himself, already a well-known infrared astronomer, arrived to become IRTF's chief scientist. He and another new colleague, Richard W. Capps, formerly of Kitt Peak, have added considerable luster to the institute's infrared group.

"I feel badly that things got to the stage that it did," says Jefferies. "I feel the whole thing was handled ineptly on all sides. But I'm glad that we—most of us—put the project ahead of our feelings. The differences and controversies have long since healed over. Those of us who stuck with it have produced a fine facility, far better than it started out to be."

Dire prophecies to the contrary, IRTF was ready in time for the Voyager mission. It was dedicated in July 1979. Among the imaging targets during the Voyager 2 encounter with Jupiter that month were atmospheric "hot spots" that had been pinpointed by IRTF images at the 5-micrometer wavelength.

Shortly after the encounter, IRTF followed the volcanically active moon Io as it passed into Jupiter's shadow, and found that it stays warmer in eclipse than the other satellites. This could prove a good way of monitoring the frequency of eruptions. (Actually, this observation is not new to IRTF. Infrared astronomers could have predicted Io's vulcanism long before Voyager, had anyone realized what they were looking at.)

IRTF spends 50 percent of its time on solar system studies. The rest of the time it ranges farther. Becklin, Gareth Wynn-Williams, Reinhart Genzel, and Dennis Downes, for example, have been using IRTF to study the vast gas and dust clouds of Orion, of which the famous Orion nebula is a very small part. Only 1600 light-years away, the Orion complex has long been known as a kind of stellar nursery, in which cold clouds of hydrogen are slowly collapsing under the influence of their own gravity to give birth to new stars. The latest IRTF work—which includes a very high resolution map of the region at 20-micrometers wavelength—shows strong infrared emission from a cluster of perhaps a half-dozen discrete objects buried deep within the densest part of the cloud, just

FDA Approves Hepatitis B Vaccine

The U.S. Food and Drug Administration (FDA) last month approved a new vaccine for hepatitis B, a particularly debilitating form of liver disease. The vaccine, developed by Maurice R. Hilleman and his colleagues at the Merck Institute for Therapeutic Research in West Point, Pennsylvania (*Science*, 14 November 1980, p. 760), is produced from viral particles isolated from the blood of human carriers of the disease. These particles—called hepatitis B surface antigen (HB_sAg)—contain proteins that are recognized by the immune system. FDA Commissioner Arthur Hull Hayes, Jr., noted that the new vaccine is "the first completely new viral vaccine in 10 years and the first ever licensed in the United States that is made directly from human blood."

An estimated 80,000 to 100,000 new cases of hepatitis B occur in the United States each year, with a fatality rate somewhere between 1 and 2 percent. The incidence is much higher elsewhere in the world, particularly in Africa and Asia. As many as 10 percent of those infected become chronic carriers of the disease, displaying relatively high concentrations of HB_sAg in their blood serum. There are an estimated 800,000 carriers in the United States and more than 200 million throughout the world. The first step in production of the vaccine is collection of blood from such carriers at special donor centers throughout the country (the hepatitis B virus cannot readily be grown in culture). The HB_sAg is isolated via a 65-week cycle of purification and safety testing before it is available for use—by far the longest production and testing cycle of any vaccine now being marketed. The first batches of the new vaccine will not be available until mid-1982.

The vaccine is expected to cost between $75 and $120 for a series of three doses. It is not meant for the population at large, but for the roughly 10 million Americans considered at high risk of developing the disease—health care workers, drug addicts, sexually promiscuous individuals, and male homosexuals. FDA says that this targeted use could cut the incidence of hepatitis B in half.

The exceptionally long period of production and safety testing has been undertaken because of fears that a vaccine from human blood might contain viruses or other unwanted materials. This possibility could be eliminated by alternative ways of obtaining HB_sAg. The most promising route was revealed this summer by William J. Rutter and his colleagues at the University of California at San Francisco. They announced in August that they had induced yeast cells to produce a hepatitis viral coat protein, which then assembled with other molecules inside the yeast cell to produce HB_sAg particles. Rutter says that this is the first time that genetic engineering techniques have been used for production of a complex, biochemical structure that probably combines protein, sugar, and fat-like molecules.

Other investigators, including Walter Gilbert of Harvard University, Pierre Tiollais of the Pasteur Institute in Paris, and Kenneth Murray of Biogene Company in Switzerland have also inserted the gene coding for HB_sAg into bacteria such as *Escherichia coli*. The bacteria do not glycosylate (attach sugar molecules to) the proteins, however, and proteins isolated from such preparations are not as immunogenic as those isolated from yeast.

Some investigators, particularly Arie J. Zuckerman of the London School of Hygiene and Tropical Health, have been critical of the use of vaccines prepared from intact HB_sAg particles. Zuckerman argues that host proteins or other cellular components embedded in the particles may themselves be deleterious to the liver or may provoke other unwanted side effects. Zuckerman and his colleagues have developed a new technique that uses detergents to disrupt the HB_sAg particle and affinity chromatography to isolate two proteins, one of which is glycosylated. They reported earlier this year [*Nature (London)* **290**, 51 (1981)] that when the two proteins are recombined in a micellar preparation they are much more immunogenic in mice than are the HB_sAg particles themselves. Zuckerman speculates that his relatively simple technique could be used with HB_sAg particles obtained from humans or by genetic engineering techniques to produce a second-generation hepatitis B vaccine that could be produced more rapidly and cheaply and that would provoke fewer side effects.

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