physical sciences

On not finding planet X . . .

Last April Joseph L. Brady and Edna Carpenter predicted the existence of a tenth planet in the solar system (SN: 5/6/72, p. 293). They were led to the conclusion by studies of the motion of Halley's comet. This planet would have 300 times the mass of the earth; its orbit would lie 6 billion miles from the sun (well outside the orbit of Pluto) and be inclined 60 degrees to the plane of the ecliptic.

In the October PUBLICATIONS OF THE ASTRONOMICAL SOCIETY OF THE PACIFIC appears the second negative result of attempts to find it. (For the first see SN: 10/14/72, p. 248.) A. R. Klemola and E. A. Harlan of the Lick Observatory looked for a body of magnitude 13 or 14, which would be expected if planet X had a reflecting power at least equal to Pluto's and a reasonable density. They report that no object brighter than magnitude 17-18 appeared in the region where planet X was supposed to be.

. . . And the theoretical case against it

In the same issue of PUBLICATIONS OF THE ASTRONOMICAL SOCIETY OF THE PACIFIC Peter Goldreich and William R. Ward of California Institute of Technology argue that the existence of planet X as predicted by Brady and Carpenter would cause drastic consequences for the rest of the solar system. The extreme size and unusual angle of the planet's orbit would cause the sun's axis of rotation to undergo a large cyclic wobble (as much as 360 degrees) away from the direction perpendicular to the plane of the ecliptic. This rotation would have a period of tens of millions of years. Planet X would also destroy the coplanar character of the orbits of the outer members of the solar system, taking about a million years to force them into different planes.

Since these catastrophes have not occurred, Goldreich and Ward conclude that planet X does not exist. The changes in the motion of Halley's comet that it was invoked to explain can come from nongravitational sources, such as energy loss due to evaporation of volatile substances when the planet is near the sun, Goldreich and Ward propose.

Mercury's surface looks like the moon's

The planet Mercury is often compared with the moon. They are both supposed to be bleak, atmosphereless bodies with extreme variations of temperature between their lighted and unlighted sides. The likeness is now carried further: Mercury's surface composition looks much like the moon's, according to observations of the planet's reflection spectrum done by Thomas B. McCord of Massachusetts Institute of Technology and John B. Adams of the West Indies Laboratory of Fairleigh Dickinson University at St. Croix in the U.S. Virgin Islands.

The data were taken at two locations: the Cerro Tololo Interamerican Observatory at La Serena, Chile, and Kitt Peak National Observatory at Kitt Peak, Ariz. McCord and Adams report in the Nov. 17 SCIENCE that Mercury's reflection spectrum in the range between 3,200 and 10,500 angstroms resembles that of lunar maria and upland. This leads McCord and Adams to suggest that Mercury is covered with a "lunar-like soil rich in dark glasses of high iron and titanium content."

earth sciences

From our reporter at the annual meeting of the Geological Society of America at Minneapolis

Mesas as garbage cans

Scientists are still searching for someplace to store the vast amounts of radioactive wastes that will be produced by nuclear power plants during the next few decades. One possibility that has been mentioned but never taken seriously enough, says Isaac J. Winograd of the U.S. Geological Survey, is certain zones of rock in the Southwest. Winograd suggests that solidified radioactive wastes could be stored at depths of 50 to 100 feet in these zones which are about 400 to 2,000 feet thick. Possible sites would be plateaus and mesas and certain valley floors in eastern Nevada.

One of the problems of underground storage of radioactive wastes is that moisture in the surrounding rock can transport radionuclides away, eventually contaminating the entire water table. Only very intense rains, unlikely in the arid climate of the Southwest, could penetrate deeply enough into the type of rock Winograd is proposing to wash radionuclides down to the water table.

The chief advantages of his proposal, says Winograd, are that the wastes would be retrievable and would require minimal maintenance. A potential liability would be the inability of some rocks in the zones to dissipate waste-generated heat.

Fingerprinting copper

Just as archaeological evidence sometimes sheds light on past environments and geological events, geologists can apply their special insights to aid the archaeologist.

Eiler L. Henrickson of Carleton College in Minnesota and George R. Rapp Jr. of the University of Minnesota are working on a way to identify the original sources of Bronze Age metal artifacts through trace-element analysis.

The major component of such artifacts is copper. Henrickson and Rapp hypothesized that copper from different regions might contain different quantities or types of trace elements. The trace-element pattern of a copper sample might thus serve as a "fingerprint" linking it to its source. Their preliminary results show that trace-element fingerprints do permit discrimination between copper from different regions. Sometimes even the specific mine can be identified.

Development of the lithosphere

Several researchers have argued that plate tectonics as we know it began about 2 billion years ago when the earth's crust became rigid enough to break into plates (SN: 9/30/72, p. 220).

Now Kevin Burke of the University of Toronto and John F. Dewey of the State University of New York at Albany extend the theory, proposing three major phases in the development of the lithosphere. The earliest, which they call the "permobile" phase, was characterized by pervasive magmatic activity. During the second phase, 2.7 billion to 2.0 billion years ago, the lithosphere thickened and the stable crustal regions known as cratons formed and accumulated unusually thick layers of sedimentary and volcanic deposits. By 2.0 billion years ago the lithosphere became rigid enough to break into a mosaic of plates, beginning the plate tectonic phase.