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.

Lynch stresses that in this case, as in the case of the neutral object found in May, the SLAC-LBL physicists are not making a flat-out claim of naked charm, but the characteristics and behavior of the new particles seem to fit what theory prescribes for nakedly charmed particles. This is especially true, he says, of their decay modes. They decay by the so-called exotic channel, which involves a different combination of two measurable characteristics (electric charge, and strangeness) from that involved in the normal channel, by which uncharmed particles decay. □

China earthquake largest in series

Perceptible motion of the giant plates of the earth's crust has apparently set off this year's series of more than a half-dozen major earthquakes, including last week's temblor near Peking. That quake, measuring 8.2 on the Richter scale, was the largest to occur anywhere in the world since 1964.

Though the exact plate movements are hard to determine, some seismologists say the African and Indian continents have moved noticeably northward over the last several months, setting off a series of quakes along a rim stretching from Italy (quake on May 6) to the islands north of Australia (the New Hebrides was shaken Aug. 2 by a quake measuring 6.9). The first of this year's series of major quakes was in Uzbekistan, USSR, on April 8, and measured 7.0 on the Richter scale.

The Chinese quake, on July 28, was by far the largest of the series and took place in the most densely populated area. Though casualty figures were not released by the Chinese government, diplomats in Peking estimated the death toll in the hundreds of thousands. The industrial city of Tangshan, some 100 miles southeast of Peking, was reportedly flattened by the quake and more than 125 aftershocks of Richter magnitude 4.0 or greater were counted in 48 hours.

Perhaps the most disturbing aspect of the aftershocks has been that their centers seem to be progressing northward toward Peking. The area affected by the quakes contains some 20 million people, many of whom have been sleeping in the open to avoid collapsing buildings. Dependents of foreign diplomats began leaving Peking over the weekend, after being requested by Chinese officials to stay away for at least a month.

Though Chinese seismologists had seen some signs of an impending quake near Peking, they were unable to pinpoint its time as they had apparently done in Liaoning last year (SN: 7/26/75, p. 55). They had only been able to say a major quake should occur before 1980. This week, however, continuing ominous signs—including unusual restlessness among animals in the Peking zoo—led the scientists to warn that more strong quakes in the area are likely soon.

In a program broadcast on Shanghai radio, Chinese seismologists said they may see "very obvious" signs foretelling a quake, but that these may often be misread. "Earthquake forecasting in our country has made great headway," the program said. "Instances of accurate and relatively accurate forecasts increase each year." However, the scientists admitted that due to the complexity of the phenomenon, such forecasting remains "in a primitive state at present."

The Chinese use basically the same indications of an impending quake as those used in the West: changes in local magnetic, electric and gravitational fields, bulging of the land, changes in subterranean water level and chemical content of the water, and restlessness of animals.

* * *

A National Research Council panel last week issued a study calling reliable earthquake prediction "an achievable goal" for the United States within 10 years, provided a national commitment to a long-term research program is made now. Such a program would require "several times the current annual expenditures for prediction research," the report concludes.

The panel calls for increased study of how people would respond to earthquake predictions, and suggests creation of a formal evaluation panel to advise public officials on predictions. Also, the panel concluded, "earthquake prediction now looks so promising, and its social consequences are potentially so profound," that an advisory unit should be established to advise the new White House Office of Science and Technology Policy in such matters. □

No vacation for DNA issue

There hasn't been a dull moment in the field of recombinant DNA research since California biologists stumbled onto the gene-grafting enzymes four years ago. This summer seemed to hold a refreshing potential for quiescence, following the release in June of long-awaited formal guidelines to govern the field and considering, as well, the traditional vacation-time lull. All is far from quiet, however, and there has been, during the past three weeks, an attempt to patent the new techniques and a barrage of letters between congressmen, an environmental group and the White House.

Stanford University and the University of California have applied jointly for a patent on certain recombinant DNA techniques. (Nobody is saying which ones right now.) The application is pending; processing takes several months.

Although details from Stanford's technology licensing office are necessarily scanty at this point, the basis for the patent application seems to be the ground-breaking research done by Stanford biologist Stanley Cohen and by Herbert Boyer at the University of California at San Francisco. They first demonstrated in 1973 that restriction enzymes could be used to transfer gene sequences.

The patent, according to Stanford's technology licensing manager, Niels Reimers, would cover only commercial uses of certain basic recombinant techniques and only in the United States. These commercial applications might include large-scale production of biologically active substances, such as insulin, hormones or antibodies, by genes transplanted to bacteria. Cohen, Boyer and both universities say they will assign any royalties from commercial use of the techniques to fellowship and research.

The first public discussion of the previously quiet intention to patent recombinant DNA techniques surfaced at the Miles symposium in June (SN: 6/19/76, p. 389). Some scientists worried that the patents would limit research, lead some industries to seek less-safe but patent-free techniques or inhibit industrial use.

The first concern is groundless, Reimers told SCIENCE NEWS, since research uses would not be patented. Second, the patents would apparently cover such key steps that "less-safe, patent-free" approaches are unlikely. And patents, Reimers says, would probably increase, not decrease, industrial safety and applications. A pharmaceutical company is more likely to spend large sums to develop an application if some exclusivity is assured, he says. Participating companies, moreover, could be required by patent provisions to adhere to the NIH guidelines for safe containment of recombinant organisms. Adherence is now voluntary for all those not receiving NIH funds.

Concern over industry's freedom from regulation led Senators Edward Kennedy (D-Mass.) and Jacob Javits (R-N.Y.) to send a letter to President Ford. In it, they urge an "executive directive and/or rule-making" to assure compliance throughout the research community—a task, they imply, Congress would undertake if the White House doesn't. The senators praised the NIH guidelines as "a responsible and major step forward."

That praise was not evident in a second set of letters from volunteers at the Friends of the Earth, a national environmental organization, to Kennedy, Javits and several other congressmen and to NIH Director Donald S. Fredrickson. In their letters, Francine Simring and Lorna Salzman formally requested that NIH "cease and desist" funding recombinant DNA research

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