DISTANCE GUIDE

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 Lunahkod 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