

(it is on the opposite side of Saturn from Fountain-Larson), but to the gravitational influence of the satellite Enceladus, two moons farther out. Enceladus circles Saturn exactly half as fast as Fountain-Larson, creating a strong gravitational "resonance" that could preserve the relationship. □

Radio signals show length of Saturn day

The length of a day on a hardrock world such as Mars can be measured by simply timing successive appearances of a convenient surface feature as the planet rotates. Jupiter, without a solid surface, shows brilliant features in its cloud tops, but they rotate at widely varying rates. It was not until scientists found that Jupiter was emitting powerful radio signals that they could, by timing peaks in the signals, measure that planet's true rotational period — in effect the period of its magnetic field. Saturn, too, lacks a solid surface, and its haze-topped clouds offer far fewer visible details to follow. Furthermore, its radio signals are far weaker than Jupiter's, and a tentative detection of them from an earth-orbiting spacecraft has been considered unreliable.

The Saturn-bound Voyager 1 and 2 spacecraft, however, have done the trick. Michael L. Kaiser of the NASA Goddard Space Flight Center and colleagues have been able to identify Saturn's signals in their data since January ("the first conclusive evidence" for nonthermal emissions from that planet, the researchers report), and peaks in the data indicate a true ("internal") period for Saturn of 16 hours 39.9 minutes \pm 0.3 minutes.

In Jupiter's case (or earth's), the modulations are caused by the tilt of the magnetic field's axis relative to the planet's own axis of rotation. Saturn's magnetic and rotational axes, however, are almost aligned, suggesting that the radio peaks are caused by magnetic-field regions of different strengths. □

Ariane 2 in the drink

The second of the European Space Agency's Ariane rockets ever to be launched—and the first to carry a payload of scientific satellites — ended up on the floor of the South Atlantic May 23 when all four of its first-stage engines stopped firing prematurely. Lost with the rocket were a Max Planck Institute satellite called Firewheel, designed to study earth's magnetic field with high-altitude injections of barium and lithium, and an amateur radio satellite known as OSCAR 9. The previous launching, carrying only an instrumented test capsule, was successfully carried out last Dec. 24. The cause of last week's mishap is being investigated. □

Deep walk in a one-atmosphere suit

In the future everyone should have ready, easy, comfortable, safe access to the sea, says Sylvia Earle, a botanist who has spent more than 4,000 hours underwater. She says this goal requires learning how to go deeper, stay longer and do more exploring of the oceans — links to our destiny.

An armored suit that looks like an astronaut's gear recently allowed Earle to lumber along the Pacific Ocean floor off the coast of Hawaii, more than 1,250 feet below the surface. It was the first dive in such a suit without a line to the surface and the deepest solo exploratory dive in the open sea.



Sylvia Earle walks in a "Jim" suit at 1,250 feet tethered to another submersible.

The suit has a self-contained supply of air, from which carbon dioxide is continuously removed. The metal shell protects the diver from the water pressure—at that depth 600 pounds of water press on each square inch. A diver breathing compressed gas, as with an aqua-lung, would have to spend at least a week in a decompression chamber before returning to the surface from such a depth. "Sylvia went down to 1,260 feet, stayed two and a half hours, got out and had lunch," recounts Al Giddings, colleague and underwater photographer.

More flexibility should be the key to future "Jim" suits, named after the diver early in the century who wore an 800-pound predecessor called the Iron Man. Earle says that already a newer model, named Sam, has more articulated rings to allow the diver enough flexibility to swim. Other "personal immersibles" being developed depend on motors and propellers for propulsion. But Earle says she abides by the engineering principle KISS — "keep it simple, stupid" — and has the greatest

confidence in an immersible with no machine except a human being propelling it. Engineers, for example, envision for the future glass or titanium suits that might allow a person to step into the ocean and dive freely to any depth.

In addition to armored, or 1-atmosphere (pressure) diving suits, Earle predicts more use of unmanned vehicles that are controlled from the surface for ocean exploration, she told reporters last week at the National Geographic Society in Washington. Another exciting development, she says, is the mixture of gases that Peter Bennett at Duke University has found that allows divers to simulate a dive to depths of more than 2,000 feet (SN: 4/12/80, p. 232).

Earle feels a sense of urgency about attempts to explore the sea. She cites a strong sense of curiosity toward the many unknown creatures the oceans contain. "It's the age of exploration all over again," she says. But she also sees ocean exploration as a requirement for continuing human survival on this planet. "We have to become more aware of our dependence on the sea as a life support system," she says. "We have to know the sea so we can take care of ourselves." □

New bedfellows: Freedom & infertility

The 1970s may have brought progress toward equality of the sexes and perhaps even a greater "sensitivity" to the needs of a person's spouse. But the decade also brought an apparent increase in infertility among married couples in the United States. Currently, about one in six couples of childbearing age experiences difficulty in conceiving or carrying a pregnancy to term, estimates Harvard University psychiatrist Miriam Mazor. She and others discussed the trend recently in San Francisco at the annual meeting of the American Psychiatric Association.

Factors contributing to the fertility decrease, Mazor says, include postponement of childbearing into the person's thirties and forties (statistically, both men and women are maximally fertile in their mid-twenties); increased prevalence of venereal disease and consequent scarring of the reproductive tract; the use of certain contraceptive methods that may lead to scarring or infections (IUD's) or problems in ovulation after use (birth control pills); and environmental factors—drugs, chemicals, radiation, etc. — that may have a delayed effect on fertility.

Although at least one study has reported that physical causes are responsible for about nine of 10 infertility cases, the problem of infertility remains fraught with psychological consequences for both men and women. (It is estimated that about 50 percent of all infertility problems are related to women and 30 percent are related

to men; the rest are "unexplained.")

In her study of more than 100 couples from 1975 to 1979, Mazor has identified three phases surrounding infertility:

- Development of narcissistic injury. "Acknowledgement of an infertility problem, whether it is after six months, one year or several years of attempting to achieve a pregnancy, is a tremendous blow," Mazor says. During this period, the person may become preoccupied with his or her body and may feel "damaged" or defective; the feeling may spread to aspects of life outside of the sexual sphere.
- Halting the infertility investigation and acknowledging the finality of the condition. "During this phase, the couple re-examine their own feelings about parenthood and go through a period of grieving for the loss of their reproductive function, of mourning for the biological children they could not have together," says the psychiatrist. Despite the modern-day lessening of pressures to have children, she says, "for most people, parenthood remains an integral part of their development as adults."
- Deciding about alternative routes. Those couples that decide not to go childless have basically two choices: adoption or, in the case of male infertility, artificial insemination by donor.

But those couples that opt for artificial insemination may face a whole new series of emotional obstacles, according to Elisabeth Chan Small and R. Nuran Turksoy of Tufts University Medical School in Boston. Citing what they call "an alarming increase in infertility" — a Florida study recently noted a marked decrease in sperm count among college students sampled in 1979, compared with those sampled in 1929 — the researchers estimate "conservatively" that as many as 250,000 births result from artificial insemination in the United States each year.

Many of the problems appear to revolve around the husband's feelings of inadequacy; when finally told they have no choice in reproduction, it is the men who "suffer a sense of profound loss [of their own biological child]," say the scientists. In addition to feelings of vulnerability, inadequacy and anger (often at the wife's fertility), the husband must deal with the prospect of the wife's artificial insemination by another male. "Consciously, while he accepts the idea of insemination, he [the husband] may unconsciously remain angry and this anger may be expressed in ways to affect the marriage which sometimes results in divorce," they note. With the help of proper counseling, however, Small and Turksoy report that "marriages usually do not deteriorate, the couples are happy, grateful and feel close to the children whom they consider their own and when queried whether they would consider having another child by the same method, the response is predominantly in the affirmative and many couples do return for further insemination." □

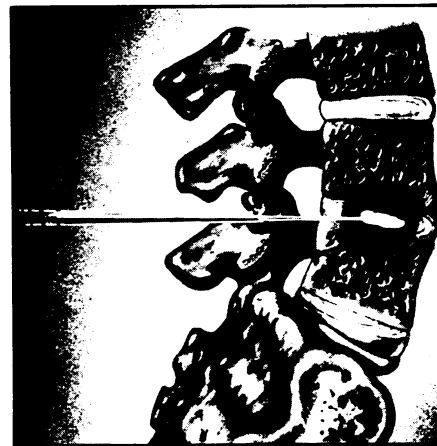
An enzyme may treat slipped disks

If a drug can be found that is safe and effective in alleviating the problems associated with slipped disks, many low back pain sufferers would be spared the trauma and costs of corrective surgery. But such a drug, some researchers feel, may have been discovered already. It has not been approved by the U.S. Food and Drug Administration because the results of clinical studies have been confusing. Now, with the help of a pending triple-blind clinical trial and data from long-term clinical observations, the FDA should be able to make a firm ruling.

The drug in question is an enzyme called chymopapain. In 1956, it was found to break down cartilagenous tissues (it made rabbit ears hang down like a spaniel's), suggesting that it might be able to dissolve cartilagenous disks that normally separate the spinal vertebrae but that sometimes slip out of place and cause excruciating low back pain. During the 1950s and early 1960s scientists at Travenol Laboratories in Deerfield, Ill., purified chymopapain, conducted safety studies in animals and then obtained FDA approval for the drug to be injected into patients' slipped disks. From 1964 to 1975, 75 orthopedic surgeons and neurosurgeons around the United States and Canada injected chymopapain into the slipped disks of some 17,000 patients. They found that the injections helped many patients and concluded that chymopapain might be a useful alternative to disk surgery for a number of slipped disk cases.

The FDA was reluctant to approve chymopapain on the basis of those findings since none of them had been obtained through a double-blind trial in which chymopapain was compared with an inert placebo and neither investigators nor patients knew what patient was getting a placebo. So such a double-blind study was set up, but the results, reported in 1975, were confounding. Chymopapain was found to have a 58 percent success rate (comparable to that reported in previous, uncontrolled studies), but the placebo (comprised of chemicals called cysteine, edetate and iohalamate) was found to have a 50 percent success rate — close enough to the success rate of chymopapain to render the results statistically nonsignificant and thus to suggest that chymopapain was no better than a placebo in helping slipped disk patients. The FDA decided, on the basis of these results, not to approve chymopapain for marketing.

But the chymopapain story was far from over. There was, subsequently, reason to believe that the placebo used in the trial really had not been a placebo (inert substance), but that two of the three chemi-



Baxter Travenol Laboratories

Chymopapain being injected into a disk.

cals in it were enzyme activators. This discovery suggested that chymopapain had not been compared with a placebo at all, but rather with a drug having physiological effects that could have helped slipped disk patients. Travenol asked the FDA if it could restudy chymopapain and resolve the questions raised by the double-blind study. In 1978 the FDA agreed, and a new, more rigorous trial got underway, the results of which are expected in July 1981. This is a triple-blind study in which chymopapain is being compared not only to cysteine, edetate and iohalamate but to saline (a substance often used as a placebo in double-blind trials and one generally accepted to be inert). If the results show that chymopapain is significantly better at helping slipped disk patients than is saline, Travenol will ask the FDA to approve chymopapain for marketing. Whether the FDA will do so, however, remains to be seen.

Still other study results, which have just been published in the May 23/30 *JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION* by Manucher J. Javid of the University of Wisconsin Clinical Sciences Center in Madison, also might influence the FDA to approve chymopapain. Javid was one of the 75 investigators who initially studied chymopapain in slipped disk patients between 1964 and 1975. But he has done something that the other investigators have not. He has followed up the patients he treated between 1972 and 1975 for three to six years to see exactly what chymopapain's long-term effects are, and as he reports, chymopapain appears to have been capable of alleviating slipped disk in 73 percent of patients over that time span. These results, he concludes, "indicate that chymopapain should be considered an advantageous alternative to surgery in appropriately selected cases."

Chymopapain is already commercially available in Canada, Britain and Switzerland and is expected to be approved by still more countries in the next few months. It is also part of a new scientific frontier — the use of enzymes as pharmaceuticals and for other medical purposes (SN: 7/22/78, p. 58). □