Another Beacon Under the Sun


NASA

For two decades, Jupiter has stood alone as the only known radio beacon, other than the earth, among the planets, pouring out bursts of energy that can be detected across hundreds of millions of miles of space by the giant ears of radio astronomy. Now there is another. For the first time, evidence has been found of nonthermal radio emissions from the planet Saturn.

The discovery was made by Larry Brown of the radio astronomy branch in the Laboratory for Extraterrestrial Physics at the National Aeronautics and Space Administration's Goddard Space Flight Center in Greenbelt, Md. He emphasizes that the finding is tentative—the signal had to be detected through the fierce radio "noise" of the earth itself—but the signature of Saturn does appear to be present.

The emissions were detected when Brown performed what is called a power spectrum analysis of the data from an earth-orbiting satellite named IMP-6, one of a series of Interplanetary Monitoring Platforms that study conditions in the depths of the solar system. In addition, Brown found that the times when the radio bursts occurred matched (within his measurement uncertainty of a few minutes) with times when Saturn had a given face turned toward the earth. In other words, the bursts carried the "signature" of Saturn's 10.5-hour rotation.

The frequencies of the pulses (from about 300 to 500 kilohertz) are so low that earth's atmosphere largely blocks them from getting through to ground-based instruments. They are also extremely weak compared to the background noise. Earth is such a noisy place for radio astronomy, in fact, that even IMP-6, which ranged from about 2,100 miles to more than 125,000 miles above the earth, heard scarcely a dozen bursts in its 18-month lifetime.

Fortunately, NASA has an even better ear, which is even now being turned toward the ringed planet. RAE-2, the second of the Radio Astronomy Explorer satellites, was launched in June of last year into an orbit around the moon, far from the aggravating static of its mother planet and the filtering effect of earth's atmosphere. A bigger plus, however, is the moon's nice, sharp-edged horizon. By aiming the satellite's antennas in the direction of Saturn, and measuring the exact time when the lunar horizon cuts off the incoming radio signals, it should be possible to precisely confirm their origin as well as to match them more closely with Saturn's rotation. The plane of the satellite's orbit around the moon is not always lined up with Saturn, Brown points out, but the relationship changes slowly enough that he expects as much as a year of data.

After that, perhaps inspired in part by the new findings from Saturn, radio astronomy branch chief Robert Stone and his Goddard colleagues hope to turn the RAE satellite's talents to the rest of the solar system. Mercury, Venus and Mars do not hold out much promise, but Uranus and Neptune may well turn out to be radio beacons in their own rights.

The difference is a matter of magnetism. Jupiter and the earth both have strong magnetic fields, while those of Mercury, Venus, Mars and earth's moon range from weak to nonexistent. One of the major implications of Brown's Saturn discovery, in fact, is that it almost demands a strong magnetic field there, a valuable datum for Pioneer 11, which will arrive there in 1979 to find out for certain.

The reason is that in order to produce such intense emissions, there must be some process that causes the energetic electrons around the planet to give off more than the sum of their individual energies. The likeliest explanation, says Stone, is that they are accelerated by spinning around the magnetic field's lines of force and dumped into an auroral zone from which the strong bursts are an amplified, collective effect. Large, primarily gaseous planets—Jupiter, Saturn, Uranus and Neptune in our solar system—are naturals for strong magnetic fields, although earth seems to be an exception among the rockier worlds. (Mercury's newly discovered weak field may produce some faint emissions, but they will be difficult to detect because of its nearness to the noisy sun.)

There seems to be a correlation between the strength of the field and the radio frequency of its bursts, and Brown's Saturn emissions suggest, not unreasonably, a field strength somewhere between those of earth and Jupiter. When more and better data become available, there is also likely to be a search for any possible effects due to Saturn's moons, such as the strong modulation of Jupiter's emissions by Io. □

Food weapon unsheathed

Government policy makers are meeting this week to decide how American food aid will be apportioned, amidst growing discussion over the use of food as a "weapon" to sustain military and political allies at the expense of more needy but less strategic countries SCIENCE NEWS has learned that the State Department has drawn up a set of three options for food aid, varying in cost from $894 million to $1.45 billion, with each option giving the largest share of aid to U.S. allies in Southeast Asia and other "traditional recipients."

The first (low) option would meet only the needs of Southeast Asian recipients in full. Option two (total food cost $1.21 billion) would "enable us to meet the Egypt and Syria political requirements" and permit small increases to Israel and Jordon. It would also provide a "minimum essential level of programming to Bangladesh, India and Sri Lanka," the nations faced with the most widespread threat of famine. A third option would give these nations higher priority, permitting the sale (on concessional terms) to India of a million tons of grain, and to Bangladesh, 350 thousand tons—some 40 percent of the country's unmet requirements through June. The State Department document says of this third option: "The humanitarian rationale is strong; there is domestic political support for such emphasis." The grain for Bangladesh, though inadequate to stop the continuing threat of famine after a year of disastrous weather in that country, is seen as America's "proportionate share we have used as a rule-of-thumb over the past two years."

(In addition to "concessional sales"—based on low-interest, long-term credit—authorized by "Title I" of the Food for Peace Program, the total costs include smaller amounts of outright gifts, under the program's "Title II." Much of this will go for "emergency" aid to places like the Sahel and Honduras.)

Though the importance of food as an instrument of foreign policy has been enhanced by the emergence of an Arab "oil weapon," the present strategy is only the culmination of a trend toward politicizing aid, begun some years ago (SN: 5/18/74, p. 322), and the State Department document tends to confirm what some scientists have been saying publicly: The United States is pursuing a policy of triage among nations (SN: 11/30/74, p. 340). Even so, the State Department may represent the more liberal view in the present negotiations: The Washington Post quoted a representative of the National Security Council as saying, "To give food aid to countries just because people are starving is a pretty weak reason." □

How cancer strikes against immunity

The interplay of cancer and the immune system is one of the hottest areas of cancer research right now. The immune components that are most active against cancer seem to be the thymus-derived lymphocytes (T cells) and scavenger cells called macrophages. There is ample evidence that cancer consists of some breakdown in the immune system. However, research by a team of Parisian immunologists now suggests that cancer does not result from a breakdown in immunity. Rather, it results from the ability of cancer cells to ward off the immune fighters that attack them.

This is the first time that cancer cells have been found to resist immune defenses. Such a finding is conceptually exciting and bound to provoke controversy and stepped-up research in cancer immunology circles. What's more, it should open new insights into whether cancer cells and the fetus share common mechanisms for resisting immune rejection. Immunologists have reason to believe that they do (SN: 8/14/71, p. 107; 7/27/74, p. 57). The finding may also lead to new approaches toward the treatment of cancer and toward birth control.

The investigators are Nobel laureate François Jacob, Robert M. Fauve, Brigitte Hevin, Hedwig Jacob and Jean A. Gaillard of the Pasteur Institute in Paris. They report their results in the PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES.

The Parisian immunologists first found that injecting cancer cells into mice did not impair their immune systems. Or at least, it did not impair the ability of their immune systems to fight bacteria. However the cancer cells managed to keep from becoming inflamed. Inflammation usually arises whenever the immune system tries to ward off foreign invaders.

This absence of inflammation, the Parisian team believes, was "indeed remarkable. Since most tumor cells are able to destroy and invade adjacent tissues, one would expect continuous release of dead cell debris to result in strong inflammation."

And the reason the cancer cells were able to keep from becoming inflamed, it turned out, was that they produced a chemical compound of molecular weight between 1,000 and 10,000.

When the same cancer cells were placed in a test tube, they were also able to repulse macrophages trying to engulf them. Several other kinds of cancer cells were likewise able to fight off macrophages in the test tube.

These results suggest that cancer does not depend on a defect in the immune system. Rather, it consists of tumors bypassing immunological defenses by two mechanisms. The tumor produces a compound that prevents inflammation. It also produces a toxic effect on macrophages attacking it. The cancer cells may possibly produce a toxic effect against T cells too, the immunologists believe, although they do not have evidence to confirm it.

Immunologists have long wondered why a fetus isn't rejected by its mother because it contains material that the mother's immune system should consider as foreign. The Pasteur Institute team has obtained evidence that partially answers this question and that links more than ever the common ability of fetuses and cancers to fend off immune invaders.

There are certain cells in the placenta of the pregnant woman that are thought to protect the fetus from immunological rejection. The Pasteur Institute team has found that these cells do not become inflamed. And the cells are able to rebuff macrophages. Although the scientists have not yet isolated any compounds from the placental cells, they think it is quite possible that both placental cells and cancer cells fight immune invaders in an identical manner.

Once the nature of the compound or compounds cancer cells use to resist immune invaders has been elucidated, immunologists might then be able to find some way to counter the substance or substances, and hence effectively treat cancer. If the same substance or substances also turn out to be emitted by placental cells they too might be countered and lead to some form of birth control. □

Fossil teeth point to earliest predator

Most of the land in Nevada and California may be high and dry now, but at one time it formed the bottom of an ocean. A new archaeological find indicates that the temperate seas that existed there 600 million years ago spawned the oldest predator yet found—a large, squidlike mollusc.

Paleontologists J. Wyatt Durham of the University of California at Berkeley and Jean B. Firby of the California Academy of Sciences in San Francisco found tiny cone-shaped teeth embedded in fossils from the White Mountains near Bishop, Calif. Their report is in the November JOURNAL OF PALEONTOLOGY.

The fossils were dated at about 600 million years by comparison with other rocks from the Lower Cambrian of California (about 550 to 600 million years ago). The teeth—or more properly "denticles" (teeth are continually repaired, denticles wear away with time)—were found in long bands similar to the rasping tongues or "radulas" of other molluscs. The denticles appear most like those of living members of the predatory molluscan class Cephalopoda, the team reports. The assignment to geologic period, phylum and class lead them to conclude that they have discovered invertebrate predators 100 million years older than any yet found.

Evidence of arthropods called trilobites, one of the most abundant sea creatures at that time and place, was found concurrently. The team suggests that trilobites may have been the major food of the ancient predator. □

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Fossil teeth from squidlike mollusc.