

plagued with data-loss problems, due in large part to the swamping effect of intense flare- and solar-wind activity from the sun, and in lesser measure to occasionally bad weather over the tracking stations on earth, which were hard-pressed to pick up the probe's weak, 10^{-20} watt signal.) One important finding relevant to Titan, however, was that when Saturn's magnetosphere is highly compressed—as it was by the intense solar-wind activity that accompanied most of the encounter—Titan is just about on the edge of the field, sometimes just inside it, other times outside. One consequence of this, scientists suggested, is that Titan's atmosphere is probably only a limited source of particles to the plasma trapped in Saturn's magnetic field, whereas Jupiter's satellite Io, much closer in to its own host world, contributes voluminously (though more from volcanically erupted gases than from a dense atmosphere) to the Jovian environment.

There were even hopes (unresolved by press time) that Pioneer 11 might have discovered a new moon of Saturn, which would make it the first spacecraft to be credited with such a find. Early on, however, it was difficult to tell whether the object—detected dimly in at least one photo—was merely Janus, or "S 11" (a tentatively identified satellite for which no orbit has been worked out, making it difficult to match its location with the Pioneer image) or, in fact, a previously unknown object.

Days, weeks and months of work will answer some of Pioneer 11's questions, and raise new ones, and the Voyagers will do the same. But the little probe, designed more than a decade ago and surviving a six-and-a-half-year journey for which it was never originally intended, has made a more familiar object out of the most distant member of the solar system that for centuries was all that earthlings knew. □

Lower SATs: Fallout from the fifties?

When the average Scholastic Aptitude Test scores of college aspirants dropped drastically in 1975, a number of explanations were offered—many of them having to do with changing sociological and educational factors, such as school busing, economic patterns and other environmental influences (SN: 11/8/75, p. 294; 9/3/77, p. 148). But University of Pittsburgh radiation physicist Ernest Sternglass envisions far different causes.

"I saw that report in a 1975 New York Times article, and it got me to thinking: What happened 18 years before?" Sternglass recalls. What happened, he says, was the largest single series of atomic bomb tests in U.S. history—303 kilotons were detonated in Nevada in 1957. Sternglass, author of several controversial

studies linking radiation exposure to cancer and other long-term physical problems, now has a new hypothesis: The sharp decline in SAT scores was due primarily not to school system or integration problems but to radioactivity that infiltrated the bodies of many youngsters when they were in the fetal stage during 1957.

"Iodine-131 seeks out the thyroid, leading to a slowing down... of the [development of] the baby in the mother's womb," Sternglass says. In addition, strontium-90, another by-product of nuclear testing, "goes for the pituitary" and is "stored in the bones of the mother of the child." It is this developmental slowdown, "even ever so slight," that the physicist says can have long-term effects on intellect, as measured by aptitude scores.

Sternglass's hypothesis, however, has met with severe opposition from other researchers familiar with the effects of radiation and atomic testing.

Sternglass tested his hypothesis by reviewing the mean SAT scores, provided by the Educational Testing Service, in various states and regions around the United States. Although the study covered about 20 years, it concentrated on the period from 1972-73 through 1976-77—meaning that most of the test takers were born between 1955 and 1959.

The results, presented last week in New York at the annual meeting of the American Psychological Association, "are indeed very startling, to say the least," says Sternglass. He found that after a number of years of slow decline, SAT scores plummeted sharply from 1973-74 through 1975-76 among students born between 1956 and 1958.

Moreover, the sharpest drop in the mean verbal score for that period—26 points—occurred in Utah, a state adjacent to the Nevada test areas. And California, another adjacent state, showed a decline of 20 points during that period. Verbal scores were lower in most regions of the United States during those years, but the drop was most marked in the western states.

Statistically, what impresses Sternglass and his followers most about the data is that after the sudden, sharp drops, SAT scores—particularly the verbal ones—just as suddenly leveled off. "We got a base line, then a drop, then a return to a plateau," says Steven Bell of the Department of Education and Psychology at Berry College in Mount Berry, Ga. If the primary causes were sociological, educational or economic in nature, Bell says, the scores probably would have dropped more gradually. "But they leveled in the absence of radiation [18 years earlier]," he says. In Utah, verbal SAT scores "bounced back up" by 9 points in 1976-77.

Sternglass also notes that Utah, a Mormon stronghold in the United States, has one of the lowest smoking and alcoholism rates and highest socioeconomic levels in

the country. "And they in fact had the greatest drop in scores—this cannot be accounted for by any other variables [outside of nuclear testing]," he says.

During the same period, 1973-74 through 1975-76, scores declined least in the midwestern states. Ohio, for example, showed only a 2 point drop on verbal SAT scores. Sternglass suggests that weather patterns, as well as proximity to testing sites, are reflected in these data. From June of 1957 to June of 1958—when the highest radiation levels were recorded in Utah and Nevada—low rainfall in the midwest may have allowed much of the fallout to pass over to the East Coast, where "heavy rainouts" are often triggered by eastern mountain ranges. New York State, for instance, showed a 17 point decline in verbal SAT scores in the affected period, he notes. But Sternglass acknowledges that he has not yet studied weather patterns during the nuclear testing periods of the 1950s—something he says should be done in future research.

The implications of the figures are frightening, Sternglass says. "The fallout in Utah from mid-1957 to mid-1958 was comparable to Hiroshima," he says. Published measurements around Salt Lake City during that period showed 249 picocuries of iodine per liter of milk, according to the physicist. Aside from the fallout's possible long-term physical effects, the lowered SAT scores could have kept many high school seniors out of college careers that they would otherwise have achieved.

"People who take SAT's are aspiring to be leaders in engineering, the sciences and other fields," he says. "If you cut down the number of people who will score over 700 on the SAT, you're cutting down on professionals in those fields. You get people dropping out of the educational system, which has implications in our unemployment, delinquency and teenage parent rates." Though such effects may be somewhat speculative, says Bell, "there is a latency effect of 18 years of a toxic insult to the fetus. What we know now is that less than optimal development is occurring."

Despite the apparently high correlation between the two events, other researchers familiar with Sternglass's work were cautious at best about accepting the hypothesis. (Sternglass was severely criticized in the late 1960s for his methods in a study that purported to show a relation between fallout and infant mortality.) Researchers at the Center for Disease Control in Atlanta and at the National Institutes of Health, who asked not to be identified, criticized Sternglass's "brushstroke" treatment of data. Said one: "You can link anything to atomic testing. You could also link [the testing to] crime in the streets and the divorce rate."

Other factors—including socioeconomic ones—would have to be ruled out before accepting fallout as the culprit for the declining scores, they said. Particularly lacking, noted a researcher at

Brookhaven National Laboratory in Upton, N.Y. (which has been following the Marshall Islanders who were exposed to exceptionally high fallout doses in 1954), are studies showing that radioactivity of the amounts recorded in the United States could indeed have the supposed effect. "As far as I know," he said, "there is nothing in the published literature that would support [that hypothesis]. . . . You would have to show a definitive study." In addition, he noted, damage to the thyroid and pituitary of the amount that would slow brain development would most likely cause other physical symptoms, such as dwarfism.

However, noted one sympathetic colleague, such fetal studies simply have not been done. In addition, the SAT scores represent an unbiased set of data, he said, and such a correlational study may "spark research in this particular area." □

Human spine partially replaced

Although many body parts can be artificially constructed and successfully replaced in the human body today, this has not held true for the spinal column — one of the body's more intricate structures and the encasement for the delicate, vital spinal cord. Faced with a life-and-death situation last week, however, a reconstructive surgery pioneer at the University of Maryland, Charles C. Edwards, attempted to replace part of a patient's spine. And to date, it looks as if his heroic effort just might work.

Jessie Thomas, a 33-year-old Baltimore woman, was paralyzed from the waist down by a cantaloupe-sized tumor, which extended from the T-12 to the L-4 vertebrae. Edwards removed the tumor on July 17; had he not done so, it would have been fatal within a year. Along with the tumor, he removed five vertebrae and the paraspinus muscles. This left Thomas with no spinal column between her rib cage and pelvis, a situation that condemned her to total immobility for the rest of her life, with little to look forward to except being turned every three hours.

In an effort to provide Thomas with a better quality of life, Edwards decided to attempt the unique reconstructive spinal surgery. The artificial spine that he designed is made of a chrome, cobalt and molybdenum alloy, stainless steel and plastic. It cost about \$1,625 to manufacture. The main section of the device is a six-inch cylinder with a groove running down the middle to cradle the spinal cord. During the operation, this cylinder was slipped behind the spinal cord and aligned with the remaining vertebrae at both ends. Then, two screw-like rods were slid from each end of the cylinder into surgically made holes in the vertebrae. Two other threaded stainless steel rods were attached with hooks to the top and bottom

vertebrae, then tightened, to prevent the spine from rotating. The cylinder contains grafted bone all the way through, which Edwards hopes will fuse with the spine and provide more permanent stability than is possible with only the man-made device.

If all goes well, Thomas may eventually be able to sit up and get around in a wheelchair. The tumor had already damaged the spinal cord, and Edwards expects little neurological refuction. But without the

surgery, the tumor would have killed Thomas, probably within a year.

Will this technique benefit other patients with more common kinds of spinal problems like paralysis or low back pain? Edwards thinks not: The replacement was a heroic solution to a unique medical problem. But he remains hopeful that it will give him innovative surgical replacement ideas for patients with other kinds of medical problems. □

Following David: Tempest bottoms out

As this article went to press Wednesday morning, Hurricane David, called one of the most powerful hurricanes of the century, was beginning to lose its punch. Downgraded to a tropical storm, its highest winds 60 to 70 miles per hour (75 mph winds would classify it as a hurricane), it had moved inland and was centered 25 miles east-northeast of Columbia, S.C.

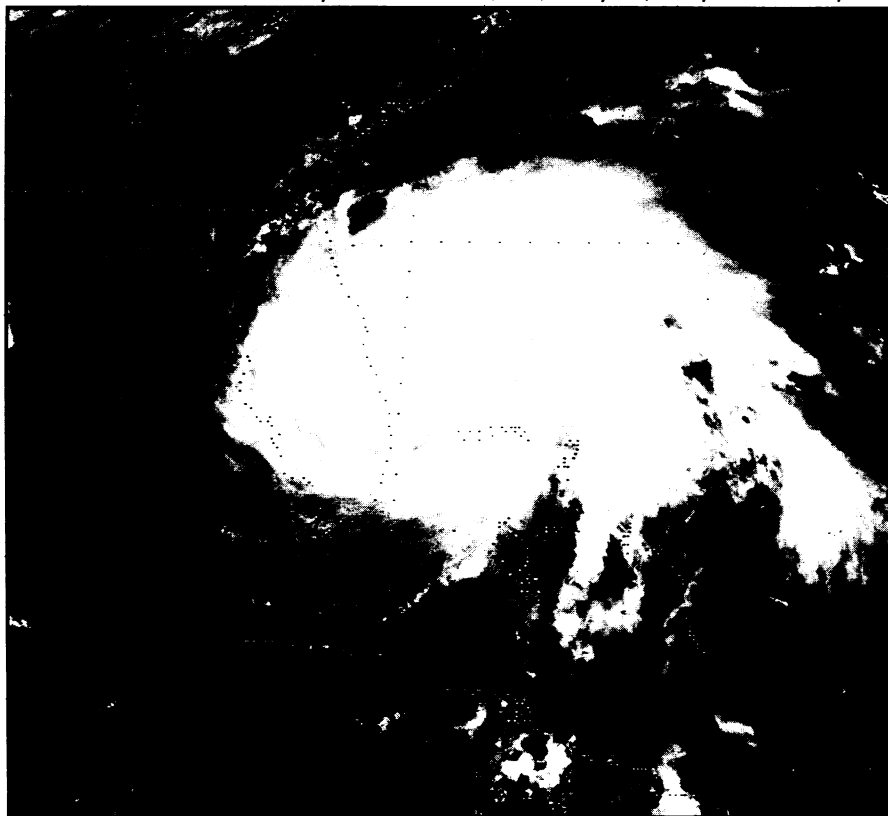
According to a spokesman for the National Hurricane Center in Miami, Fla., the most serious danger from the storm is now heavy rainfall and flooding inland and squalls along the coast. Quite a different picture from the howling fury of a few days previous. During its week-old lifetime, David visited destruction along a path from the Lesser Antilles, including the island of Dominica, to Puerto Rico, Hispaniola and the eastern edge of Cuba and to Florida, where it skipped suddenly northward, sparing the populous condominium-packed Miami, but churning up Florida's Atlantic coast, lashing Savannah,

Ga., and the South Carolina-Georgia barrier islands and heading inland 50 to 75 miles west of Charleston, S.C.

At its height last Friday, David's winds whipped up to 150 mph and it measured 300 miles wide. Only two other hurricanes this century — Camille in 1969 and Labor Day 1935 — have been as powerful. Dominica, where an estimated 95 percent of the homes were destroyed, and the Dominican Republic, where an estimated 800 people were killed and 90 percent of the nation's crops were destroyed, were considered the hardest hit. David's death toll ranged from 850 to 1,000 — making it one of the six deadliest hurricanes of the century and the deadliest since Hurricane Fifi took 2,000 lives in 1972. Estimated property damage in the Dominican Republic ranged between \$600 million and \$1 billion; in Florida, estimates ran as high as \$40 million.

If anything can be fortunate about David, it is its timing. The hurricane kicked

Hurricane David churns north past Palm Beach, Fla., in Sept. 3, 3:03 p.m. satellite photo.



NOAA/INSS