GEOPHYSICS

Earth Has Helium Halo

Helium shell 900 miles thick surrounds earth. The halo reaches 1,500 miles, above which hydrogen extends into the interplanetary space, Ann Ewing reports.

➤ THE EARTH HAS A HALO of helium surrounding it in a shell 900 miles thick, starting some 600 miles above the surface.

Information radioed to earth from Explorer VII confirmed the existence of this helium halo, Dr. Robert Jastrow of the National Aeronautics and Space Administration's Goddard Space Flight Center, Greenbelt, Md., said in Washington, D. C. The idea that earth would have a surrounding shell of helium was first suggested by Prof. Marcel Nicolet, director of the Centre National de Recherches de L'Espace, Brussels, Belgium.

Dr. Jastrow reported on results of space experiments in the 25th Wright Brothers Lecture at the Institute for Aeronautical Sciences in Washington. He said the earth's atmosphere was now thought to be a mixture of mainly nitrogen and oxygen molecules up to about 75 miles, then a layer consisting predominantly of atomic oxygen between that height and 620 miles. Beyond that is the helium halo, which extends up to 1,500 miles, above which is a hydrogen atmosphere that extends out into the interplanetary medium.

The average temperature of the upper atmosphere is 2,000 degrees Fahrenheit, Dr. Jastrow reported, and it shows daily fluctuations, being highest in the late afternoon and lowest in the early morning. Because the upper atmosphere is extremely responsive to the sun's output, scientists have been able to predict its temperature during the current sunspot cycle, which is is now approaching the low point of its 11-year cycle.

The pre-dawn temperature of the atmosphere will reach a low point of 440 degrees Fahrenheit in 1964. The density of the upper air merges into the density of the interplanetary gas at an altitude of about 6,000 miles. However, instruments on the very early satellites showed that an additional layer of particles in the upper atmosphere, which includes the Van Allen belts, is now known to reach out to about 60,000 miles.

This additional layer of particles is called the magnetosphere, because it exists only due to the presence of the earth's magnetic field. Dr. Jastrow said its discovery was the most significant contribution of the International Geophysical Year and of the first years of the space program, not only because the radiation may prove to be a hazard to manned space travel, but more because of the role the Van Allen particles have in influencing the properties of the upper atmosphere.

The Van Allen zones are related to the process by which energy is transferred from the sun to the earth in the form of particles, magnetic fields and radiation during major solar flares. The effects of this energy transfer involve not only temperature changes but magnetic storms, the aurora and radio communication disturbances. There have even been suggestions of a correlation between flare activity and the weather.

The available evidence suggests that the Van Allen zones and the entire magnetosphere of which they are a part constitute a reservoir in which solar flare energy can be stored in the form of trapped particles until a subsequent solar event disturbs the magnetic field. The particles are then dislodged from the zones "as apples are shaken from a tree," Dr. Jastrow reported.

The shaking occurs, he said, when the oncoming solar plasma cloud hits the earth's magnetic field, producing changes in the field that scatter the particles out of their spiraling orbits around the lines of force.

When the particles are dislodged, they descend through the horns of the Van Allen zone, transferring their kinetic energy to the atmosphere by ionizing collisions. This is probably the cause of the aurora, Dr. Jastrow said. He urged that future research be concentrated on measuring the low-energy particles in the trapped radiation zones.

Preliminary research suggests that at an altitude of 2,100 miles, there is a heavy concentration of electrons with energies between 10 and 20 volts, Dr. Jastrow said.

The frequency of solar flare occurrence varies during the 11-year sunspot cycle. Flares are always accompanied by intense magnetic effects, as much as 1,000 gauss (a unit of magnetic density), which are in some way connected with their generation. As a cloud of charged particles erupts from the site of the flare and moves out into interplanetary space, it drags along the magnetic field of the flare site.

The magnetic field is frozen in the plasma cloud and must move with it because of the high electrical conductivity of the plasma. Thus the cloud expands into space, drawing out the lines of magnetic force like loops of taffy. Although the strength of the magnetic field lessens as the cloud expands, it is still appreciable when it envelops the earth and the roots of the field always remain within the flare site on the sun, Dr. Jastrow said.

When a flare erupts in the direction facing the earth, the radiation and the clouds of charged particles travel across space to collide with earth's atmosphere. Although the energy carried by the solar stream is less than one-millionth of that radiated by the sun in the form of visible light, it neverthless appears to be responsible for the many geomagnetic effects, such as auroras.

Dr. Jastrow paid tribute to Dr. Thomas Gold of Cornell University, Ithaca, N. Y., who outlined many of these ideas concerning the propagation of solar disturbances on the basis of "very slight evidence."

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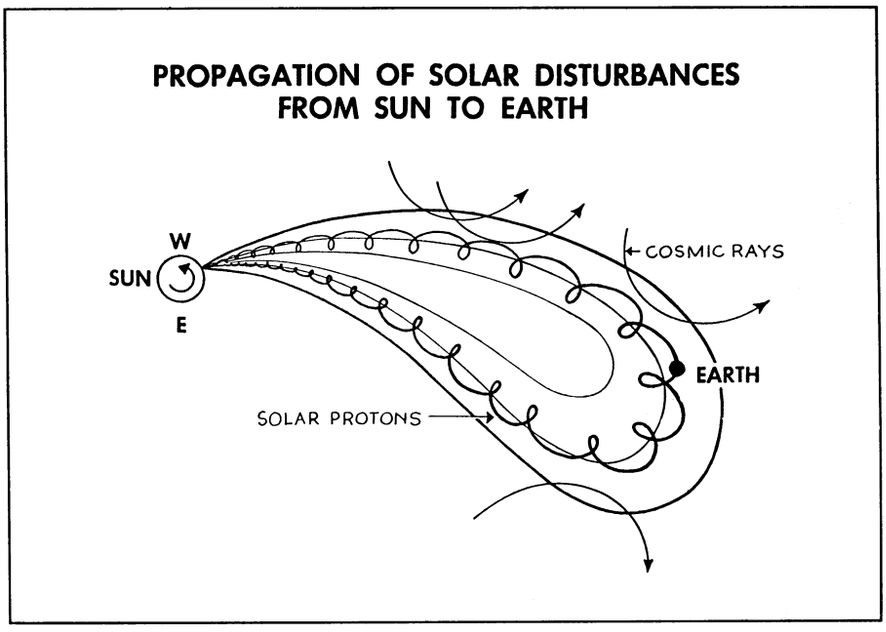

SPREADING SOLAR DISTURBANCE—This drawing shows, many scientists believe, how the sun flings out some of its matter into space, enveloping the earth and causing many geomagnetic effects. Solar protons spiral along the lines of force, which still have their roots in the sun's surface where the flare occurred. The plasma cloud repels cosmic rays from space, resulting in the so-called Forbush decrease.