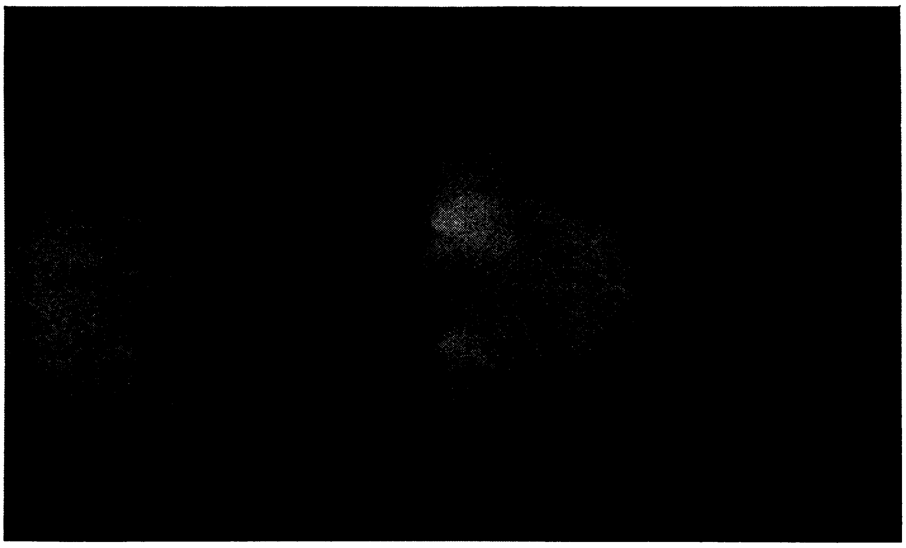
VAN ALLEN BELTS

Mapping the dip

Between the east coast of South America and the southwestern coast of Africa lies a region where the earth's magnetic field is relatively weak. For the bands of particles trapped in that field—the Van Allen belts—this means a closer approach to the planet, forming a dip in the belts known as the South Atlantic Anomaly. Particles that would descend to an average height of 250 miles above the earth over most of the belts' area (and in some places get no closer than 550 miles) might, in the dip, sink as low as 90 or 100 miles.

Unfortunately for space scientists radiation can produce genetic and growth changes.

Last week, the space agency took its first detailed look at the dip. About a 20-minute drive from the sleepy Brazilian town of Natal is the small, barren Barreria do Inferno launch site of Brazil's space agency, the Comissão Nacional de Actividades Espaciais. From there a Canadian Black Brant sounding rocket lofted an 80-pound instrument package on a long, curving trajectory which carried it some 475 miles up through the belts before it splashed into the South Atlantic. The



NASA

Simulation of the Van Allen belts: The dot marks the South Atlantic dip.

who want to map the belts, this is below the altitudes of most satellites, leaving a blank spot in the charts equivalent to the uncharted parts of the ocean below. It is not, however, below the altitude of many manned orbital flights. Much of the little that is known about the anomaly, in fact, came from experiments aboard Gemini spacecraft.

The space agency is planning to put men in orbit for extended periods of time as part of the Apollo Applications Program. Information will be needed for AAP, if that is ever funded, or for the Defense Department's Manned Orbiting Laboratory, which is more likely to be so. There is increased interest in finding out just what the anomaly is really like. Launching men into space so that they pass briefly through the belts may not be particularly hazardous, but a lengthy stay in orbit might be a different matter. The three-day flight of various animals, plants, spores and individual cells aboard Biosatellite 2 last September indicated that prolonged exposure to weightlessness combined with

unusual flight—with American control, a Canadian booster and a Brazilian launch team—was planned as one of the highest sounding probes ever launched by the National Aeronautics and Space Administration, and was only the second time that the agency has used the Black Brant.

Among the instruments aboard were three ion-chamber dosimeters to measure the overall radiation rate. Electrically, all three were the same. One, however, was enclosed in a shield designed to match the wall thickness in the Apollo command module crew compartment; another was shielded like the Apollo lunar module, while the third was an unshielded control.

In addition to the practical value, there is also considerable scientific interest in the belts in the vicinity of the dip, which largely accounts for the extreme height of the probe. Besides the dosimeters, the payload contained magnetometers for magnetic field measurements, a spectrometer to measure electrons at five different energy levels, and a heavy ion detector to measure low-energy particles.

Though the belts are fluctuating somewhat all the time, the probe was designed to take a quick look that largely ignores these relatively small variations to measure the present general contours of the dip. A year from now, a second probe will be sent up to see what broad changes there have been, followed, 12 months later, by a third. "We're looking at the general climate up there, as opposed to the weather," a space agency scientist says.

GOOD NEWS GONE BAD

Gossip and the TMV

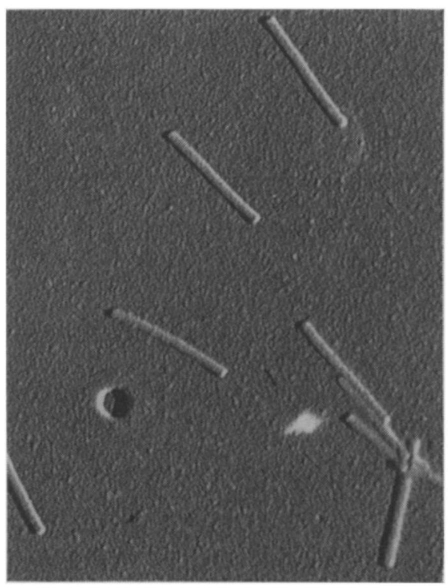
Since the publication of Nobelist James D. Watson's book "The Double Helix" (SN: 3/2, p. 210), almost everyone is aware that scientists gossip as much as the rest of humanity. Often, in fact, gossip and rumors are the media through which scientists first learn of major accomplishments about to be announced.

That the rumor generating process can sometimes be very unsatisfying was demonstrated amply last week.

That was when many scientists were predicting a major announcement from molecular biologists at Cambridge University in England: the discovery of the atomic structure of the tobacco mosaic virus.

This virus particle contains upwards of a million atoms. Delineation of its atomic structure would be a great technical tour de force and would reveal much of the methods and forces by which large assemblies of atoms are held together.

"If an exact structure for so large a particle were obtained," says Dr. R. A. Plane, head of the department of



Dr. Russell Steere

TMV, × 50,000; structure promised.

chemistry, Cornell University, "it would be more than an order of magnitude better than anything done so far."

The rumor gained currency with a report that the Cambridge Molecular Biology Laboratory under the direction of Nobelist Max Perutz had achieved a "breakthrough in virology . . . with creation of a very high resolution electron density map of the tobacco mosaic virus."

The report—which achieved the stature of print—quotes the laboratory as saying that individual molecules (not atoms) within the virus can be seen on the map, and says the achievement will give biologists their best understanding yet of the mechanism of viral self-assembly.

"Complete rubbish," says Dr. Perutz. "Complete rubbish. I can't imagine where the information came from."

Dr. Perutz explains that he himself is working with the structure of the red blood pigment hemoglobin and is about to publish some results. He says, however, that a colleague at his laboratory, Dr. Aaron Klug, is working with tobacco mosaic virus—among several other viruses.

Dr. Klug is working on the three-dimensional visualization of such structures as virus particles, using techniques for manipulating photographs taken with the electron microscope. Dr. Perutz says the visualization techniques being worked out by Dr. Klug have great potential value for the study of structures, but so far they have not been used to reap practical results.

"The pictures taken so far are very pretty," Dr. Perutz says. "But they show no more than was already known."

LAST LAP

Gravity waves evidence

The long search for gravitational waves (SN: 4/27, p. 408), which scientists have believed for 50 years should exist but never were able to find, may be in the final lap.

The latest report on detection of events possibly caused by gravitational waves, from Dr. Joseph Weber of the University of Maryland, moves somewhat closer to definite commitment. Others using the same experimental information would probably have been even more definite.

Gravity waves would be a gravitational analogue to the electromagnetic waves, such as radio, light and X-rays.

Dr. Weber's cautious report reverses the language of the one he made in March 1967. Then he said:

"The possibility that some gravitational signals may have been observed cannot completely be ruled out."

His judgment now is that his instruments, which operated 24 hours a day for several years, respond about once a month "to a common external excitation which may be gravitational radiation." Observations of other events made in the two months since he submitted his report to the June 3 PHYSICAL REVIEW LETTERS have not changed Dr. Weber's mind.

However, he will not make a stronger statement at least until the results of other tests now underway are available.

If these results are negative, then Dr. Weber and his co-workers, or others in the field, may be able to pinpoint the cause of the events so far recorded by his instruments.

One experiment in progress is a search over other frequencies and bandwidths than those already detected, including the pulsar frequencies ranging from 40 to 1400 megahertz. Another is the separation of the two detectors over a distance of 700 miles between Argonne, Ill., and College Park, instead of the slightly more than one mile used so far on the Maryland campus.

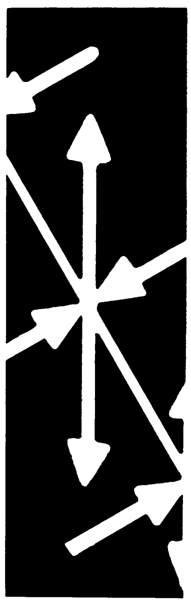
The existence of gravitational waves is predicted by Einstein's theory of general relativity. Any mass that is accelerated should generate gravity waves.

Dr. Weber's instruments to detect gravity waves are based on the small effect they are predicted to have on a relatively large mass.

The ideal detector for gravitational waves would have several instruments such as Dr. Weber uses spread out over miles in the form of a cross. In that way, the source of any gravitational wave could be detected since there should be a time delay between receipt at any antenna compared to the next in line.

Dr. Weber has taken a step in this direction by separating his two instruments by 700 miles.

Rotating binary stars or, perhaps, other galaxies like the Milky Way but far beyond it, or the center of the Milky Way itself, are likely sources for gravitational radiation.



The absorption cross section of a gravitational wave detector is proportional to its mass, the largest that can now be instrumented being the earth, though there are plans to plant such an instrument on the moon. Observation of coincidences would indicate gravitational radiation.