IONOSPHERIC PHYSICS

Long-distance radio communications, as for example between New York and London, depend for their success on a region of rarefied, ionized gases, high in the atmosphere. This region, which exists at levels 50 to 250 miles above the earth, is known to physicists as the ionosphere. Radio waves, emitted from a transmitter at one point on the earth's surface, strike this region and are reflected, much as a mirror reflects light, to radio receivers many hundreds of miles away.

From the days of Marconi, who sent the first long-distance radio signals between this continent and Europe at the beginning of the century, our modern civilization has been steadily more dependent on the ionosphere for communications, radio telephony, and radio navigation. Yet the existence of the ionosphere (which enabled Marconi's signals to get through) was only a hypothesis until 1925, when Breit and Tuve demonstrated that a radio signal sent directly upward could be returned to an adjacent receiver.

Since that time ionospheric physicists have been exploring the nature and characteristics of this electrified region high over the whole earth and have learned that it is an area of extreme complexity, constantly changing and subject to many external influences. Within the region are layers of dense ionization which change radically with time of day, with season, and even from year to year. Moreover, the characteristics of the ionosphere vary markedly at different locations over the globe.

Ultraviolet light from the sun is the principal agent which accounts for the ionosphere. This incoming radiation knocks out electrons from the sparse atoms high in the atmosphere, creating the electrically active ionosphere. But it is well known that the sun's radiation is extremely variable, both from day to day and over the long 11-year sunspot cycle. Many other geophysical phenomena, such as geomagnetism, the aurora, and perhaps meteors and thunderstorms, are directly related to the behavior of the ionosphere.

A solar flare on the sun is often immediately followed by an ionospheric disturbance which effectively disrupts communications. Long-distance radio communications may be completely blotted out or very substantially limited. Active sunspots may be followed by a period of intense geomagnetic storminess or violent auroral displays, and concurrently by major paralysis to long-distance communications. This is particularly true in the higher latitudes where effective communications frequently have been known to be unsatisfactory for periods as long as several days continuously.

The IGY pattern of ionospheric observing stations has been carefully planned to provide a global picture of the "normal" ionospheric layers, as well as to study the equally important geophysical factors associated with radio storminess. These stations send waves out vertically overhead and receive the reflections from the ionosphere at an adjacent receiver. This program will be supplemented by oblique measurements which will extend the area of exploration from about 600 to 1,200 miles around each location.

The information from this network of ionospheric sounding stations will be assembled into worldwide patterns (much as a meteorological map is constructed) from which reliable radio communications can then be developed. Predicting the future state of the ionosphere is one of the major problems in ionospheric physics. The prediction