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Ground-Based Astronomy

Astronomy is in the midst of a vital era.* During the 1950's came the discovery by optical methods that the abundance of heavy chemical elements varied from star to star and was related to stellar age. This finding suggested that the elements were continuously synthesized in the stars and distributed by stellar explosions. Other major discoveries have come from radio astronomy. One of these is the observation that some galaxies emit great quantities of radio energy. The radio emission is due to synchrotron radiation resulting when high-energy electrons encounter a magnetic field. Associated with the electrons must be heavy particles. Thus, the discovery of these radio explosions shows that magnetic fields exist in interstellar space and that large numbers of high-energy particles are moving through these fields.

Simultaneous optical and radio observations recently have led to identification of a new class of astronomical objects. These are quasi-stellar sources whose presence was originally signaled by strong radio emission. In optical studies the objects appear similar to ordinary stars. The radiations have large red shifts indicating that distant objects are radiating energy at an enormous rate. Calculations suggest that a new type of energy source is required—perhaps the release of energy stored in a gravitational field of a collapsing body.

As a kind of sideline to consideration of these great cosmological phenomena, ground-based astronomy has made significant discoveries concerning our solar system. Recent optical studies have yielded new information about the atmosphere of Mars. A total atmospheric pressure of about 25 millibars is indicated, with about 14 microns of precipitable water. Warm spots on the moon and unevenly hot regions in the atmosphere of Venus also have been observed. Radio astronomy has yielded a more accurate measurement of the distance to the sun, estimates of the composition and roughness of the lunar surface and of the temperature and structure of the surface of Venus. Fluorescent radiation from the lunar surface has been observed. Spectroscopic study of this light promises to reveal the nature of attendant chemical events. These contributions relate importantly to the space effort. For instance, the new estimates of the density of the Martian atmosphere have affected designs of equipment for landing capsules.

The potentialities of existing equipment have been only partially exploited. Improvements in auxiliary equipment are opening new opportunities. It was exploitation of new infrared detectors that led to the discovery of warm spots on the moon. Development of new devices such as image tubes promises extension of the effective range of telescopes.

A conspicuous potentiality in radio astronomy is the improvement in resolution to be obtained by constructing extended arrays of moderate-size radio telescopes. Such an array could detect and resolve radio sources even at the bounds of the observable universe.

The total cost of a 10-year program designed to provide important new facilities and additional astronomers has been estimated at $227 million. The Panel* is conservative when it states, ". . . an investment in ground-based astronomical facilities of the order of one-half of 1 per cent of that going into the space effort would be consistent with a balanced program of federal support for science."

—PHILIP H. ABELSON

*The material contained in this editorial was largely derived from an excellent report entitled "Ground-Based Astronomy. A Ten Year Program," prepared by the Panel on Astronomical Facilities for the Committee on Science and Public Policy of the National Academy of Sciences.