SCIENCE

Solar-Terrestrial Relationships

THE earth, if it were the eighth planet from the sun, would become a barren, frigid mass imbedded with thousands of cubic miles of ice. Terrestrial oceans would be mainly of liquid nitrogen and oxygen, and the atmosphere would consist of a thin, rarefied film of gradually escaping hydrogen and helium.

Luckily, the earth is the third planet of the solar system; its remarkably favorable aspect toward life emphasizes the strong influence of the sun. Earliest man expressed his appreciation of the sun's importance by worship and deification, and a few moments' reflection will reveal that solar-terrestrial relationships are involved, one way or another, in most of man's activities.

Aside from variable fractions of nuclear and tidal power, all available energy resources on the earth stem from solar radiation. The absorbed radiation of past centuries lies locked mainly in fossil carbon, organic remains, and the free oxygen of the atmosphere. Present radiation is stored by photosynthesis, evaporation of water, ionization, and dissociation, but is also available in water-, wind-, and direct solar-power.

The sun, notwithstanding its tremendous imporance to earth, is a mediocre star, located near the outskirts of our galaxy and, like so many others, has nothing in the way of size, mass, radiative emission, or other characteristics (with the possible exception of a planetary system) to distinguish it from thousands of others. As it appears today, solar energy results from the thermonuclear fusion of hydrogen into helium, and should last for several billion years. The temperature of the photosphere is roughly taken as 6000° C, but there are indications of emissions at a higher temperature in the ultraviolet region.

The diverse radiations from the sun markedly influence the terrestrial atmosphere. Solar emissions in the x-ray and ultraviolet region of the electromagnetic spectrum produce the ionic layers so important for radio communications. Abnormal radiation in the ultraviolet by solar flares intensifies the lower electrified regions of the terrestrial atmosphere and produces marked, though temporary, changes in the atmospheric parameters. Solar ultraviolet radiation, below 3000 A, penetrates approximately to 20–30 km above the earth's surface, forming the ozone layer, which acts as a life-preserving shield from the otherwise harmful effects of the ultraviolet to mankind below. The remaining radiations, mainly in the visible and infrared, (after partial absorption by the dense, lower atmosphere) reach the earth's surface to warm and sustain life. In general, the net energy influx from the sun must be accounted for; that not stored by one means or another must be reradiated by the earth in order to maintain the temperatures so favorable to life. An important related phase of the study of solar-terrestrial relationships is the weather, particularly the investigation of long-range weather trends—a study yet in its infancy.

The influence of the sun is not limited to fuel reserves and atmospheric influences. Of vital importance is the question of feeding the global population. The greatest single source of usable solar energy (over 99 per cent) occurs through photosynthesis, which is not only the basic source of food but also the greatest source of fuel. Cultivation of vast quantities of algae both for fuel and for food may yet become commonplace, especially after conventional farming methods have been pushed to the limit.

At the Geophysics Research Division many phases of solar-terrestrial relationships are being actively examined. These include studies of the solar spectrum, the solar constant, and the statistical correlation of solar phenomena (such as sunspots, flares, and prominences) with associated terrestrial activity (such as ionospheric disturbances, magnetic variations, aurorae, weather, and variations of atmospheric constituents). The practical applications of the results of this research are innumerable.

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