was 50 to 200 electron-volts. The cloud of electrons and ions was thus traveling across the lunar surface at a velocity of some 18,000 miles an hour.

The SIDE experiment, in addition to detecting the LM impact, picked up gases in the LM area from the astronauts' suits and from the LM itself. But the Apollo 12 SIDE, which is still operable, had an even more dramatic role, says Dr. John Freeman of Rice University. "It said both hello and goodbye to Antares." About six and one-half minutes after the lunar module Antares' ascent engine ignited, the Apollo 12 instrument picked up ions from the rocket exhaust. The question facing scientists working with these experiments is how do these electrons and ions become accelerated to the high energies seen on the instrument. The answer could give insight into earth phenomena such as the Van Allen radiation belts and the auroras.

The cold cathode gauge also immediately began sending back data to earth. All of these instruments, which measure the lunar atmosphere or the solar wind or electrons and ions about the lunar surface, will have to go through a period of settling down before actual scientific data can be taken.

The active seismometer, however, yielded data during the astronauts' first walk on the surface. Thirteen of 21 small explosive thumper charges were successfully fired by Mitchell. Says Dr. Robert Kovach of Stanford University: "We were surprised that our signals [from the active seismometer] did not ring quite as much as we would have guessed based on the past passive seismic results. They were closer to what we have observed on earth." The velocity was surprisingly low, down to a depth of about 50 feet. "We did not see what we thought would be a major solid surface."

The portable hand magnetometer revealed another remarkable fact about the new site. It measured a magnetic field at the moon surface at two locations—one of 101 gammas close to the LM, the other of 42 gammas near the rim of Cone Crater. This compares to the 37-gamma field at the Apollo 12 site. "This tells us," says Dr. Gene Simmons of MSC, "the magnetic field of the surface of the moon varies spatially."

Of the moon landing Commander Shepard says, "Apollo 14 has been a smashing success, but I don't really think we will be able to assess at this point what the contributions will be." The scientists agree that it was a success. Dr. Paul Gast, chief of lunar and earth sciences division at MSC, and other scientists who came to MSC during the flight were all grins over the operation of the new station and over the fact that the astronauts had been able to return to the station right before they entered the LM to realign the antenna to improve telemetry strength. Dr. Gast says of the Apollo 14 feat, "The astronauts' capability as field geologists on the lunar surface should not be sold short. Their only limit was time." And Dr. Robin Brett, also of MSC, summed up the nine days this way, "Every time a new crew goes to the moon, it is always exciting and surprising."

Apollo 14 was no exception. □

ENVIRONMENT MESSAGE

Leadership on land

Since World War II, the real estate business has boomed as houses, highways, shopping centers and other uses of land have proliferated in response to a growing and increasingly affluent population. The result in many instances has been ugliness and waste. Land-gobbling freeways have been built through rich agricultural valleys instead of on the less tillable hillsides. Garish commercial strips have blighted new suburban developments. Forests and shrubbery have yielded to bulldozers clearing space for new subdivisions. Zoning laws have often been weak and ineffective—or easily manipulated by real estate interests. And Adam Smith economics have been the primary ruling force in land use decisions.

Just as President Nixon's Keynesian 1972 budget was an unexpected departure from traditional Republican fiscal policies, so his second annual environmental message this week is a major departure from the usual Republican attitude of hands-off business—especially in the area of land use. "Our goal must be to harness the powerful mechanisms of the market place, with its automatic incentives and restraints, to encourage improvement in the quality of life," the President said. But despite this lip service to free enterprize, what really is envisioned in the message is a major shift toward government planning.

The President proposed legislation for a national land use policy which would "encourage the states, in cooperation with local government, to plan for and regulate major developments affecting growth and the use of critical land areas." The program would spend $100 million in Federal funds over the next five years to assist the states in land use planning. More important, the President said that steps would be taken through executive action "to assure that federally assisted programs are consistent with the approved state land use programs." Since nearly every new land use development receives Federal assistance of one kind or another—from Federal Housing Administration insured loans for home buyers to Environmental Protection Agency grants for sewers—this control mechanism could be a powerful Federal weapon against reckless development. The land use proposal was the major new initiative in the President's message. But earlier proposals were strengthened, or extended, in what environmentalists see as a message which recognizes the realities of a deepening environmental crisis. Among its other proposals:

- An emission charge on sulfur oxides.
- Doubling of Federal funds for sewer and sewage treatment construction.
- Streamlining of pesticide regulation.
- Regulation of toxic substances before they are placed on the market.
- Regulation of noise pollution.
- A number of other land use proposals, including an urban parks program, preservation of historic buildings, expansion of the wilderness system, regulation of power plant siting and regulation of the environmental effects of surface and underground mining.

Most of the proposals will require Congressional action. At a press conference this week, Russell Train, chairman of the Council on Environmental Quality, Interior Secretary Rogers C. B. Morton and EPA Administrator William D. Ruckelshaus told newsmen that the proposals are not just broad generalities; they have been spelled out in detail in 300 pages of proposed legislation, most of which will go to Congress this week. □

SYMMETRIC FISSION

Over or around the hump

That nuclear fission can occur has been repeatedly demonstrated. How it occurs is still a subject of investigation after 30 years.

One of the first pictures of nuclear fission put forth was the liquid-drop model suggested by the late Niels Bohr. He proposed that the matter of a nucleus was a kind of uniform fluid and that a fissioning nucleus was like a drop of liquid that had become too large for its surface tension to hold in a spherical shape. Gradually it deformed itself until it split into two.

Liquid drops split symmetrically into two equal parts. But nuclei that fissioned did so asymmetrically, into unequal parts. So the original liquid-drop model appeared less than adequate.

Nevertheless, at the annual meeting of the American Physical Society in New York last week—a meeting that nowadays seems noteworthy more for politics than science—the discovery of symmetric fission of the sort envisioned

in the early liquid-drop model was reported by Dr. Walter John of the Lawrence Radiation Laboratory at Livermore, Calif., on behalf of himself and colleagues Drs. E. Kenneth Hulet, R. W. Lougheed and J. J. Wesolowski.

The symmetric fission was found to happen to the element fermium. It comes, however, in company with asymmetric fission—some nuclei divide unevenly and some divide evenly—and it is taken as evidence in favor of an emendation of the liquid-drop model, the so-called double-hump theory.

The idea of gradual deformation and splitting in the liquid-drop model became basic to theories of fission. Nuclei were seen as stretching themselves from spheres into ellipsoids, then dumbbells and finally splitting in two. It was found that there existed a so-called fission barrier: The more ellipsoidal a nucleus became, the harder it was to distort further until a certain point of maximum difficulty was passed. After that further distortion became easier.

Fission would occur if the maximum point was successfully passed. It was like climbing a hill. Each step was harder than the one before until the summit was reached. Then it was all downhill.

Discovery of the so-called nuclear isomers forced an elaboration of this view. It was found that nuclei of certain elements—californium is an example—could be divided into two groups. One, the ground state group, lasted a fairly long time before fissioning; the other, the isomer group, fissioned after a much shorter time. Since an element's characteristic lifetime was supposed to depend on the size of its fission barrier, the single barrier could not explain two lifetimes.

Some Russian theorists found that if they calculated the energy engendered by the orbital motions of neutrons and protons inside the nucleus and added this to the liquid-drop model, they got a double-hump theory. Instead of one point of maximum difficulty there were two, with a region between where distortion was first progressively easier, then harder again. The isomers were nuclei that were momentarily in the valley between the humps and needed to pass only the second barrier to complete fission.

As long as distortion is taken along one axis only, this double-hump theory predicts symmetric fission. But theorists found that if they introduced additional distortion in a perpendicular direction —if they made the nucleus egg shaped instead of a symmetric ellipsoid—the nucleus could get around the second barrier more easily. This is something like going around a hill instead of over it, and it produces asymmetric fission as the unequal halves of the egg come apart to form daughter nuclei.

Nuclei take the easiest possible way to fission, so most elements split asymmetrically. In the case of fermium, says Dr. John, the second barrier is very small, almost not there, and so some fermium nuclei go one way and some the other. For heavier elements, where the second barriers are smaller still, there should be even more symmetric fission.

Dr. John does not expect the discovery to have an immediate effect on the economy of fission reactors. The elements in which symmetric fission occurs are too rare to be used as fuels. He expects the new result to be useful in the study of nuclear dynamics and structure, especially the shapes of nuclei. Some nuclei, certain rare earths for instance, have highly distorted shapes, yet do not fission. The question is why. □

NEW SUPERNOVA RELIC

A blast that lit the sky

NASA

Gum nebula: Lit by a supernova.

Nebulae, extended bright patches in the sky, fall into two general classifications. Some are supernova remnants, splotches of matter blown out of a star by a supernova explosion and heated by it until they glow. Others are clouds of ionized hydrogen surrounding particular hot stars that pump energy into them so that they glow continuously. The latter are called Strömgren spheres after the Danish astronomer Bengt Strömgren.

There is one nebula, the Gum nebula, which stretches across 50 degrees of the southern sky, that defies classification under either of these heads. Drs. John C. Brandt, Theodore P. Stecher and Stephen P. Maran of the National Aeronautics and Space Administration's Goddard Space Flight Center in Greenbelt, Md., and David L. Crawford of the Kitt Peak National Observatory at Tucson, Ariz., conclude that the Gum nebula is the first known representative of a third class that combines certain characteristics of both of the others. Their argument is published in the Feb. 1 ASTROPHYSICAL JOURNAL LETTERS.

The Gum nebula was discovered by an Australian astronomer, Dr. Colin S. Gum, in 1952. It had not been noticed before that because it is too big and too tenuous.

It is not visible to the naked eye. "You can't see it," says Dr. Maran. "The surface brightness is too low. You have to have a wide-angle lens and red filters."

The Gum nebula is about 2,600 light years across in its longest dimension and appears to be somewhat elliptical in shape. It would have had to be a supercollossal supernova to have blown matter from a star up to 1,300 light years into space, so the Goddard-Kitt Peak group argues that the Gum nebula cannot be a supernova remnant in the way that the Crab nebula, for example, is a supernova remnant.

On the other hand, although there are stars within the Gum nebula, there are not enough of the right kind of hot stars to ionize such a volume. Thus, the Gum nebula cannot be an ordinary Strömgren sphere.

Instead, the group proposes, the Gum nebula is a fossil Strömgren sphere made by a supernova that happened 11,000 years ago. As the Goddard-Kitt Peak astronomers see it, the supernova gave off a tremendous blast of ultraviolet light which ionized interstellar hydrogen clouds for light-years around.

What is glowing is not matter that was ejected by the explosion but hydrogen that was there before it. The light is produced as the electrons of the hydrogen lose energy and gradually recombine with their nuclei. Unlike Strömgren spheres that are being pumped by hot stars, this one is gradually burning out as the hydrogen recombines.

The measure of the age is provided by the Vela pulsar, which lies in the nebula. According to the most common theory of pulsars, a pulsar is what remains of the core of the star that explodes in the supernova, and pulsar theory gives 11,000 years for the age of the pulsar. On this basis the nebula has between 50,000 and 100,000 more years to glow.

Dr. Maran explains the absence of other such supernova relics in two ways. First, to light up a large amount of hydrogen, a supernova would have to occur in the central plane of the galaxy, where most of the hydrogen is. Second, there may be others around, but they may be too young to see: At first such a cloud would radiate in the radio range. Only after thousands of years would it shift to visible light. □