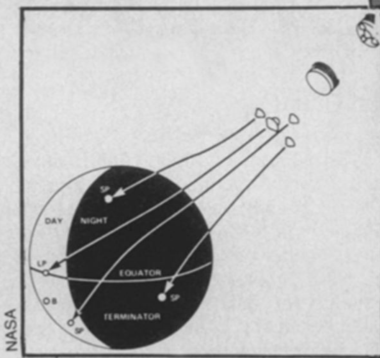
SCIENCE NEWS OF THE WEEK

Probes Bound for Venus Atmosphere

Following a decade of planning, the first U.S. spacecraft designed to penetrate the atmosphere of Venus were launched on August 8 from Kennedy Space Center in Florida, bound for a December 9 encounter that will last barely an hour. Heavily instrumented to study the atmosphere's composition, structure, temperatures and winds, the individually targeted Pioneer Venus probes are not designed to survive their landings. They will, however, have to contend with clouds of sulfuric acid, temperatures as high as 485°C and pressure that will reach 90 times the sea-level atmospheric pressure of the earth.

Some U.S. researchers have criticized the quality of the scientific data provided by the several Soviet craft that have successfully "soft-landed" on the inhospitable planet's surface, but they speak more respectfully of the engineering that enabled the measurements to be taken at all. In building the Pioneer Venus probes, says project manager Charles F. Hall of the NASA Ames Research Center, the spherical, pressure-resistant outer spheres took many months to machine from solid titanium forgings, made more difficult by the need to leave openings for instruments. Many of the openings are fitted with sealed windows of sapphire, and one is actually of diamond. Thick blankets of insulation, necessary to keep the interiors below 38°C only centimeters from outside temperatures that have been compared to a self-cleaning oven, had to be made free of even microscopic gaps.

The cluster of probes, making the trip from earth mounted on a single, cylindrical "bus," includes one large probe and three small ones (plus the bus itself, which is also instrumented). The large probe, carrying the atmospheric-composition experiments, will separate from the bus 24 days before reaching the planet and head for a planned entry near the day-side equator. With 20 days to go, the bus will be set spinning at 48 r.p.m. in order to "throw" the small probes to their selected entries at the day- and night-side mid-southern latitudes and the night-side high northern latitudes. Corresponding coordinates on earth, says one Pioneer Venus scientist, would put the large probe in the Amazon basin, with the small probes at the tip of Norway, near Madagascar and near Montevideo, Uruguay. All will enter on the same day, including the bus itself, which is targeted at the high southern dayside latitudes. (A Pioneer Venus orbiter, launched on May 20, will have been on station since December 4, making radar and other measurements, though the probes will transmit direct to earth.) □



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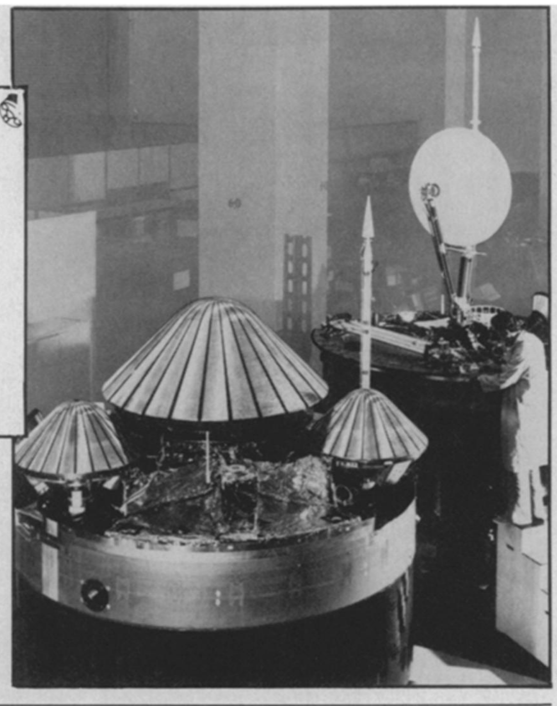

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Conical heat-shields atop the Pioneer Venus 2 spacecraft "bus" indicate its large probe and two of the small ones, due to enter the atmosphere of Venus on December 9. Orbiter spacecraft is in background. Diagram shows probe entry pattern.

Star quarks make the big time

One of nature's more ironic facets is that the attributes of cosmic gargantuans like ordinary and neutron stars, black holes and quasars depend directly on the physical processes governing the infinitesimal nucleus. This modern realization has evolved since the renowned nuclear physicist and Nobel laureate Hans Bethe explained that stars (like hydrogen bombs) are very luminous because within their fiery interiors, hydrogen is continually being fused into helium.

It is expected, therefore, that following soon after each new discovery in high energy physics, will be an elaboration of its ramifications — usually exotic — on astrophysics. One of the latest is provided by two Massachusetts Institute of Technology physicists, who have added their refinements to the several-years-old speculation about stars largely composed of quarks, those sub-nuclear will-o'-the-wisps that have since the 1960s compelled and taunted the collective ingenuity of high energy physicists worldwide.

Understanding the general idea behind quark stars depends simply on realizing that any star remains stable as long as the gravitational attraction caused by its own mass upon itself is exactly counteracted by some outwardly eruptive effect, like that caused by its radiation. An aging star soon ceases to produce enough radiation to maintain this delicate balance and therefore collapses under its own weight to become either a white dwarf, neutron star or black hole. The possible existence of quarks might alter these options somewhat. In particular, instead of ending up as a neutron star with a solid core (a stellar fate often spoken of in connection with pulsars), a suitably massive star would not cease collapsing until it rested upon the skeleton that most fundamentally undergirds it — quarks.

Walter B. Fechner and Paul C. Joss's innovative contribution to the continuing saga is their use of a realistic (that is, consonant with current empirical knowledge) model of quark behavior. In their analysis they used an expanded and more sophisticated variation of a basic idea that has come to be known as the MIT bag model, wherein quarks are pictured mathematically as tiny inmates of an impenetrable balloon. For greater realism, the two MIT physicists took account furthermore of the possibility that within a bag, quarks interact amongst themselves.

The astrophysical result of this hypothetical picture of quarks is that stable quark stars can exist (previous studies have split on this issue), but that their outward appearance would be very similar to that of neutron stars. Many stars that are currently identified as neutron stars, Joss told SCIENCE NEWS, may therefore actually be these quark stars.

An interesting consequence of this speculation would be, as the authors describe in their July 27 NATURE article, that such quark stars "may exclude the possibility of a neutron solid in the core of a collapsed star." But astrophysicists currently believe that seismic activity in these cores within many pulsars is responsible for occasional abrupt changes in their otherwise faithfully periodic radiation intensity. In such instances, for example, "the giant glitches in the pulse period of the Vela pulsar," they wrote, "could not be the result of 'corequakes' in a neutron solid, and an alternative explanation for this phenomenon would be required." □