Space Sciences

Jonathan Eberhart reports from Ithaca, N.Y., at the Natural Satellites conference.

Hyperion: A moon in chaos

Voyager 2 had barely begun taking its few close-ups of Saturn's moon Hyperion during the spacecraft's flyby two years ago when scientists realized that the object was an odd one. Far from spherical in shape, it was at first compared to a hamburger, then to a fat hamburger, then—as subsequent photos showed it from different sides—to a fat, *oval* hamburger. (One recent tabulation lists its principal dimensions as 350 by 234 by 200 kilometers.) Even more bizarre, however, was Hyperion's motion. Other solar-system moons that are close enough to their planets have had the speeds with which they turn on their axes damped by tidal friction until they match the times required to go around their orbits. The result, as with earth's moon, is that such a satellite always keeps the same face toward its planet. But Hyperion does not appear to be following the rules. The only rule it does follow, in fact, says Jack Wisdom of the University of California at Santa Barbara (UCSB), may be the rule of chaos.

In the days and weeks following the Voyager encounter, it became apparent that determining the satellite's spin axis and the orientation in space of its axis was not going to be an easy matter. One early idea was that Hyperion was perhaps still "wobbling" from a major impact, since its irregular shape suggested that it could be a fragment of a larger body; but such a wobble would be expected to settle down into some stable position. And in Hyperion's case, according to Wisdom, with UCSB colleague Stanton J. Peale and Francois Mignard of CERGA in Grasse, France, that may never happen.

Instead, says Peale, "Hyperion appears to have been slowed by tidal friction to a state where it is forced to tumble chaotically, with large, essentially random fluctuations in its spin rate, in the direction of its spin axis relative to inertial space, and in the orientation of the spin axis relative to the body itself." In fact, adds Wisdom, in fewer than two trips around Saturn, Hyperion's spin rate may vary from a rotation every 10 days to no rotation at all.

One reason, the researchers believe, is the changing torques due to the effect of Saturn's gravitational field on the satellite's irregularly distributed mass. This would not be enough by itself, however. Jupiter's elongated moon Amalthea, for example, rotates stably on its shortest axis while the long axis is oriented towards Jupiter. The other factor in Hyperion's chaotic state is the fact that its orbit is kept out-of-round (with a large eccentricity of 0.104) by a gravitational "resonance" with Saturn's huge moon Titan, the next satellite in.

Direct observations have not yet confirmed Hyperion to be rotating chaotically—two analyses, in fact (though with limited data), have indicated a spin period of 13 days — but some researchers, says Wisdom, have found its spin axis to be nonperpendicular to the plane of its orbit, a strong indication of the chaotic, essentially unpredictable state. Furthermore, notes Peale, a 13-day period would not be in synchronous rotation with Saturn, and would thus indicate an unstable situation even if the mass distribution is not as strange as the photos suggest.

The moons of Uranus: Activity?

Very little is known about the moons of distant Uranus, but Kevin D. Pang and Jack W. Rhoads of Jet Propulsion Laboratory in Pasadena, Calif., suggest that they may be "geologically active." Of all known solar-system objects, the scientists report, the Uranian satellites show the largest increase in brightness of reflected sunlight as the angle between a ground-based observer and the sun approaches 0°. This effect resembles what one would see if their surfaces were coated with a layer of tiny, spherical ice particles. Such particles, says Pang, could be produced if some kind of "ice volcanism" were erupting fountains of water droplets, which would then freeze into spherical shapes and fall back to the surface. Voyager 2 may take a close look in 1986.

Biomedicine

From the meeting in San Antonio, Tex., of the Endocrine Society

Fertility boost: Hormone plus pump

Infertility problems were expected to be among the first medical applications of a reproductive hormone characterized and synthesized in 1971. Analogs of gonadotropin releasing hormone (GnRH), also known as luteinizing hormone releasing hormone (LHRH), show promise as contraceptives (SN: 9/26/81, p. 197) and cancer treatments (SN: 3/27/82, p. 215). But applications to fertility have proved difficult because of inability to mimic the natural pattern of GnRH release in the body. GnRH is normally secreted from the hypothalamus in a pulse every hour or two.

The development of a portable pump for delivering insulin to diabetics offers a new way to administer a variety of hormones. Several research teams have used it to give small doses of GnRH every 90 minutes. David Hurley and colleagues at Prince Henry's Hospital in Melbourne, Australia, report successful induction of ovulation in women with inadequate natural stimulation of the ovaries by gonadotropin hormones.

In conventional therapy, the first attempt is an anti-estrogen drug called clomiphene. If this treatment fails, direct injection of the gonadotropin hormones can be attempted. Because there is a narrow margin between effective treatment and overstimulation of the ovaries, multiple pregnancies (twins, triplets, etc.) occur in 20 to 30 percent of cases.

In an experimental alternative, Hurley and colleagues administered GnRH under the skin with the small battery-operated pump. The pump was worn continuously by each patient for one to four weeks. Hurley reports that ovulation occurred in 29 of 36 courses of treatment given to 14 women. Twelve singleton pregnancies resulted. Hurley says the major advantage of GnRH therapy over gonadotropin therapy is that it allows normal feedback control to operate, thereby minimizing risk of multiple ovulation.

Therapy with GnRH also has been applied to women with polycystic ovarian disease. Their ovaries contain many small cysts and fail to release eggs regularly. H. J. T. Coelingh Bennink of the State University Hospital AZU, in Utrecht, The Netherlands, injected GnRH into the veins of patients every 90 minutes with a computerized, portable pump. Bennink reports ovulation in 30 of 42 courses of treatment and eight women became pregnant. All the pregnancies were singleton.

Work by Bennink and others has demonstrated that without treatment women with polycystic ovarian disease have a decreased and variable, natural interval between pulses of GnRH. Bennink suggests that the increased GnRH pulse frequency could be responsible for the characteristics of the disease.

Another method for increasing fertility in some women with polycystic ovarian disease is simple weight loss, reports Stephen R. Harlass, Stephen E. Plymate and Richard P. Belts of Madigan Army Medical Center in Tacoma, Wash. Women with this disease are frequently overweight. But Plymate says that because some patients won't or can't lose weight, and obese patients often do not respond to clomiphene, there still is need for the GnRH therapy.

Goiter and the water supply

A potent inhibitor of thyroid gland function detected in well water has been linked with goiter prevalence in a South American town. Eduardo Gaitan of the University of Mississippi Medical Center in Jackson reports that the chemical resorcinol (1, 3-dihydroxy-benzene) is present in a well supplying the part of Calendaria, Colombia, where goiter is widespread despite adequate dietary iodine. The thyroid inhibitor is not found in a well serving people who have a low incidence of goiter. Gaitan links the presence of resorcinol to high levels of organic materials in the rocks and soil. Laboratory studies show resorcinol blocks incorporation of iodine into the thyroid gland and impairs an enzyme important in producing active thyroid hormones.