SCIENCE

Smog in Space

With billions of stars and millions of galaxies within the range of many telescopes, it might seem that there is now abundant raw material to which to apply the routine processes of astronomy—that is, the measurement and analysis of the brightness, positions, chemistry, and motions of stars and star systems. Astronomers could be content with their customary riches, but the science appears to be dashing off in nonroutine directions. Within the past few years one novelty after another has distracted the astronomer's attention away from standardized photometry, astrometry, and spectroscopy.

About half a century ago astronomers became aware of the existence of calcium gas in space outside the atmospheres of stars. The material was found through the discovery that in some stellar spectra the K line of calcium is double, one component being associated with the star and showing the appropriate displacement to reveal, with the other absorption lines, the motion of the star, and the second component indicating that its source is calcium gas that is essentially motionless in space, or at least not moving with the star. For this discovery, and subsequent similar developments, the stars form the backdrop against which one measures the gases and other materials of intervening space. The light from the stars is absorbed by the interstellar gas, or scattered by the interstellar dust, or absorbed and scattered by the gas attached to dust—that is, by interstellar smog. The invisible material of interstellar space thus becomes "visible" because of its effect on the penetrating starlight.

From calcium the astrophysicists went on to other gases—sodium, carbon, nitrogen, oxygen, iron, titanium, etc.—sometimes discovering the interstellar gaseous stuff through its absorbing effect, and sometimes through its reradiation of the light of stars.

The importance of the interstellar medium has attracted an increasing number of observers and interpreters. The dust particles of space are linked up with meteors and comets in the solar neighborhood, and with the dark and bright nebulosities in the Milky Way. Perhaps one half of the total mass of the Milky Way is in the form of this dust and gas of interstellar space.

For all studies of the structure of our Milky Way, and for the determination of the distances of stars and galaxies by means of their brightness, this interstellar material is obviously important. If it dims a star, it may mislead us in estimating distance. If it is associated with supergiant objects, it may be of prime importance in theories of the evolution of stars.

Among recent surprising discoveries about the interstellar medium are its polarization of light from distant stars and its chemical composition as revealed by cosmic radiation.

Up to a few years ago we knew little about polarized light from distant sidereal bodies. Sunlight reflected off the moon is slightly polarized, as is light reflected off any appropriate surface. There is polarization in the zodiacal light, and some hopeful attempts have been made to find polarized light from the Andromeda Nebula and other sidereal bodies. Theory indicates that light emitted from certain stellar surfaces should be polarized, and in the search for that effect Hiltner and Hall ran onto the exceedingly interesting fact that light from many stars is slightly polarized, not by the atmospheres of the stars, but by the particles of intervening space.

The subject is too new to give proper interpretation to the differences in the intensity and direction of polarization. In a few years we shall probably have extensive observations and competent theoretical interpretations of this new implement for exploring space. Refined theories of the nature and structure of our Milky Way and the nature of the interstellar medium will undoubtedly use the implications of the new results.

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