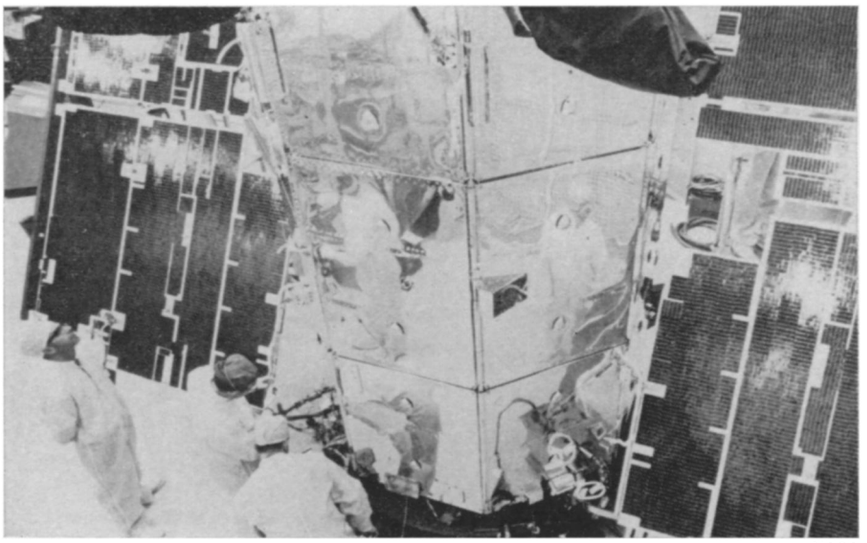
SATELLITE ASTRONOMY

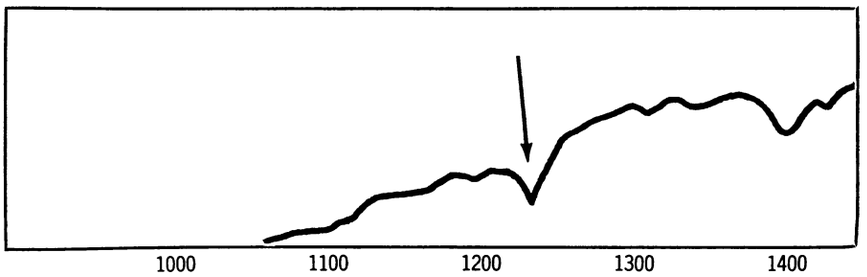
Riddle from Andromeda

First results from OAO-II may require revision of cosmological theories



NASA

OAO-II: Results show surprising variations in the ultraviolet range.



NASA/University of Wisconsin

Ultraviolet spectral scan of epsilon Persei shows hydrogen absorption.

Ever since Orbiting Astronomical Observatory II was launched and proved to be operating successfully last December (SN: 12/21, p. 616), scientists have eagerly awaited announcement of the first results. They came at the American Astronomical Society meeting in Honolulu last week from two of the principal investigators, Drs. Arthur D. Code of the University of Wisconsin and Robert J. Davis of the Smithsonian Astrophysical Observatory in Cambridge, Mass.

The 11 telescopes in the 4,400-pound observatory, orbiting in a near-circular 480-mile-high path, are being used to study extremely hot, young stars that emit most of their energy in the ultraviolet.

Dr. Code says the seven telescopes of the Wisconsin experiment have revealed unexpected and intense ultraviolet light in several old galaxies. So much ultraviolet light from the Andromeda galaxy (M-31), and so little from M-81, is puzzling, he says, since both "are rather old, garden variety galaxies.

"I do not have the answers yet," he says. "There is a possibility that we might have discovered an old quasar a few million light years away." The 30-odd quasars now known are considered by most astronomers to be very bright objects at distances of billions of light years, although some disagree with this interpretation (SN: 11/30, p. 554).

Dr. Code believes that the full impact of OAO-II results will not be felt for at least two years, but predicts that some theories on cosmology will have to be modified and others discarded by that time. The OAO data studied so far, he says, provide an argument against the steady state theory of the universe, which holds that the universe looks the same, from any point, at any time (SN: 6/15, p. 575).

"The OAO-II data show," Dr. Code says, "that the total density of luminous matter in the universe is probably not high enough to support a theory of a steady state universe, or even an evolving closed universe."

One theory requiring a change relates to the temperature figures assigned to young, hot stars that have masses in excess of 15 times the sun. Such stars are considerably hotter than 20,000 degrees K., he reports, and are aging about twice as fast as had been assumed, burning hydrogen at an extremely rapid rate.

This result resolves a discrepancy between the theoretical predictions of the thermonuclear energy produced in these stars and the observed light from the objects.

Several galaxies have been studied in the Wisconsin experiment, including M-31, M-81, M-82 and M-87. While M-31 and M-87 radiated much more ultraviolet light than was expected, M-82—an exploding galaxy—and M-81 radiated very little. This unexpected observation is without explanation yet, but it does provide information on how much light galaxies radiate. Dr. Code suggests that some of the blue stellar objects found in searches for quasars may be galaxies whose excess ultraviolet radiation has been shifted by recessional velocity into the visible spectrum.

Another implication of the excess ultraviolet radiation is that theoretical models must be recalculated using these new galactic brightnesses before comparison with observations of total sky brightness is valid. The level of total sky brightness is used as one test of cosmological theories.

Unlike the Wisconsin experiment, in which one object at a time is studied, the Smithsonian Astrophysical Observatory's four telescopes aboard OAO-II are producing a pictorial map of the sky in ultraviolet. These stellar maps should prove as valuable to astronomers and future astronauts as sky charts of visible objects are to navigators.

To date several thousand stars have been photographed down to a magnitude of about 10, Dr. Davis reports. By the end of this year, the aim is to have photographed about 12 percent of the sky, or some 20,000 stars.

One percent of the observed stars are some two to four magnitudes fainter in the ultraviolet than current theories predict, another observation without explanation.

The shortest wavelength band observed in the Smithsonian experiment includes the Lyman alpha line of atomic hydrogen at 1216 angstroms. The glowing cloud of Lyman alpha radiation in the earth's outer atmosphere occasionally fogs the SAO television pictures, reducing the sensitivity to stars in the shortest wavelengths of ultraviolet. However, the ability to record this phenomenon is predicted to lead to a better understanding of the nature and origin of this cloud.

The Wisconsin experiment also measures ultraviolet light down to, and somewhat below, the Lyman alpha line. However, the measurement then is in absorption, rather than the inverse process of emission registered by the Smithsonion experiment. The absorption indicates the number of hydrogen atoms between the earth and the star whose ultraviolet light is being monitored.

The 4,400-pound satellite is the heaviest and most complex unmanned observatory developed by the United States. Its performance in orbit has so far been virtually flawless, pointing precisely at specific stars, planets or galaxies as directed from the ground by a team involving 25 scientists. Its aiming stability is comparable to a marksman holding his rifle sight on a bullseye less than two inches in diameter at a distance of one mile for many minutes.

Two orbiting observatories remain in the OAO program of the National Aeronautics and Space Administration. OAO-B will carry a Goddard Space Flight Center 38-inch telescope, and OAO-C will have Princeton University's 32-inch telescope aboard.

"OAO-II has clearly demonstrated that we can send a highly complex observatory and extremely delicate instruments into the space environment and operate them around the clock from the ground," says Dr. Fred L. Whipple, director of SAO. ◇

CANCER THERAPY

EB virus and leukemia

Roswell Park

Dr. Grace: vaccine within a year.

Roswell Park

EB virus: from mono to leukemia.

The suspicion that viruses cause human cancer remains to this day little more than a hypothesis. Circumstantial evidence shows that viruses clearly cause cancers in mice and other animals and they are associated with some human cancers (SN: 11/9, p. 463). But proof of their role in humans has eluded the most careful researchers, partly because they cannot inject a suspect virus into a patient and wait to see whether or not he develops a lethal disease, as they can with albino rats.

Nevertheless, in at least one type of human cancer, the circumstantial evidence implicating a viral culprit has reached such proportions that scientists are talking about a vaccine against it. The cancers are leukemia-like malignancies of the lymph system; the suspect is the EB or Epstein-Barr virus. "If we had the money," says Dr. James T. Grace, director of the Roswell Park Memorial Institute in Buffalo, "we could develop a vaccine within a year."

The first bit of evidence of an EB virus-cancer tie-in came from Africa when Dr. Dennis Burkitt of the Medical Research Council of London isolated the virus from cells of children with lymphoma, a relatively common form of lymph cancer in that country.

Later, Dr. Grace and co-workers at Roswell Park looked for it in healthy volunteers and cancer patients, finding antibodies to EB virus in 99 percent of their volunteers and, in high amounts, in 98 percent of patients with lymphomas, leukemia, Hodgkin's disease and other cancers. Thinking back to the African findings, scientists reasoned that the high incidence of malaria there could throw light on the question. Dr. Grace speculates that "disease is a rare consequence of EB virus infection," and the presence of the malaria parasite could alter the body's immune response and lay it open to attack by EB viruses.

Shortly afterwards, work by virologists Werner and Gertrude Henle of the University of Pennsylvania again pointed the finger of suspicion at the virus. They isolated it from patients with infectious mononucleosis and researchers now believe that it actually causes that disease. "In fact," Dr. Grace told a seminar sponsored by the American Cancer Society in New Orleans, "infectious mononucleosis may be a self-limiting form of leukemia." That is, it causes alterations in the lymph system that are reversible, while the changes seen in leukemia are no longer reversible.

It is possible, he believes, that mononucleosis may actually confer an immunity to leukemia. At Roswell Park, a leukemia patient injected with the virus developed infectious mononucleosis and experienced temporary remission of his disease. One man who developed mononucleosis while he had leukemia was ostensibly free of cancer for two years. Other cases of remission associated with mononucleosis have been reported. The evidence remains circumstantial, partly because temporary remission from leukemia is not entirely uncommon in any case.

However, as more and more links between the two diseases and the virus turn up, Dr. Grace becomes more and more optimistic. Human mononucleosis cells induce lymphomas in hamsters. In microscopic studies of liver and spleen tissues from leukemia and mononucleosis patients, pathologists are unable to distinguish the histological findings in one case from those in the other. Lymph-node tissue from both types of patients also appear to be pathologically identical.

"What I would like to do," the Buffalo researcher says, "is conduct a long-range epidemological study with EB