however, there seems to be more cohesion among the particles than expected. The walls of the trench dug by the lander's scoop failed to collapse inward as anticipated. A close study of the trench and its environs, says geophysicist Henry Moore, suggests a soil cohesion of about 1,000 dynes per square centimeter, about like that of wet beach sand, although this is unlikely to imply a wet landing site. The cohesiveness, however, was not too great to prevent one of the lander's footpads from becoming completely buried in the soil, aided apparently by the fluidizing effect of trapped atmosphere, the minimal particle-packing due to low gravity and the apparent slight doming of the pad's impact site. The bulk density of the soil at the trench, says Moore, is about 1.8 to 2.0 grams per cubic centimeter. This, he adds, is the sort of bulk density produced by packing together soil particles with individual grain densities like the 3.0 grams per cubic centimeter of typical lunar rocks or the 2.6 grams of common terrestrial feldspar.

As the pace of activity accelerated on the surface, the Viking 1 orbiter continued its rounds, providing data on the planet's large-scale features and seeking a landing site for Viking 2, which would reach Mars orbit on Aug. 7. One of the Viking 1 photos revealed a huge domed feature in the planet's northern latitudes, fully a mile across, with an uncanny resemblance to a human face. Said Viking site-selection chief Harold Marsursky: "This is the guy that built all of Lowell's canals." ☐

'And now a message from Uranus . . .'

It took nearly two decades for pioneering radio astronomers to realize that the earth was not the only planetary source of nonthermal radio emissions in the solar system. Jupiter's powerful radio bursts were discovered in the early 1950s, after which another 20 years passed before Larry W. Brown of NASA's Goddard Space Flight Center in Maryland detected the same phenomenon coming from the planet Saturn (SN: 12/14/74, p. 372). Now Brown has tentatively added a fourth planet to the list: Uranus.

The evidence is subtle indeed, consisting of no more than 6 brief radio bursts, each less than 3 minutes long, painstakingly extracted from about 500 *days* of data from the IMP-6 satellite, sixth in the so-called Interplanetary Monitoring Platform series. Since Uranus is much farther from earth than Jupiter or Saturn, and is also smaller and less massive with presumably a proportionately smaller magnetic field, its radio emissions are extremely weak by the time they reach an earth-orbiting satellite. As a result, Brown first had to pare away numerous possible sources of confusion before he could tell whether such signals were present.

First, because the sun is the "loudest" radio source in the sky, he scrapped all data gathered when the sun was within 20° of the line between Uranus and the satellite. Earth is another big noisemaker, so out went everything taken when the satellite was less than 4 earth-radii from the planet. To weed out spurious signals, Brown then rejected all of the remaining data except that in which at least three adjacent channels in the IMP-6 receiver indicated the direction of Uranus, and then chopped off all frequencies below 185 kilohertz to eliminate powerful terrestrial interference which could exceed his previous 4-earth-radii limitation. (The frequency cutoff alone, says Brown, knocked out 999 of every 1,000 bursts in the data.) He then excised all remaining signals with intensities greater than 20 times that of the galactic background radiation in order to filter out ultra-strong solar and terrestrial bursts whose very strength could mislead the satellite as to their true direction of origin. But because the strongest galactic radiation happened to be coming from the approximate direction of Uranus at the time, he also rejected everything with *less* than three times the galactic signal strength.

The remainder was Brown's prize: 6 bursts, with peak strengths at about 475 kilohertz and ranging from 375 to 600 kHz. But he strongly emphasizes that the analysis was "very, *very* difficult" and that the results are "very iffy." The Saturn emissions were detected in the same batch of IMP-6 data, but those, besides being stronger, could be double-checked by matching pulses in the signals against the planet's 10.5-hour period of rotation. Uranus, tilted 98° on its axis, offered no such possibility. Also, the Saturn data were later confirmed by the moon-orbiting Radio Astronomy Explorer satellite, which could get extremely precise positional fixes by timing the signal cutoff at the sharp limb. Uranus was in the wrong position for this to work either. The only possibility of confirmation, Brown says, lies in a satellite to be launched in 1978 as part of the U.S.-European International Sun-Earth Explorer series, one of whose instruments will have the right frequency range and aiming system to possibily do the trick.

It is just possible that Brown has found the last major radio source in the solar system that can be detected from earth. Mercury's slight magnetic field may produce some emissions, but they would be extremely weak, and the planet is so close to the sun that they would be almost impossible to detect anyway. Neptune is a likely emitter, but its smaller size (relative to Jupiter, Saturn and Uranus) probably means that its bursts are at such low frequencies that they are completely lost in earth's own radio noise. Mars has a field so weak that the Viking orbiters don't even carry magnetometers, and Pluto is simply too small. Of course there *are* some large, interesting moons. . . . ☐

Getting a charge out of charm

Most of the recent discoveries in particle physics have involved new objects related to a theoretically conjectured property of particles (quantum number) known as charm (SN: 6/26/76, p. 408). Two months ago we reported the discovery of the first particle that seemed to exhibit the new property openly, or "nakedly" as some physicists like to say (SN: 6/5-12/76, p. 356). This, like nearly all the previous new particles of the last two years, had been found in the products of electron-positron annihilation collisions in the SPEAR storage ring at the Stanford Linear Accelerator Center.

The particle found in the spring was electrically neutral. It often happens in particle physics that electrically charged particles of similar nature exist to match a neutral one, and SLAC now reports the discovery of negatively and positively charged particles that appear to go with the neutral one. The experiment that did the work is the same one that found all the others. It is operated by a consortium including a few dozen physicists from the staffs of SLAC and the Lawrence Berkeley Laboratory.

The newly found particles have masses of about 1,876 million electron-volts (1,876 MeV). This compares favorably to the mass of the neutral one, 1,865 MeV. Usually there is a slight mass difference between electrically charged and electrically neutral particles that share the same characteristics otherwise. In this case, according to one of the experimenters, Harvey Lynch of SLAC, the missing mass—the mass of the uncharged particle or particles involved in the action—comes out equal to that of the neutral one, a seeming indication that all three are made at the same time.

The evidence for all of these particles comes from their radioactive decay products. The particles themselves are not recorded, and there is no equipment that detects charm directly. What appears in the data is a resonance, a sudden sharp increase in the ratio of one class of particle (hadrons) to another class (leptons) in the decay products. The narrower the resonance, the more certain the experimenters are that they are dealing with a short-lived particle of a definite mass as the stage between the electron-positron annihilation and the recorded decay products. This one is extremely narrow, Lynch says, too narrow for the detectors to resolve in fact, or less than 40 MeV wide.