they, too, showed a significant increase in I.Q. — a mean increase of 10.2 points. For four more months, both groups of subjects continued to receive the vitamin-mineral supplements, leading to a total mean I.Q. score increase of 16 points over their baseline scores. The largest gain, of 25 points, occurred in a Down's child.

Thus vitamin-mineral supplements do appear capable of raising the intelligence of the mentally retarded, including Down's syndrome victims, Harrell and her colleagues conclude. They also report that the supplements led to more outgoing personalities, a height gain and loss of fluid in the face and extremities among subjects.

In the opinion of George Bouthilet, director of the President's Committee on Mental Retardation, located in Washington, the results of Harrell and her team would be of enormous importance if confirmed by other scientists. He cautions, however, that previous reports of nutrients raising the I.Q. scores of the mentally retarded have not been duplicated. Felix de la Cruz, a Down's syndrome specialist at the National Institute of Child Health and Human Development in Bethesda, Md., tends to agree with Bouthilet. If the results of Harrell and her colleagues can be replicated, he says, there would be reason for enthusiasm. Until now, though, he explains, studies suggesting that megavitamins can help various neurological problems, including Down's syndrome, have not been well-conducted — some, for instance, didn't use controls — or they could not be duplicated. Ped Tjossem, chief of the mental retardation branch of the NICHHD, says, "Some scientists have claimed that megadoses of vitamins and minerals can improve the I.Q. of the mentally retarded, but we've been unable to verify them. Thus I would be skeptical until I've seen the data [of Harrell and her colleagues]."

In contrast, Henry Leland, a psychologist with Ohio State University Medical School in Columbus, points out that there is fairly good evidence that nutritional supplements can help control the behavior of some autistic children, and that elimination of food additives from the diet can lessen hyperactivity in some hyperactive children. "So I can't rule out this diet thing" where the research of Harrell and her co-workers is concerned, he says. On the other hand, he adds, "it isn't great shakes" that somebody has raised the I.Q. scores of the mentally retarded with nutrients because it is easy to manipulate people's I.Q. scores with all sorts of techniques. So, for the results of Harrell and her colleagues to be truly meaningful, he asserts, they should show not an increase in I.Q. score, but rather that nutrients have made the subjects more teachable, more communicative, more responsible and independent. "If this type of thing improves," he concludes, "then we've got a treatment." □

# Voyager 2: New plans for Saturn

The complex series of computer commands that will control the Voyager 2 spacecraft's scientific activities during its August encounter with Saturn took two years to develop, and was ready well before even the Voyager 1 Saturn flyby of last November. Project officials expected that a few changes would be necessary once Voyager 1's findings were available, but, says one scientist, "we weren't ready for this." Voyager 1's startling discoveries, particularly about the planet's rings, have prompted a radical revision of the agenda for Voyager 2, resulting in unanticipated long hours not only for the researchers, but for the teams that must translate the scientific requirements into the elaborate, detailed command "sequences" that will be radioed up to the craft's computer.

Out of about 100 command "links" (groups of commands governing individual observing episodes, such as a 3-by-5-photo mosaic of Saturn's limb) used in the 20 hours before and after the Aug. 25 closest approach, says Voyager assistant project scientist Ellis Miner, more than half have had to be modified, including about 20 that have been completely thrown out and replaced. "If we were editing a book instead of command sequences," says imaging team scientist Richard J. Terrile, "normally at this point we'd be changing a few paragraphs. Instead, we've been changing whole chapters." And because Voyager 2's instruments were already booked to capacity in the original plan, every added observation has meant dropping an old one, resulting, for example, in the elimination of all formerly planned satellite photos that would not have been sharper than similar pictures from Voyager 1. But the researchers don't begrudge the changes.

*The rings:* Saturn's major puzzle from the Voyager 1 encounter was the discovery of the "braided," or at least multi-stranded nature of the thin F-ring. Only a couple of photos show the phenomenon clearly, says Terrile, but Voyager 2 will make it a major target. Photos from above and below the ring plane, taken perpendicularly and at angles, should enable three-dimensional analysis of the braiding, while sequences of pictures will tell whether it changes with time and track it around the planet. Numerous proposed explanations for the braiding have flooded into Voyager headquarters from scientists and others around the country and elsewhere, but the project scientists are leaning toward a gravitational effect from the two tiny moons (S-13 and 14) whose orbits enclose the ring, possibly combined with electromagnetic or electrostatic influences.

Nearly as puzzling are the approximately radial "spokes" photographed by Voyager 1 in the wide B-ring. Several candidate hypotheses have invoked the presence of tiny particles, levitated (perhaps electrostatically) out of the ring plane and radially aligned by Saturn's rotating magnetic field. Voyager 2's cameras and ultraviolet spectrometer will try for a quick edge-on look as the spacecraft flashes through the ring plane (less than half as far from Saturn as Voyager 1), in hopes of revealing whether there is indeed such a small-particle "atmosphere." One idea is that the spokes may be triggered by electrostatic bursts (detected by Voyager 1), and the craft's plasma-wave and radio-astronomy instruments have been reprogramed for additional high-data-rate scans to find out more.

Eccentric or elliptical rings were also detected among the round ones by Voyager 1, whose successor will photograph them at selected fixed longitudes over a period of time in hopes of measuring their precession rate. Such rings are among perhaps a thousand or more thin "ringlets" discovered to be comprising the overall ring structure, and Voyager 2 will try to measure their number and width by tracking a star across the structure's entire radius to measure the times when the star's light is cut off. Other photos will tell whether the detailed structure found in the Cassini division between the A- and B-rings has changed since Voyager 1.

*The moons:* Giant Titan was Voyager 1's specialty; Voyager 2 will only make some polarization studies to analyze particle sizes in its dense atmosphere. The prime satellite target is Enceladus, strangely smooth and the shiniest known solid object in the solar system. Its brightness (a geometric albedo of about 100 percent) may be due to backscattering, says assistant imaging team leader Laurence Soderblom, which could indicate a fairly new surface — of interest since Enceladus may be subject to a lesser version of the same tidal stresses tentatively linked with Europa's myriad streaks and Io's volcanism. Evidence of surface relief will be sought by photographing the object's terminator at different positions.

*The planet:* Aurora-type emissions were detected near Saturn's equator by Voyager 1's UV spectrometer in scans of that portion of the planet's limb or edge. As a result, Voyager 2 is being programed to expand the search to cover the limb of the entire northern hemisphere. One goal is to see whether the emissions are stronger at certain latitudes, such as those where the upper atmosphere is penetrated by magnetic-field lines that pass through the rings. Photography of visible features in Saturn's cloudtops will be concentrated near the north polar region, where such details (though far fainter than Jupiter's) seem most prominent. Magnetic-field and trapped-particle measurements will be largely as originally planned, but with different results if Saturn turns out to be, as tentatively suggested, in Jupiter's magnetic tail during the flyby. □