SPACE SCIENCES

From our reporter at the meeting of the Division of Planetary Sciences of the American Astronomical Society in Honolulu

Backtracking meteorites

The Apollo astronauts brought back their lunar samples, and there is talk of sending automatic spacecraft to collect some pieces of Mars in 15 or 20 years. But if two University of Arizona researchers are correct, earthbound scientists are already in possession of samples from a still more distant source, Vesta, a 500- to 600-kilometer chunk of rock in the most distant reaches of the asteroid belt. Numerous meteorites have struck the earth, of course, and a large number have been recovered. But their specific origins are unknown, thus giving special significance to the idea of identifying the only samples from any known extraterrestrial source except the moon.

They are called eucrites, a rare class of basaltic meteorite believed to have been formed in lava flows on the surface of their parent body. That they may have come specifically from Vesta is the possibility raised by Michael J. Drake and Guy J. Consolmagno, based on a lawyerlike assemblage of evidence gathered by themselves as well as by several other researchers. First, infrared spectra and albedo measurements have shown Vesta to have a surface very much like the eucrites. Second, the authors point out, it is "the only surviving asteroid with a eucrite-like surface which is large enough to allow for partial melting, separation of the melt from the source region and protection and the residuum (mantle) from meteorite-creating impacts." There are meteorites, called chassignites, that are possible candidates to have come from the residual mantle material, but their extreme rarity—perhaps two are known—"implies that the residuum, and hence, the parent body, is still intact."

The theory is not without problems. It used to be thought that even earth's moon was too small to contain enough radionuclides at solar-system abundances for the sort of heating that makes surface lava flows. But Vesta is far smaller still. So if it is the eucrites' parent body, other researchers suggest, either it was somehow enriched in radionuclides, or it cooled extremely slowly (letting its internal heat build up to lava-forming temperatures), or it was heated by some external source.

Also, Vesta is very far out in the asteroid belt. How did the eucrites get from it to earth, particularly without the aid of some cataclysmic outside impact that would have destroyed Vesta itself? It has also been pointed out that although many meteorites are chondrites (eucrites are not), there are very few known chondritic asteroids, raising the possibility that perhaps most meteorites do not come from the asteroid belt at all, or at least the main portion of it. The answer, alas, may require a sample of Vesta itself.

Simulating Jovian organics

The well-known experiments in which organic materials were produced by irradiating a simulated Jovian atmosphere with ultraviolet light began more than 15 years ago. The gaseous products of the reaction were readily analyzed. The accompanying brown sludge was reported in 1975 to be about 95 percent sulfur from the hydrogen sulfide provided in the test chamber. Now the remaining 5 percent has been successfully analyzed, revealing a wide range of complex organics—a tempting list of prospects that could be sought by the entry vehicle in the proposed Jupiter Orbiter and Probe mission.

The model atmosphere contained hydrogen and helium (both in reduced proportions to make the reaction products of the less abundant constituents more conspicuous), methane, ammonia, ethane, water and hydrogen sulfide. Heating and analysis by gas chromatography and mass spectrometry revealed the following components, besides the sulfur, in the sludge, according to B.N. Khare and Carl Sagan of Cornell University and colleagues from the University of Arizona:

Alkenes, alkanes, C_3-alkylbenzene, aromatics, thiophenes, alkylthiophenes, alkylmercaptans, alkyldisulfides and the nitrogenous compounds hydrogen cyanide, acetonitrile, alkylthiocyanates, acrylonitrile and allyl isocyanides.

Some of these compounds may be too rare for the probe craft to detect them, Sagan points out, but the possibilities are, to say the least, intriguing.

Jupiter: Moons by the bunch

Jupiter's eight outer satellites, divided by their orbits into two four-moon groups, may have originated in the capture and fragmentation of two larger objects by the proto-Jovian nebula that was just about to condense into a solid planet, according to James B. Pollack and Michael Tauber of the NASA Ames Research Center and Joseph A. Burns of Cornell University. The gas drag of the nebula probably captured the two objects in the last year or two of its approximately 100,000-year lifetime, the researchers calculate, since a longer drag period would have slowed the objects until they spiraled all the way into the center. The nebula would have been less dense in its outer portion, and this is consistent with the fact that the combined mass of the four outermost satellites is less than that of the four others (which would have required greater drag to slow them down to the point of capture). The reason far more moons-to-be were not captured at the same time, say the authors, is that the capture mechanism worked on only a small part of the size range of the asteroids that were the objects' presumed source: objects too large would have passed right through the nebula and little ones would have either burned up or spiraled into destruction.

The same calculations also suggest that the captured objects were composed of relatively weak materials such as carbonaceous chondrites or icy conglomerates, since rock would have been too strong to fracture from the internal stresses caused by deceleration. A test of the theory may be whether future spectroscopic studies reveal that Saturn's moon Phoebe, which follows the same kind of elongated, highly inclined orbit characteristic of capture by gas-drag, turns out to be made of rocky material, since it is not part of a group in like orbits.

'Weather' on Neptune

From early 1975 through early 1976, Neptune brightened appreciably in the 1-to-4 micron band, according to Richard Joyce of Kitt Peak National Observatory and Carl Pilcher and colleagues of the University of Hawaii, while the absorption lines of the planet's usually predominant hydrogen and methane showed only weakly. The cause, says Pilcher, may have been "an extensive, high-altitude cloud" of 1-micron-or-larger particles that later partially dissipated, thus providing what seems to be "the first observational evidence for atmospheric activity on Neptune."

The finding raises a difficulty for astronomers who measure the albedos or reflectances of the planets and those who are concerned with possible variations in the sun's energy output. Until now the albedo of Neptune (and that of Uranus) had been presumed constant and used as standards in such work. Comparisons of planetary albedos have often been used to determine whether the energy received by the earth from the sun is constant.