

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 Smithsonian experiment. The absorp-

tion 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. ◇

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 epidemiological study with EB

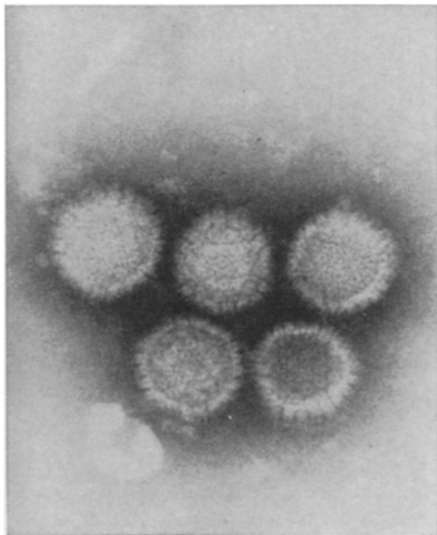
CANCER THERAPY

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

virus vaccine in military men. If a vaccine can be developed, it might be useful in the Armed Forces where considerable man-hours are lost among young men because of infectious mononucleosis." Whether or not a vaccine would ultimately be useful in treatment of patients with clear cases of cancer is a moot point. Some researchers feel that by then it may be too late to change cell behavior, but it would almost certainly be a prophylactic agent.

Already, researchers at Roswell Park are working to develop a vaccine that would eventually be produced by a drug company, but Dr. Grace's prediction of success within a year is, he ad-

FORMALDEHYDE

Life's building blocks in space

In the rarefied conditions of interstellar space, getting two atoms close enough together to form a molecule is difficult. Getting four together is several times harder.

Yet the chemistry of interstellar space is getting rapidly more complex and most recently definitely organic. The discovery of the first polyatomic organic molecule, formaldehyde (H_2CO), in interstellar space has been made by Drs. Lewis E. Snyder and David Buhl of the National Radio Astronomy Observatory; Benjamin Zuckerman of the University of Maryland and Patrick Palmer of the University of Chicago.

Formaldehyde joins a growing list that started years ago with single atoms. Within this decade astronomers progressed to the identification of diatomic radicals, and in recent months found stable compounds, notably ammonia (NH_3) (SN: 12/28, p. 639), and water (H_2O) (SN: 3/8, p. 234).

Because it is an important factor in the chemistry of life, formaldehyde lends a new dimension to astrochemistry. Its discovery lends support to theories of how life began on planets.

" H_2CO is the first organic polyatomic molecule ever detected in the interstellar medium," say the four astronomers, "and its widespread distribution indicates that processes of interstellar chemical evolution may be much more complex than previously assumed.

"We now know that polyatomic molecules containing at least two other atoms than hydrogen can form in the interstellar medium," they say. "Their formation apparently does not require extremely unusual interstellar conditions. . . . Hence large regions of the galaxy may be filled with clouds containing formaldehyde."

The formaldehyde was found by its characteristic absorption of radio signals coming from sources behind it. Seeing an absorption line that might be

mits, more ideal than practical. "It is the best of times; it is the worst of times," he told the seminar, declaring that this is the moment when scientists are beginning to see the sunlight at the end of the road of 15 years of concentrated basic research, and it is the time when money to support studies that could produce real answers within a decade is at its lowest.

"Biomedical science is in serious crisis, and I say that flatly," he says. If the President's budget for fiscal 1970 is accepted by Congress, \$186 million will be allocated for cancer experiments, \$500,000 less than in fiscal 1967.

Even if the Roswell Park attempts to

formaldehyde and that seemed to be associated with certain interstellar gas clouds, the astronomers subtracted from the observed frequencies the shifts that would be brought about by the known velocity of the clouds. The rest frequencies so calculated matched very closely an absorption line of formaldehyde determined from a sample of the compound at rest in the laboratory.

"We regard the close coincidence of astronomical and laboratory rest frequencies as a strong argument in favor of the identification with H_2CO ," the four astronomers say, "since we find no other molecule composed of astrophysically abundant elements that has a microwave line with a rest frequency that lies within our error bars."

Formaldehyde has been found so far in the directions of 16 out of 27 sources of continuous broad-band radio emanation that the four astronomers have looked at. In many cases the presence of formaldehyde seems to be associated with clouds of other interstellar molecules, notably the hydroxyl radical (OH).

There is a possible relation of such abundance of formaldehyde to the origins of life. Various theories of the origin of life have postulated mixtures of methane, ammonia, hydrogen and water in planetary atmospheres acted upon by ultraviolet radiation or lightning to produce the beginnings of living beings. Mixtures of these elements have been used to produce artificial amino acids in the laboratory.

But the problem in such theories is how these gases could have gotten into planetary atmospheres where life could have formed. Ammonia, water and hydrogen are now known to be in interstellar space, and formaldehyde is good indirect evidence for methane since one way to make formaldehyde is to react methane with hydroxyl.

develop the anti-cancer vaccine proceed without many unexpected stumbling blocks, the beginning of long-range observations of its effectiveness will be delayed while researchers do the studies of effectiveness and toxicity required before the Government approves its experimental use, Dr. Grace points out. And then it would be a matter of 15 years before the data could be evaluated. What scientists would hope to find, though, is that the incidence of leukemia-like cancers among persons who had received the vaccine would be far lower than the incidence in the same number of controls in the general population.

Thus if all these gases are present in interstellar clouds, and if stars and planetary systems are formed by condensation of these clouds, as many astronomers assume, then the mystery of how the gases got into planetary atmospheres is solved. ◇

SUCCESS STORY

NASA budget booms



NASA

Apollo 9: success spells more money.

Nothing succeeds, judging by early handling of the National Aeronautics and Space Administration's fiscal 1970 budget request, like success. The space agency's fortunes have been declining ever since their 1966 peak, but three successful manned Apollo flights out of three attempts have had a strong influence on the Congressional climate, and may loosen the purse strings.

Once a Federal agency has submitted its request for funds for an upcoming fiscal year, the first indicator of the success it will ultimately have is often the changes made in the request by the appropriate subcommittees of the