SCIENCE NEWS OF THE WEEK

Saturn's Moons: Confirming the Unexpected

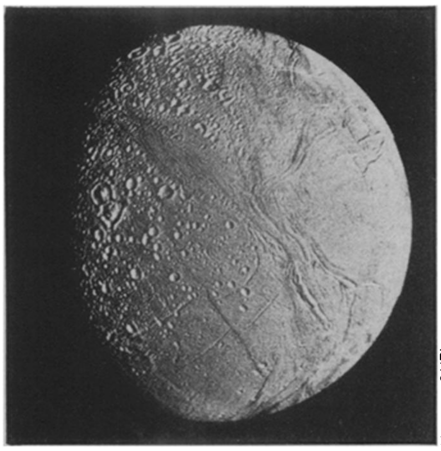
Less than three years ago, says Laurence Soderblom of the U.S. Geological Survey, an explorer sent from earth to study the planets of another star might have had rather limited expectations of what he would find, based on the then-existing knowledge of our own solar system's diversity. But that was before the two Voyager spacecraft provided close looks at the moons of Jupiter and Saturn. From now on, Soderblom says, "we're going to expect the universe to be a blend of bizarre, exotic, wonderful things."

The latest support for such a change in perspective is the mass of photos and other data from Voyager 2's recent flight through the Saturn system. Researchers have scarcely had time to begin their analyses, yet even a glance makes the point.

Consider the moon Enceladus. There had been hints that it might be strange — calculations that tidal heating (a favored explanation for the active volcanism on Jupiter's Io) might affect its surface, and long-distance photos from Voyager 1 last November showing it to be curiously smooth. But in Voyager 2's close-ups, the reality is stranger still. About half of Enceladus is indeed smooth, as though some process has erased the abundant craters still visible on the rest of its surface. Their absence suggests the smooth part to be relatively young — less than 100 million years old — and Soderblom notes that it may be changing still. "Why," he asks, "should a process that has been at work through 98 percent of the age of the solar system suddenly stop now?"

But what is the process? The tidal heating alone in Enceladus is thought to be too weak to significantly soften the crust of a largely water-ice satellite. One possibility under consideration is that there is more to the ice than water. The leading candidates are ammonia and methane (nitrogen, presumably from photo-dissociated ammonia, and methane make up most of the atmosphere of Titan), both of which melt at far lower temperatures than water ice. If the idea is to release volatile materials so that they can rise to the top and resurface the satellite, notes Torrence Johnson of Jet Propulsion Laboratory, ammonia could reduce the heat needed from tidal heating by 100°C.

Enceladus: Cratered, cracked, smooth.



Voyager 2/JPL

Another sign of activity (at some time) on the smooth surface is an abundance of linear features, often many hundreds of kilometers long. Some resemble the fractures on Jupiter's moon Ganymede, creating an appearance like the cracks in earth's polar ice sheets. A particularly Enceladean variety, however, is what Soderblom describes as "ropy" features, seemingly accumulated on the surface as though flows of cold molasses, poured into a bucket of the same stuff, had frozen into place. Even the ordinary cratered terrain is atypical judging from the photos, which suggest to Soderblom that the craters are notably shallower in some regions than in others, as though parts of the surface had undergone different thermal histories.

Another odd iceball is Tethys, marked by what may be the largest crack for its size in the solar system. Part of the huge lineament was photographed by Voyager 1, but the latest pictures reveal it to extend some three-quarters of the way around the satellite. Spanning as much as 200 km in width, it represents about 5 to 10 percent of Tethys' surface — just about what one would expect, says Soderblom, from the expansion due to freezing of a Tethys-sized sphere of ice. Unclear is why the vast stretchmark, if such it is, should take the form of such a regular girdle, rather than a more complex fracture pattern. The satellite's other major scar is also unusual — a 400-km crater, whose floor seems to have risen into a dome that towers several times higher than the crater's rim.

Iapetus was known to be an oddity even from earth-based observations in which it showed as nothing but a point of light. Its leading hemisphere (the one facing its direction of motion around Saturn) is several times darker than the trailing side. Perhaps the leading pre-Voyager explanation for the phenomenon (though it was far from unanimous) was that dark material from Phoebe, the one known Saturnian moon farther away from the planet, had been transported inward and swept up by Iapetus' leading side. Even Voyager 1's distant photos showed the light-dark boundary to be rather irregular for such a process, but Voyager 2's closer look made the case still tougher. Craters far around on the bright, trailing side show dark floors within their shiny surroundings. It is "inconceivable," Soderblom says, that they were formed by dark material simply sweeping around from the front. Furthermore, earth-based observations seem to indicate that the spectral reflectivities of Phoebe and the dark side of Iapetus are not a perfect match. If better spectra confirm this impression, it will be support for an alternative view that Soderblom and others have come to favor: that the dark material comes from within Iapetus itself, even though the satellite's low density suggests a mostly ice composition. One suggestion is that the dark material simply flowed out onto the low-elevation parts of the surface, which happen to be concentrated on one hemisphere, while the dark-floored craters result from meteorite impacts that punched through an icy "highland" overlay. Mars shows such a hemispherically divided asymmetry in its surface elevations, Soderblom points out. The fact that the asymmetry on Iapetus happens to divide its leading and trailing sides, he says, might just be coincidence, though another possibility is that a global ice cover was eroded from the front side by outside material — such as from Phoebe.

Even Phoebe, nearly four times as far from Saturn as Iapetus and following a steeply inclined, retrograde orbit strongly suggesting it to be a captured object, is a curiosity. Barely 200 km across, it was expected to be an irregularly shaped chip off some old block, with self-gravity too weak to pull it into roundness. Yet Voyager 2's far-away photos, while they reveal little else, do show that Phoebe is, at least roughly, a sphere. □

Rabbit gene active, heritable in mice

Two generations of mice producing a rabbit blood protein are the result of gene transfer experiments at Ohio University. These experiments, scientists there say, appear to be the first to demonstrate successful transfer of functional genetic material between mammalian species. The achievement is important for the study of development and of genetic diseases. It also may have important applications in agricultural animal breeding.

In experiments to be reported in the October issue of the PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES, Thomas E. Wagner and colleagues injected copies of the rabbit gene for beta-globin, a subunit of hemoglobin, into the sperm-derived package of genetic material within a recently fertilized mouse egg. The eggs were cultured in test tubes for several