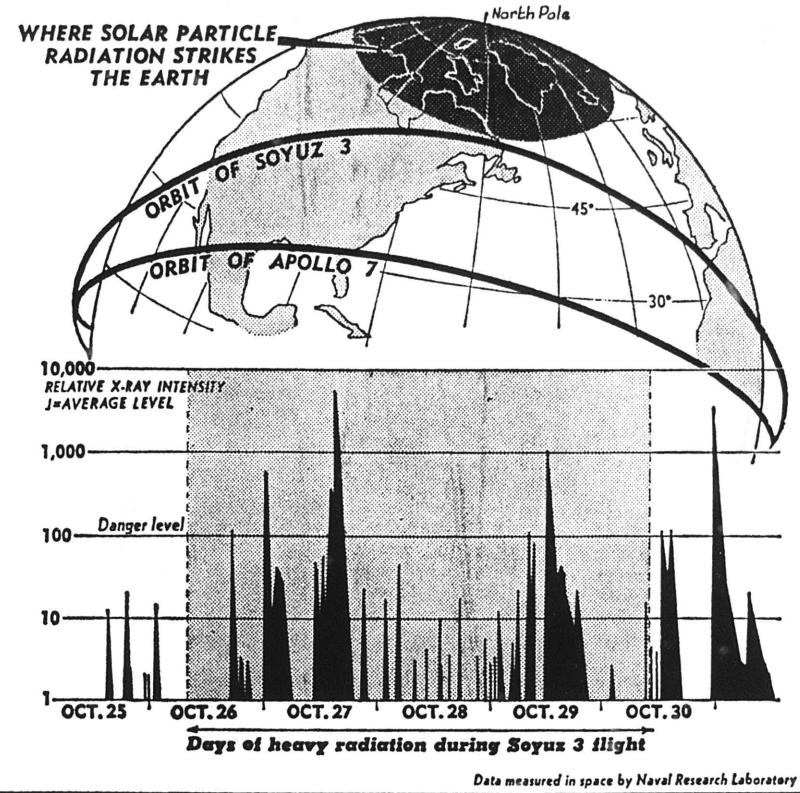
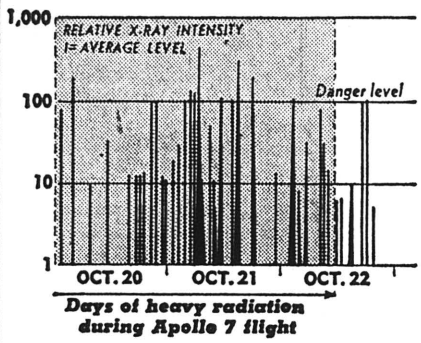
HEAVY RADIATION FROM THE SUN NOW PERILS SPACE FLIGHTS

With the sun at a new peak of sunspot activity, the possibility that astronauts will encounter hazardous radiation in space has been greatly increased. While the Apollo astronauts were in orbit last month a series of sharp solar eruptions was detected. Far more severe eruptions occurred during the manned flight of Soyuz 3. A major flare after that flight showered the polar regions with high energy protons. The Soyuz orbit would have nudged this area and the flight may have been cut short because of that. The Apollo orbit, in lower latitudes, was screened by the earth's magnetism, but flights to the moon, of course, would be affected.





Data measured in space by Naval Research Laboratory

Science

The Sun-Spot Menace to Astronauts

When President Kennedy set the end of this decade as a deadline for the landing of Americans on the moon he probably did not give much thought to sunspots. Yet the recent manned flights of this country's Apollo 7 and the Soviet Union's Soyuz 3 served as reminders that these sunspots are reaching their peak. The storms associated with the sunspots sweep across the interplanetary seas, presenting radiation hazards for our program to land men on the moon.

Ever since Galileo made his first sunspot drawings in 1612, scientists have kept a watch on our parent star, noting that at intervals of about 11 years the number of sunspots reaches its peak.

In the sunspot regions, bright patches, or plages appear, sometimes fringed by walls of fire thousands of miles high. Giant geysers of flame soar into space, only to rain back into the churning cauldron of the sun. From time to time accumulated magnetic energy is suddenly released in a violent eruption, or "flare."

A brilliant fireball of awesome dimensions rises through the solar atmosphere. There is a flash of X-rays and often a peculiar burst of radio waves. Particles ejected by the flare follow a curving "magnetic highway" through space that may or may not intercept the earth. If they do, a spacecraft near our planet will be subject to intense radiation and on earth there will be a severe magnetic storm and auroral displays.

Polar Cap Absorption

If the eruption is particularly severe, hydrogen nuclei (protons) are hurled out almost at the speed of light. Channeled toward the polar regions by the earth's own magnetic field (which protects the rest of the earth), they plunge into the atmosphere, ionizing the air—that is, knocking loose the electrons. This blacks out long-range radio traffic over the polar areas — a so-called "polar cap absorption" event.

All of these things occurred during and immediately following the space flights of last month. Last weekend a noted Czech scientist, Dr. L. Krivsky, suggested that the Soyuz flight may have been cut short on Oct. 30 because of the threatening activity on the sun.

Now the Naval Research Laboratory in Washington, D.C., has assembled X-ray recordings made in space throughout October by the satellite Solrad 9. These serve as a highly sensitive index of solar turbulence. They show more than 30 small outbursts during the closing days of the three-man Apollo 7 flight and far more intense activity during the Soviet one-man flight.

The observed X-rays are not "hard" enough to penetrate a spacecraft, but they herald eruptions that can throw out showers of protons that could. According to scientists at the Naval Research Laboratory, as well as Dale Bucknam, chief forecaster of the Space Disturbance Forecast Center in Boulder, Colo., the Apollo astronauts at no time were in any danger.

Not only were the eruptions less severe during the flight of the astronauts than later, but Apollo's orbit kept it inside the protective umbrella of the earth's magnetic field. The force lines of this field arch out thousands of miles above the equatorial region, whereas the astronauts were circling the earth less than 200 miles aloft.

Russians in High Latitude

However, because its launching sites are in high latitude, the Soviet spacecraft are placed in orbits that reach north beyond latitude 51 degrees. Therefore they nudge the zone where the force lines of the earth's magnetism bend down toward earth. This zone reaches its southernmost extremity near the southern tip of Greenland, as shown in the drawing above. It is within the border of this zone that high-energy protons, ejected by the sun, rain fiercely on the atmosphere.

As Bucknam pointed out last week, such a polar radio blackout could play havoc with Soviet attempts to bring down the Soyuz spacecraft. He felt this was probably a more serious consideration than any radiation exposure.

However, just after Soyuz 3 returned to earth on Oct. 30 there was a major flare, followed by a severe maghetic storm and polar blackout. If astronauts had been in orbit — and particularly if they had been outside their spacecraft, exploring the moon — they could have been subject to hazardous radiation.

The astronauts, however, can take comfort in the many warning signs that preceded this event. Both the X-ray recordings by Solrad 9 and ground-based observations around the world, fed to the International center in Boulder, showed the build-up of activity on the sun. On Oct. 29, according to Bucknam, there was "a very unusual event" marked by a rapid sequence of small flares. It was a prelude to the major flare that occurred the next day, just after Soyuz 3 had dropped into the Indian Ocean.

For journeys to the moon it should be possible to postpone or cut short a flight if the sun looks ominous. In case of miscalculation, the radiation exposure, if the astronauts are inside the spacecraft, would be severe only during the most intense outbursts. However, on prolonged journeys to other planets, such as Mars, there will be no escape. It may therefore be necessary to design the spacecraft so that a portion of its interior will be shielded from such radiation.

—WALTER SULLIVAN