protons make up the overwhelming majority—some 85 percent—of the primaries. The nuclei of helium isotopes 3 and 4 come to about 13 percent. All

nuclei heavier than helium make up only two percent, but these heavy elements carry astrophysical information of decisive importance.

More and more sensitive techniques have gradually found heavier and heavier elements. In the last few years examination of meteorite samples gave the first evidence of very heavy nuclei, those more massive than iron's 56 atomic units.

Finally five square meters of photographic emulsion flown on a balloon by Peter Fowler of Bristol University in England have yielded a few dozen particles with atomic weights up to 232 and possibly beyond. This has raised the possibility that transuranic elements—radioactive elements beyond atomic weight 240, no longer found naturally on earth—exist in primary cosmic rays.

Professor Fowler flew two balloons last year from the U.S. National Center



NRL

Heavy cosmic ray track in emulsion.

for Atmospheric Research in Palestine, Tex. He plans to go back later this year and fly two more. At least one American group, composed of physicists from Washington University, St. Louis, also plans to fly large area emulsions from Palestine this year.

The presence of transuranic elements at the source of the cosmic rays is expected. As Prof. M. W. Friedlander, one of the St. Louis group, puts it, once a process of element building has started, there's no reason to cut it off at any arbitrary level.

All the transuranics are naturally radioactive, however. Survival of any of them long enough to reach earth would have important implications for estimates of cosmic ray ages, which in turn says something about the length of the journeys and the source.

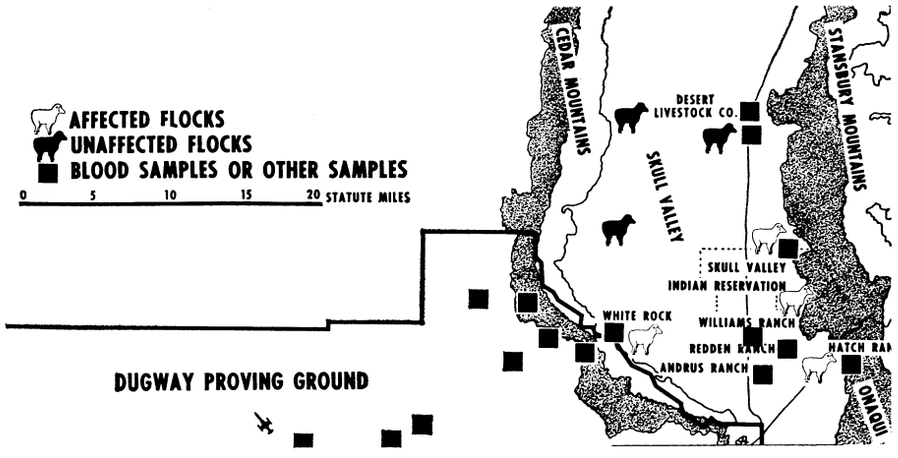
But the measurements will not be straightforward; the journeys are not straight nor at uniform speed. Interstellar magnetic fields are believed to both accelerate cosmic rays and bend their paths. These effects smooth out the products of random explosions—probably supernovas — until the primaries arrive at the earth equally from all directions and have a more or less steady flux — two or more particles per square centimeter per second, varying with the solar cycle.

A majority of experts believes that nearly all this flux comes from within our own galaxy. In our galaxy we see only one supernova in 300 years, but, says Dr. Maurice M. Shapiro of the Naval Research Laboratory, there is evidence that actual rate of occurrence may be higher, up to one every 30 or 40 years. Such a rate could supply the cosmic ray flux.

But much more study is needed to give definite answers to cosmic ray questions. As Prof. Friedlander puts it, scientists are now getting a whiff, rather than a taste, of what they seek.

SKULL VALLEY

Sheep die near nerve gas tests



Army

Death apparently blew from the tiny plane (bottom left) to Skull Valley herds.

On March 13 a plane flew by. On March 14 the deaths began. Within the first week some 5,000 corpses lay on the rugged slopes of Utah's Skull Valley.

The victims were sheep, who simply began dying one day with no advance warning except a sudden loss of muscular cordination, followed by collapse. Autopsies at first revealed practically nothing, and Federal, state and university investigators were at a loss.

There was one fact: Bordering the grazing area is Dugway Proving Ground, the U.S. Army's main testing facility for chemical and biological weapons.

The day before the sheep began to die, the Army had fired several 155-millimeter artillery shells containing Sarin, a U.S. variation of a nerve gas developed by Germany prior to World War II. That same afternoon, 160 gallons of an unnamed persistent nerve chemical were disposed of by burning in an open pit, and 320 gallons of a similar persistent agent were sprayed from a "high-performance" aircraft flashing along 150 feet above the ground. The spraying took place some 27 miles from the nearest sheep kill.

At first the Army said it "definitely was not responsible" for the deaths, which by the beginning of last week had topped 6,400. Then it changed to the view that "no definite cause of death" had been established. As investigators chipped away at other possible causes, the official statements backed off even further. "We are still saying that as far as has been determined, we had nothing to do with it," an Army spokesman said a week after the first report.

Meanwhile, the dead and dying sheep were confounding doctors and scientists from the Federal and state Departments of Agriculture, the U.S. Public Health Service, the University of Utah and the Army itself; the bodies revealed hardly any symptoms of anything, let alone nerve gas.

"We've pretty well ruled out contagious disease," reports Dr. Jordan