

Attacking the redshift

Many astronomers who study quasars believe that these objects are among the most distant in the universe that can be seen from earth. If the distances to the quasars are determined in the same way as are the distances to galaxies—by measuring the degree to which their light is shifted to the red end of the spectrum—many of the known quasars come out to be billions of light-years away.

A few of the quasar astronomers have maintained that the quasar redshifts are not reliable indicators of distance. They believe that quasars are considerably nearer than they seem to be, and that people studying them are not looking out to the edge of the universe nor back several billion years in time. "I've maintained that evidence indicates that quasars are in the local supercluster of galaxies," says one of them, Dr. Halton Arp of the Hale Observatories in California.

Dr. Arp now presents evidence against the reliability of redshifts as distance indicators for some kinds of galaxies. If it is accepted, then it will be necessary to be even more cautious in using redshifts in figuring quasar distances.

The redshift-distance relationship goes back to early studies of galaxies. They showed that the light from distant galaxies was strongly shifted to the red end of the spectrum. Taking this as a Doppler shift, the apparent stretching of the light waves due to motion of the galaxies, astronomers concluded that all the distant galaxies appear to be moving away from our own—the greater the redshift, the greater the relative velocity.

This could only happen in an expanding universe. To an observer standing at any point in an expanding universe, all the galaxies he sees will appear to be moving away from him. The farther any galaxy is from the observer, the faster it will seem to be going. From this astronomers worked out a velocity-distance relationship, and for decades they have applied it, first calculating the velocity from the redshift.

Dr. Arp reasoned that the redshift-distance relation could be attacked if objects with very different redshifts could be shown to cluster together in the sky. He set out to study the cases of companion galaxies, small galaxies that appear to be matter ejected from larger galaxies situated nearby. Such galaxies should show only small differences in redshift.

Dr. Arp has found two instances, which he has reported in papers in *ASTROPHYSICAL LETTERS*, in which the

redshifts of companion galaxies are so different from those of their main galaxies that the use of redshifts to measure velocities comes into question. The latest of these is the galaxy NGC 7603 and its unnumbered small companion. The redshift of NGC 7603 gives a velocity of 8,800 kilometers per second; the companion's redshift gives 16,900 kilometers per second. Yet there is a bridge of luminous matter that connects the two. Dr. Arp argues that with such a large relative velocity between the two galaxies, gravitational forces could not have produced the bridge. Therefore, the redshift is not a reliable guide to velocity. The second case involves NGC 772, where the companion's velocity is 19,000 or 20,000 kilometers per second and the main galaxy's, only a few thousand.

"Here is a case where redshifts are brought severely in question," says Dr. Arp. The galaxies in question are rather peculiar, he says, and he is not suggesting that redshifts are a false guide for normal galaxies. Quasars, on the other hand, are even more peculiar than peculiar galaxies and the caution should apply more strongly to them. "Everybody is on tenterhooks to see what will happen next," he says.

But what causes the redshifts, if not velocity? Some students of quasars have suggested that strong gravitational fields might do it, but there is doubt that quasar fields are strong enough and it is almost certain that galaxies could not have fields strong enough to produce an appreciable redshift. Dr. Arp says that at times he has thought some physical principle "we don't understand" was at work. Among understood principles inverse Compton scattering, in which light strikes particles such as electrons and gives them some of its energy and becomes reddened in the process, might work. Whatever it is, he says, it is likely to be "nothing simple." □

SOVIET CRAFT

On the way to Mars

As Western space observers expected, the Soviet Union launched a scientific station to the planet Mars last week. Named Mars 2, it was at least the third and possibly the fifth spacecraft the Russians have sent toward Mars. The U.S.S.R. had announced two previous flights, Mars 1 in 1962 and Zond 2 in 1964, both of which failed.

Tass called Mars 2 "an automatic interplanetary station . . . to carry out a complex of scientific research about the planet Mars and the space surrounding it." In addition, the station will "study characteristics of the solar

plasma, cosmic rays and the radiation situation" on the way to Mars.

The weight of the spacecraft, 10,251 pounds, compared with the United States' Mariner I spacecraft of 2,200, suggests to most observers that the station will be either a Mars orbiter or a lander. If the spacecraft lands, chances are it will be an automatic station similar to Lunahod to travel over the surface and send scientific data back to earth.

Mars will be at its closest approach to earth this year—an event which occurs every 15 to 17 years. The United States originally had planned to launch two orbiters (SN: 5/15/71, p. 330) but the failure of Mariner H left only one, Mariner I, which was to be launched late this week. □

CRIMINAL SOCIOLOGY

Observing police misconduct

Police protection is becoming a necessity for the police. Last week two of New York's finest were attacked by surprise with automatic weapons and seriously wounded. Two days later two more officers were shot four to six times in the back and brutally slain. Since then the New York City police have been wearing black tape over their badges in protest against these seemingly mindless murders. The police want to know why they are under attack and how they can protect themselves.

The best protection any police force can have, says sociologist Dr. Albert J. Reiss Jr. of the Institute of Social Sciences at Yale University, is a clean record. In a study for the National Crime Commission he has observed the rates of criminal activities for on-duty policemen in three metropolitan areas in the United States. Dr. Reiss finds disturbingly high incidences of police engagement in brutality, theft and extortion. Some of his findings were reported this week in New York at a briefing on the behavioral and social sciences sponsored by the Council for the Advancement of Science Writing. Full findings will be published in book form this summer.

A group of 36 observers (12 ex-policemen, 12 social scientists and 12 lawyers) rode with patrolmen on 8-hour shifts, 6 or 7 days per week for 6 to 8 weeks, in Chicago, Boston and Washington, D.C. The policemen were told that the observers were checking public attitudes toward the police.

A total of 6,000 reactions were recorded and the rate of criminal violations by the officers was found to be high. In Chicago, for instance, 10 percent of the officers actually committed a felony in the presence of the observers. The most common felony

was assault on a citizen. "Such assaults," says Dr. Reiss, "were rarely in response to physical aggression by the citizen and never necessary to sustain an arrest." In Chicago, 7.3 percent of the officers were observed using excessive force on citizens. In Boston, 6.1 percent and in Washington 5.2 percent were guilty of assault.

The second most common felony was theft from a burglarized establishment. The third most common crime was extortion or shake-down of citizens in the acceptance of gratuities as bribes. The rates for these crimes were not as high as for assault, but Dr. Reiss points out that all findings in this study are minimal due to the presence of the observer.

Violations of department rules by patrol officers on duty were also recorded. Drinking on duty (more than three shots of whiskey) was as high as 17 percent in Washington. As many as 20 percent of those observed in Chicago slept while on duty. In Boston 18.4 percent of the policemen were guilty of neglect of duty, and 2.7 percent of the Chicago police falsified reports.

These rates of felony would not be alarming in a civilian population, but they are high for a group of men who are enforcers of the law. Dr. Reiss acknowledges that most policemen are not offenders but he still regards the problem as serious. "Police departments will remain vulnerable to internal and external subversion until we gain both internal and external systems of accountability that are workable," he says. The best protection for our policemen, he feels, are stronger quality control systems within the system and stricter evaluation from outside. □

ASTRA funded

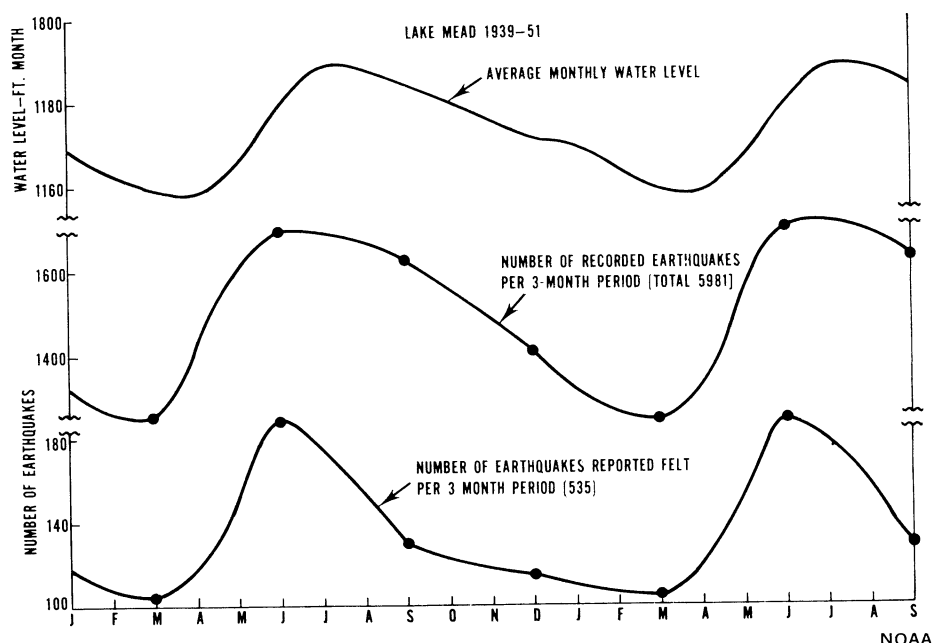
Project ASTRA (SN: 10/10/70, p. 300), the University of Washington's creative project to use astronomical techniques and telescopes to study the earth's atmosphere, received a \$113,281 grant from the National Science Foundation last week. The money is for one year's experimentation with the concept. By studying atmospheric interference lines on photographic film plates kept during the last 50 years, scientists can make comparative studies of the increases and types of pollution throughout the world.

INTELSAT agreement

Negotiations between the United States and some 80 nations over the INTELSAT (the international satellite system) ended last week with an agreement to place the management of INTELSAT under the control of a "Director General" instead of COMSAT (Communications Satellite Corp.).

FIVE DAM STUDY

Reservoir loading and earthquakes



Lake Mead: Correlation between seasonal water level and seismic activity.

Terra firma is somewhat less solid than it seems. A number of manmade disturbances, such as nuclear explosions, fluid injections at oil fields and the filling of reservoirs, appear to be able to perturb its crust enough to cause earth tremors. Recently, however, man has begun to realize that these same events may also have a stabilizing influence.

Now Wendell V. Mickey, a seismologist with the Department of Commerce's National Ocean Survey, reports that in some cases the filling of reservoirs has been followed by a decrease in seismic activity in the surrounding area.

Mickey has compared seismological data from five areas of the United States where large water impoundments exist or are planned: Glen Canyon, Arizona; Flaming Gorge, Utah; Lake Mead, Nevada; and San Luis and Cedar Springs, California. In areas surrounding the Glen Canyon and Flaming Gorge reservoirs, he told a symposium on manmade lakes in Knoxville, the number of earthquakes, especially within 40 kilometers of the dams, actually decreased as the lakes were filled. At Flaming Gorge, filled to operating level by November 1962, there were 701 earthquakes in 1961, 669 in 1962, 665 in 1963, 258 in 1964, 85 in 1965 and 215 in 1968. The Glen Canyon reservoir was filled by May 1963. At this site, there were 170 earthquakes in 1961, 149 in 1962, 173 in 1963, 62 in 1964, 50 in 1965, and 109 in 1968. The seismic activity at these locations, Mickey points out, would normally dis-

play some periodicity, but the correlation between the filling of the reservoirs and the decreases in seismicity could be significant.

At Lake Mead, Mickey found the most dramatic evidence to date of the direct effects of water loading. Lake Mead, created by Hoover Dam, contains about 44.1 billion tons of water. Effects of reservoir loading at this site have been studied since 1938, when the U.S. Coast and Geodetic Survey (now National Ocean Survey) established a seismometer at the dam site. Seismic records for the period from 1939 to 1951, Mickey has found, show a clear correlation between the number of earthquakes and seasonal changes in water level, with the fewest earthquakes in March, when the water level was lowest. The peak in both earthquakes and water level came in June and July. This periodicity disappeared when the Glen Canyon and Flaming Gorge reservoirs were built, as these reservoirs, located upstream from Lake Mead, control the amount of water flowing into it. The rate of earthquake occurrence at Lake Mead decreased by 50 percent.

At the fourth site, San Luis, located within 13 miles of a major fault system, water loading behind the dam apparently had no influence on seismic activity. The last site, at Cedar Springs, is about 50 miles east of Los Angeles near the San Andreas Fault. A large dam is planned for this spot, and as it is filled, seismic activity will be monitored to uncover any correlation with variations in the weight of the water. □