6,000 degrees K.), surrounded by a dense cloud of gas and dust that does the actual infrared emitting. The star and associated cloud cannot be seen directly at visual wavelengths, but rather strangely they can be seen by reflected light. The reflection comes from two large dust clouds farther away from the object.

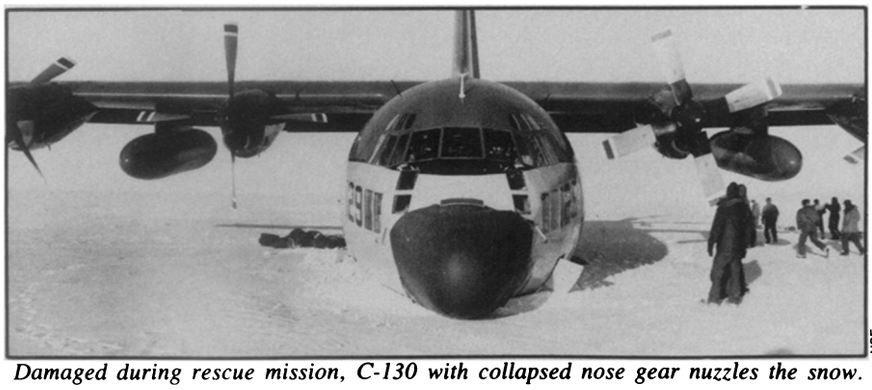
The dust cloud around the central object could either be imploding or exploding, an astronomical snapshot cannot for the moment tell which. But the reason for supposing that it is likely to be exploding and therefore the beginning of a planetary nebula is that CRL-618 is located above the plane of the galaxy about 3,000 to 6,000 light-years from the solar system, and that is a region where there should be little of the dust that condenses to form new stars.

The suggested scenario, therefore, is that CRL-618 is an ordinary star in the process of becoming a white dwarf, one of the generally accepted endpoints of stellar evolution. What happens is that the star has finished burning the hydrogen in its core. The core collapses, and the heat generated by the collapse blows off the outer layer to form a planetary nebula that gradually expands around the star.

About 600 such planetary nebula stars have been catalogued in the Milky Way galaxy—the Ring nebula and the Dumbbell nebula being the best known. But in all those, the planetary nebula has already reached a sizable distance from the central star. CRL-618 would be the first one caught just at the beginning.

Westbrook's work was part of a collaboration with Maarten Schmidt, Gerry Neugebauer and Eric Becklin of the Caltech faculty, K.M. .Merrill of the University of California at San Diego, C.G. Wynn-Williams of Cambridge University in England, and another Caltech graduate student, Steven Willner. □

Rough flying for Antarctic research



NSF

Damaged during rescue mission, C-130 with collapsed nose gear nuzzles the snow.

When the first of Richard E. Byrd's Antarctic expeditions visited the bottom of the world in 1928, it arrived with three aircraft, one of which, a Fokker Super Universal monoplane, was abandoned in the frozen wastes when 150-mile-per-hour winds blew it away from a frozen lake in the Rockefeller Mountains east of Little America. Four aircraft accompanied the second trek in 1933, two of which crashed at Little America, and a third was so badly damaged while being loaded onto a ship for the return trip that it was scrapped when it reached the United States. Lincoln Ellsworth's first attempt to fly across Antaractica, in January of 1934, ended when his plane, the "Polar Star," was damaged by the breaking-up of the sea ice in the Bay of Whales. The first official U.S. Antarctic expedition of the 20th century, the Antarctic Service Expedition of 1939 to 1941, was forced to abandon two of its four aircraft.

Aircraft have been and still are vitally important to operations on the world's south polar cap—for supply, rescue, scientific research and general transport—but Antarctica has demanded a heavy toll. From the 1946 Operation Highjump, still the largest expedition ever sent there by any country, through the end of Operation Deep Freeze 1973, 50 aircraft were lost during U.S. operations, 20 of them helicopters. During the same period, 29 deaths resulted from aircraft accidents.

At the same time, costs—of research in general and of the aircraft themselves—have continued to grow. As a result, an ironic succession of mishaps this year has been "almost entirely" responsible, according to a National Science Foundation official, for reducing the number of U.S. scientific personnel in Antarctica by more than 50 percent. The U.S. Antarctic Research Program is funded by NSF to the tune of $29 million for fiscal 1976.

On Jan. 15, a U.S. Navy C-130 Hercules transport, engaged in support operations during preparation for core-sample drilling in the ice, was taking off from the site when one of its JATO (Jet-Assisted Take-Off) units exploded, causing the plane's right wing to burn off and destroying two engines in the process. The extra thrust provided by the JATO units is valuable in the thin air and icy terrain, where it enables the ski-equipped planes to take off in much shorter distances, saving vital time in runway preparation. Fortunately, no one was killed or injured in the accident—or in the ones to follow.

The same day, another C-130—they are the workhorses of Antarctica—was flown in to rescue the crew of the first, which included members of a French scientific party. It was decided that the plane would take off without using its JATO devices. But during the longer run over less-prepared surface the plane struck an icy hummock which completely collapsed its nose gear. A third C-130 successfully rescued both crews, but left behind at the site were more than $18 million worth of vital transportation—40 percent of the U.S. workhorse fleet on the frozen continent.

Few places on the planet's "land" area could be less inviting spots in which to conduct massive repair operations. The double disaster took place essentially in the middle of nowhere, about 650 miles from the U.S. base at McMurdo and slightly closer to Vostok, the Soviet base at the south magnetic pole. The elevation at the site is more than 7,000 feet above sea level, and the mean temperature is about 30 degrees F. below zero. At Vostok, the lowest known temperatures in the world have been recorded: a trans-shivering 126.9 degrees F. below zero. Summer in the Northern Hemisphere is the winter of winters in Antarctica, leaving a working season that runs only from about October through February.

A full-scale repair operation was obviously necessary if the two vehicles were to be salvaged. Lockheed, the planes' manufacturer, fabricated an entire center section for the ruined wing, but it would have to be installed in the field. The effort was not able to get underway until mid-October, when engineers, technicians and equipment began arriving at the site. Then, last month, on Nov. 4, the JATO unit on a C-130 being used in the operation broke free from its mounting, sheared into an engine and left a third crippled aircraft stranded in the cold.

It is also the least damaged of the three, points out Navy Capt. Eugene W. Van Reeth, who heads the Navy's Antarctic support program, and repair efforts are concentrating on it first. It will not be possible to complete work on the other two planes, however, until the next Antarctic summer, around the end of 1976.

The damage has not been confined to aircraft. The U.S. scientific complement in Antarctica, which included about 300 people last year, is down to little more than 100, says Guy Guthridge of the National Science Foundation. Most of the reduction is due to the costs involved in the recovery operations for the planes, as well as to the reduced airlift capacity for conducting and supporting research. "Many projects," says Guthridge, "were either curtailed or brought out of the field."

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The NSF is buying two more C-130's—another $18 million—but they are not scheduled to be delivered until 1977. They will be equipped with JATO units, but Guthridge points out the Navy investigated each of the previous mishaps (including a 1971 crash when a malfunctioning JATO blew off a propeller, leaving the aircraft stuck until it is now in snow "up to its tail") and found nothing that would justify imposing a permanent ban on the devices.

Meanwhile, the C-130's remain vital to work at the bottom of the world. "Those planes give the United States a flexibility that no other nation has in the Antarctic," says Guthridge. For both coastal and inland heavy-lift operations, he says, their high wings, high engines (to clear snow drifts) and huge tail doors (a bulldozer can simply be driven in and out) make them ideal. "If you ever had to design a plane from scratch," he says of the Antarctic mission, "it would probably look just about like a C-130." □

Multination look at tri-planet hydrogen

A proposed data exchange involving three countries may lead to significant conclusions involving three planets, as well as the sun. The idea has been put forward by Jacques L. Bertaux of the Aeronomy Service of the French National Center for Scientific Research, designer of the ultraviolet photometers that are studying the atmosphere of Venus from aboard the two Soviet Venera spacecraft now orbiting that world.

Hydrogen in the Venusian atmosphere, now being measured by the photometers, is a scientific puzzlement. The U.S. Mariner 5 spacecraft measured it in 1967, but when Mariner 10 repeated the feat in 1974, it reported barely half as much hydrogen as did the previous observation. Bertaux's idea is, in essence, to make use of "outside consultation" with two other planets: Mars and the earth.

About two weeks before Venera 9's Oct. 20 arrival in orbit around Venus, Bertaux came to Princeton University, control center for the U.S. Copernicus astronomy satellite. Copernicus carries a high-resolution spectrometer covering the same wavelengths as the Venera photometer. Perhaps, he suggested, Copernicus could be aimed to observe Mars and the earth on some of the same days that Venera was doing so around its cloudy planet. Combining results from all three planets might reveal a common influence. As it turned out, Copernicus was just about to do that very thing.

Joel S. Levine and David S. McDougal of the National Aeronautics and Space Administration's Langley Research Center in Virginia, together with Edwin S. Barker of Princeton and Don E. Anderson of the Naval Research Laboratory, are now preparing to analyze the results of that experiment. Although Copernicus has been largely a stars-only observer, it was turned toward Mars and the earth for four orbits every fifth day during November. A primary goal, says Levine, is to see whether the timing of hydrogen variations in the atmospheres of the two planets can be matched with the 27-day cycle of the rotation of the sun, believed to be a possible cause of hydrogen changes due to its effect on upper-atmospheric heating. If the Venera data, supplied to Bertaux by the Soviet Union, can be swapped for the Copernicus data, both sides will be able to examine hydrogen processes from three, not just one or two, places in the solar system. (In addition, the earth-orbiting Atmosphere Explorer C and D satellites were observing solar emissions of hydrogen-exciting photons directly during the same time period.)

There are also, of course, scientific reasons for studying hydrogen on the three planets individually. Besides questions of water vapor and other compounds, Venus still poses the riddle of the widely disparate Mariner measurements. On earth, so-called "odd-hydrogen" compounds (H, OH, HO_2) play a significant role in the natural destruction of ozone.

Mars, with the two elaborate Viking probes due to arrive there next summer, is particularly exciting. Mariner 9 showed that atomic hydrogen spectra from the Martian atmosphere vary by as much as 20 percent from one day to the next. This could be because of solar variations, which the multispacecraft study should reveal, or, says Levine, because the hydrogen content itself is really that fickle. Hydrogen, after all, is only a trace element on Mars, he points out. If no more hydrogen were added to the Martian atmosphere, he says, it would be completely gone within as little as two to five hours, due to thermal escape.

The U.S.-French-Soviet data exchange is expected to be finalized this week. It may be as much as two months before the Venera data are available to Bertaux, but when the time comes, the swap will be a clear case of planetary synergy. □

Soviet space briefs: Bio-Vostok, Soyuz 20

An unmanned Soviet Vostok spacecraft was launched Nov. 25, carrying at least 11 biological experiments, four of them provided by the National Aeronautics and Space Administration at Soviet invitation (SN: 10/18/75, p. 248). The U.S. experiments include such life forms as plant cells and fish embryos. Each experiment has both a near-weightlessness version and a control counterpart to be conducted in a one-gravity centrifuge. Placed in an orbit initially ranging from 141 to 251 miles above Earth, the satellite is expected to remain aloft for about 22 days. □

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Another unmanned craft, Soyuz 20, docked with the Salyut 4 space station, suggesting that Soviet space officials are investigating the possibility of automatically resupplying the station to enable longer manned missions. Launched Nov. 17, Soyuz 20 was the first unmanned craft to rendezvous and couple with a Salyut. There were no announcements of attempts at transferring consumables or other materials from spacecraft to space station, though Soviet officials have discussed the concept of automated orbital "tankers" in the past. □

President for AAAS . . .

Former Connecticut Congressman Emilio Q. Daddario, director of the Congressional Office of Technology Assessment (OTA), has been elected president of the American Association for the Advancement of Science for 1977. Following usual AAAS procedure, Daddario will take office next year as "president-elect," and in 1978, as chairman of the board.

Daddario was a member of the House for 12 years, serving as chairman of the Subcommittee on Science, Research and Development and as chairman of the Special Subcommittee on Patents and Scientific Inventions. He has directed OTA since its establishment in 1973.

Two new members of the AAAS board of directors have also been elected for four year terms beginning in January: Rep. Mike McCormack (D-Wash.), chairman of the House Subcommittee on Energy (he is one of only two scientists in Congress), and physicist Chen Ning Yang, the Albert Einstein Professor of Physics at State University of New York, Stony Brook (1957 Nobel Prize for physics). □

. . . and Soviet Academy

Anatoly Alexandrov, one of the few members of the Soviet Academy of Sciences who is also on the Communist Party's Central Committee, was elected president of the academy last week. The 75-year-old physicist replaces Mstislav Keldysh, who resigned abruptly last spring, after 14 years in the post.

Tensions between the Soviet Academy and the party have apparently been mounting for some time, culminating in the postponement of the celebrations to mark the academy's 250th anniversary last year. Some observers see Alexandrov's election as a sign that party control of the once autonomous academy has now been completed. The main speaker at the academy meeting on the day of the election was chief party ideologist Mikhail Suslov, who told the scientists their devotion should be "to the cause of the party and the people." □