SCIENCE NEWS OF THE WEEK

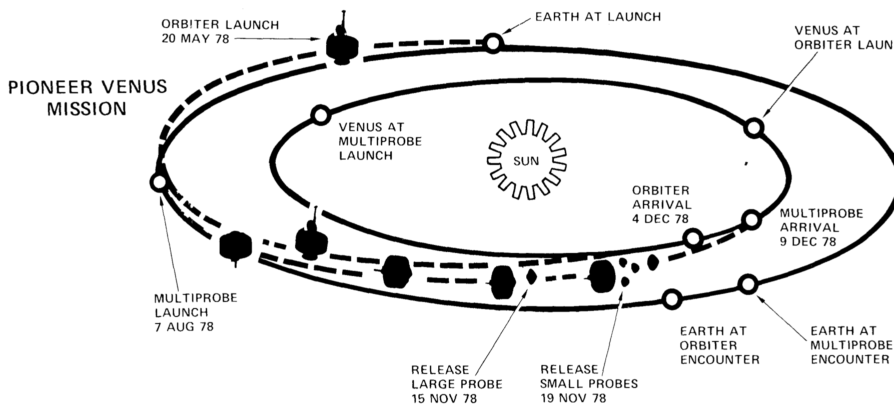
Pioneer Venus Orbiter Is On Its Way

Three U.S. spacecraft have been to Venus, all of them "flybys" that grabbed their readings in a burst of activity as they zipped past their target planet and were gone. On May 20, the first U.S. Venus orbiter was launched from Kennedy Space Center in Florida, designed to circle the sun's second-nearest world for at least one full Venus year (243 earth-days long) following its December 4 arrival. The orbiter is part of a complex mission called Pioneer Venus, whose other component (to be launched August 7) will send one large probe, three small probes and the "bus" that carried them all on separate dives into the atmosphere.

Although most of the major planetary objects in the solar system have been described not only in their own terms but by how they differ from the earth, it is Venus with which the terrestrial comparison seems most baffling. It is similar enough to earth in size and distance from the sun (and thus presumably in the materials that were available when it was being formed) that it has long been nicknamed earth's twin sister. Yet its atmospheric pressure at the surface is nearly 100 times earth's; temperatures there would melt lead; all is wrapped in cloud layers, some of which consist almost entirely of sulfuric acid. This is a twin?

The orbiter will circle the planet every 24 hours, ranging from about 66,000 kilometers above the surface down to as low as 150 km. Since the plane of the orbit will be fixed (in inertial space), with Venus rotating beneath it, the low points of successive orbits will occur over different parts of the planet, and at different angular distances from the sun-Venus line. This should enable, for example, detailed mapping of the currently uncertain region where the solar wind interacts with the planet's influence. A major unanswered question is whether a weak magnetic field or merely an ionosphere "holds off" the solar wind, whose degree of penetration could be a major factor in the chemistry of the upper atmosphere.

The orbiter's dozen scientific instruments include a cloud photopolarimeter that is also designed to photograph cloud features by ultraviolet light (a capability added, according to project scientist Larry Colin, when Mariner 10's UV images in 1974 showed that there was far more to see in the clouds than a mere fluffball). A radar mapper will yield surface heights to within as little as 100 meters, though horizontal resolution is only 20 to 40 km (compared to tens of meters in a proposed Venus-orbiting imaging-radar mission). Other sensors will measure temperatures, ions, neutral atoms, the solar wind, magnetic fields and other phenomena. □



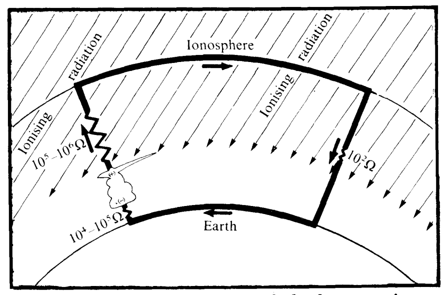
NASA

Sun and weather: An electric link

According to folklore, Benjamin Franklin nearly killed himself proving that lightning is electricity. Since then, at least, people have known that electricity is involved with the weather. So is the sun. The statistical evidence for correspondences between solar cycles and terrestrial weather cycles grows stronger and stronger. Yet, as Ralph Markson of Massachusetts Institute of Technology points out in the May 11 NATURE, scientists have hesitated to postulate a physical connection in the absence of a plausible mechanism. Markson suggests one: It is electrical, and involves thunderstorms.

One might have thought first of a thermal mechanism. But the solar thermal power received at the earth does not vary by more than one percent, so it is hard to use as an explanation for variable phenomena. Furthermore, the solar cycles to which the weather cycles appear connected involve largely electric and magnetic phenomena (such as sunspots and solar flares or the earth's passage through sectors of the solar magnetic field.

Markson proposes that there is a kind of global electrical circuit. Electrical storms act collectively as the generator in this system. The earth and the atmosphere form a kind of capacitor: The "outer conductor" here is an equipotential surface at about 60 kilometers altitude. The inner conductor is the earth's surface. Between the two is a leaky dielectric, the atmosphere. Current generated by the storms flows from the cloud tops to the ionosphere. The return part of the circuit, from ionosphere to earth in the fair weather areas, takes place by diffusion of ions through the air, positive ions downward, negative ions upward.



Markson/Nature

1,500 storms charge up global capacitor.

In this global electrical circuit, unlike one that someone might set up to do some practical work, most of the resistance is in the generator. Upward of a million ohms (90 percent of the resistance in a global "circuit" involving 1,500 thunderstorms generating an ampere of current apiece) is concentrated in the generator. Electrical engineers may wince, but this factor means that the major part of the resistance is available to be affected by changes in the atmospheric conductivity. These conductivity changes come about through changes in the ionizing radiation reaching earth from space. The solar phenomena to which connections are sought can change the earth's environment in one way or another so as to alter the amounts of ionizing radiation reaching the upper atmosphere. The result of an increase in ionization would be more thunderstorms. Thunderstorms release a lot of energy, an average of 100 million kilowatt-hours each, and an increase in this energy could affect global atmospheric circulation cells and weather and climate cycles.

Of course, Markson's hypothesis must be tested, and as an inducement to testing he indicates that it gives people a potential way to do something about the weather. Human-induced changes in upper atmosphere ionization (by nuclear explosions and other means) could inadvertently or deliberately change the weather. □