More Probes into Interstellar Space

FROM the cosmic ray physicist has come a new and important contribution to our knowledge of the interstellar medium. We have long accepted the evidence that a large percentage of the energy of the universe is carried in the cosmic rays. But we still do not have any acceptable theory of the origin of cosmic radiation. Does it come from the original hypothetical explosive event that produced stars and galaxies some thousands of millions of years ago? Or does it come as a by-product of the supernovae, or of the "flare" stars? Or does cosmic radiation originate in the interstellar dust, assisted by the machinery of magnetic fields? Or is it perhaps somehow generated from the sun and its atmosphere, and manipulated by magnetic fields of earth and sun?

Cosmic rays at the earth's surface are mostly of secondary origin—the products of the violent interaction of primary cosmic rays from outer space and the atoms of our upper atmosphere. But the high-flying balloons that leave most of the earth's atmosphere below them are now richly in touch with primary radiation. Thanks to the skillful efforts of Minnesota and Rochester investigators, these speed-of-light particles that we call cosmic rays are found to contain not only the nuclei of hydrogen atoms (protons) and helium atoms, but the nuclei of many of the heavier elements. In other words, the nuclei of elements such as carbon and iron are impelled by some means to hurtle through space with light velocity and help produce the penetrating radiation measured at the earth's surface.

An extraordinarily interesting new development is due to Bernard Peters and his fellow-investigators at Rochester. They are now able to make a chemical analysis of cosmic radiation, detecting the hydrogen, helium, carbon, nitrogen, oxygen, and other elements, going in weight up to, but not as yet passing, the atoms of iron. The relative abundances of the various atoms found through the measurements of cosmic rays are comparable to the abundances throughout the universe found in other ways. There are some anomalies that incite further work and further discovery, such as the scarcity or absence of neon in the sun's atmosphere, and its considerable abundance on the earth and in cosmic radiation.

Again a new tool for exploring space has been developed—a tool scarcely imaginable a decade ago. It has come from a liaison of the sciences—electronics, cosmic chemistry, astronomical spectroscopy, and the counting of stars on stellar photographs.

Also from outside the main lines of astronomical work there has come in recent years the marvelous development of radio astronomy. The new science has gone far since the first work on the character of radio echoes from the ionosphere, which intimated that shooting stars in those atmospheric strata are responsible for the sudden ticks and jerks in signal strength. The early work also involved Milky Way static and the bouncing of radio signals off the moon. There is increasing activity in this field in the United States, where much of the basic pioneer work was done, but we must give top credit to the Australians, the English, and the Canadians.

We now have in radio (microwave) astronomy one of the most potent tools imaginable for the detection of meteors, since radio echoes can reveal in daylight, through clear sky or clouds, as well as at night, the innumerable meteors that the photographic plate cannot catch, or the eye see. The electronics engineer has opened a new epoch in the astronomy of the dust particles of our atmosphere.

A few years ago the words radio star made no meaning at all. Now we have a list of three or four score of these mysterious spots among the stars, where no star can be seen, but from whence come meter-length radio signals. In addition, we now have on record a general "Milky Way Static," and the new large equipment is beginning to work on the radio waves from around sunspots.

HARLOW SHAPLEY

Harvard College Observatory

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