PHYSICS

The Things in Space

Bits of matter, bursts of energy have been detected in space by United States and Russian space probes. Radiation that could endanger astronauts has been discovered.

➤ EMPTY INTERPLANETARY SPACE "ain't necessarily so." There are things out there.

Bits of matter. Bursts of energy. And great patterns of force—magnetic, gravitational and electric. With satellites, scientists are learning more about these phenomena.

Millions upon millions have been spent on satellites and little by little scientists are learning about the dangers astronauts will meet in the gaps between the planets.

These gaps seem to contain very dilute gases, their atoms very widely spaced. Scientists think these gases are primarily hydrogen. But space also contains great energy that cannot be accounted for by the normal motion of the gases.

This energy is radiation that, in quantity, could kill an unprotected spaceman. Some of the radiation is cosmic radiation that can penetrate 17 feet of lead. It is thought to originate mostly from outside the solar system. Some cosmic rays, however, come from our sun.

Other types of radiation stream from the sun too. This radiation is not as "hard"—the scientists' word for penetrating—as cosmic radiation.

"Soft" light and heat rays are produced at a fairly constant level. More erratically, the sun produces ultraviolet radiation, some of the shorter waves of which come through the earth's atmosphere and cause sunburn.

Ultraviolet Can Alter Gases

In space, the ultraviolet rays are abundant enough to alter interplanetary gases. Ultraviolet rays ionize the gases, knock out their atoms' electrons so that the atoms are short on electrons.

Thus normally neutral atoms are changed into electrically charged ones. Usually, charged atoms would attract and collect their lost electrons until they became neutral again, but the gases in space are so dilute that the atoms and electrons are too far apart to do this. So the atoms remain charged.

A fully ionized gas is called plasma. Plasma is like no other gas state because it conducts electricity and is influenced by magnetic fields. Under certain conditions a plasma can disrupt radio communications between a space vehicle and the earth.

The sun also radiates radio waves and charged particles.

Ionized gas or plasma is attracted by the sun's gravity. This gravity keeps the plasma from escaping into interstellar space and also pulls interstellar gases into the solar system. Most of these gases, however, originally were spewed from the sun in occasional solar eruptions. Some of the gases may also come from the sun in a constant process somewhat like evaporation.

Besides gravity, solar radiation pressure may also influence the distribution of the gases. Many earth satellites, particularly the balloon-like Echo, have had their paths shifted by the faint but steady pressure of this radiation.

This pressure is only one-fiftieth of an ounce on Echo, yet each day it pushes the satellite 3.5 miles closed to the earth.

Near earth, and presumably near other planets with an atmosphere, ultraviolet and X-rays from the sun ionize the outer atmosphere. That is why the earth's upper atmosphere is called the ionosphere. The solar radiation cannot penetrate very deeply into the atmosphere, thus the ionosphere creates an insulating blanket between the more fully ionized interplanetary plasma and the lower atmosphere.

The density of the atmosphere varies at upper altitudes in harmony with the rotation of the sun, an American scientist learned from the Russian satellite Sputnik II.

Dr. Luigi G. Jacchia of the Smithsonian Astrophysical Observatory made this discovery by studying the air drag that showed up in tracking data from the Russian moon and confirmed the data with America's grapefruit sized Vanguard I.

The drag, Dr. Jacchia found, has a 27-day pattern. The sun has a 27-day rotation.

Thus, scientists now believe that when an active region of the sun faces the earth, radiation increases and heats the earth's outer atmosphere. This heating causes an expansion that carries more atmosphere up to the area of the satellite and therefore exerts more drag on it.

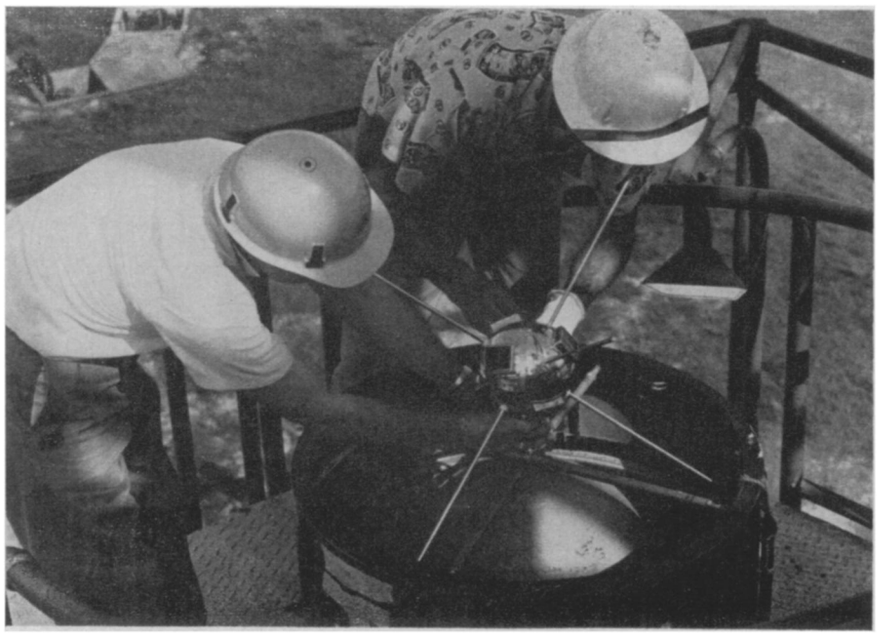
But the radiation in space affects the area of the earth in still another way:

Satellites Explorer I and Explorer III revealed that the earth is surrounded by trapped radiation. Dr. James A. Van Allen, the State University of Iowa professor in charge of instrumentation for these satellites, concludes from Geiger counter readings in the satellites that the radiation consists of charged particles restrained by the earth's magnetic field. Explorer IV confirmed this.

The United States also exploded three small atomic bombs high above the earth. This "Argus Experiment" injected high-energy electrons into the earth's magnetic field and thus created artificial radiation belts.

Probes Show Radiation Zones

In late 1958 and early 1959, space probes such as Pioneers III and IV and Mechta showed that the belt of radiation had an inner zone and outer zone, separated by a less intense area. The probes showed the radiation in the belt was stronger and more dangerous to astronauts than was radiation in space and that the radiation in the inner zone remained about the same while



GRAPEFRUIT SHOT—Engineers install a sphere atop the third stage of a Vanguard test rocket. The Vanguard satellite has provided a wealth of data on the earth, atmosphere and space.

th. outer zone showed great fluctuations, probably connected with solar activity.

The earth's radiation belt may be the greatest radiation danger an astronaut will face. But he could also be harmed if he should be in space when the sun bursts with solar flares.

Pioneer IV in March, 1959, showed the energy particles of the earth's outer radiation belt increased after solar disturbances. Other satellite and probe data showed connections between these activities and visible auroras.

Besides the magnetic and gravitational forces and the streams of plasma and radiation, interplanetary space also has meteors that can puncture satellites and space probes.

Meteors may be great masses of several hundred tons or, much more commonly, tiny specks that would merely sandblast a satellite or probe. If one of the big ones, like those that caused giant craters in Arizona and northern Siberia, should strike New York at a meteoric speed of many miles a second, the resulting blast waves would destroy the city as suddenly and certainly as a nuclear bomb. Luckily, large meteors are very rare.

Meteors that reach the earth's surface are called meteorites. Wholly metallic meteorites, called siderites, are chiefly an iron-nickel alloy. Some meteorites are composed of silicates and metal; these are called sideriolites. Meteorites composed almost entirely of silicates are called aerolites.

When meteors from space hit the earth's atmosphere, they become "shooting stars" heated to incandescence by friction with the air. Meteors that are very fast moving are believed to come from interstellar space, but scientists know very little more about them than that.

Some of the slower ones seem to be in the orbits of comets.

If a spherical vehicle with a one yard diameter and one-quarter inch thick skin were sent into space, some scientists think the mean average time between punctures might be 150,000 years. Other scientists calculate the mean average as short as 300 years.

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Electron Accelerator Will Be Built for NBS

➤ A $1,700,000 accelerator that can hurl an intense beam of electrons at speeds close to the velocity of light with a very high precision will be built for the National Bureau of Standards in Washington, D. C. The intense source of electrons will provide the NBS with greatly advanced research and engineering capabilities.

The new linear electron accelerator, or Linac, will be 100,000 times more powerful than existing NBS high energy equipment. Measuring 100 feet in length, Linac will produce electron beams with peak energies up to 150,000,000 electron volts and power outputs of 40 kilowatts or more. It will be built by the High Voltage Engineering Corporation, Burlington, Mass.

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