computer resources to be applied to the collection of data during the normal cruise operations in progress.

The three top scientific priorities built into BML-5 are: obtaining fields and particles measurements five days before and after the Neptune flyby; providing a radio occultation by Neptune for the purpose of measuring the properties of the Neptunian atmosphere; laying a mosaic of images over the large satellite Triton. Although some images of Neptune itself would also be taken, they are not felt to be of as great interest as Triton. One hopes that BML-5 will never be invoked and will simply sleep until it is removed just before the Neptune encounter; but the protection would prove invaluable should the remaining receiver fail, an event with a probability of a few parts out of one hundred.

Also in September, a new computer programme was loaded in the Flight Data Subsystem (one of three types of on-board computers) of Voyager 1 in order to provide for the changing needs of that spacecraft as it recedes further from Earth. In general, lower data-rate options need to be made available since the increasing distance from Earth results in weaker received signals at ground-based antennae.

Work on the Neptune encounter *per se* is moving along rapidly. A change in approach from the Uranus-cruise work plan has started earlier development of Voyager 2 computer loads for the Neptune encounter period (June to October 1989). This plan utilises a lower level of flight team staffing, but for a longer period of time, and constitutes a more efficient application of resources than waiting till later and then rapidly building up the flight team. Of course, some increase in staffing will occur before Neptune, but not with as steep a gradient as for the Uranus encounter.

The Neptune encounter can be subdivided into four phases: Observatory, Far Encounter, Near Encounter, and Post Encounter. To date, the Neptune Observatory Phase has been planned to the level of stringing the desired observations into a time-ordered list: a so-called integrated time line. Observatory Phase features final calibrations of instruments and will also include movies of Neptune, built up from numerous single images, and stroboscopic imaging of the planet to study the evolution of individual features, should they be visible in the atmosphere.

Work is currently in progress on the integrated timeline for the Post Encounter Phase. The other two, more complex phases will be done last.

From time to time we will look in at the Voyager flight team as it continues to prepare for the final planetary encounter of that historic mission.

ICE Spacecraft to Smithsonian Museum

In a ceremony at the Smithsonian Institution's Air and Space Museum in Washington during September, Dr. James Fletcher, the Administrator of NASA, deeded the International Cometary Explorer (ICE) to the museum.

There is one hitch; the spacecraft is still in outer space after having successfully flown through the tail of comet Giacobini-Zinner on September 11 of last year. However, in the year 2014, the ICE spacecraft will return to the vicinity of Earth when, presumably, it can be captured by NASA and placed in the Smithsonian's collection. The National Air and Space Museum has an analogous deeded claim to the Viking 1 Lander on Mars – named the Thomas A. Mutch Memorial Station, after the former NASA Associate Administrator and space scientist who died in 1980 while climbing in the Himalayan mountains. The Museum is charged to retain the Mutch Station plaque, now on display in the main hall, until it can be transported to Mars by American astronauts and affixed to the Lander.

The ceremony of transfer, on the first anniversary of the ICE encounter, served to open a symposium, "Acrobatic Satellites in Deep Space," sponsored by NASA's Goddard Space Flight Center. The symposium took place in the Museum's Albert Einstein Planetarium and addressed the topic of gravity-assist missions, of which ICE is an outstanding example.

Dr. Kathleen Howell, of Purdue University, led off the symposium with the paper "Gymnastic Basics: Understanding Spacecraft Acrobatics." After discussing the fundamentals of the gravity-assist method, she underscored how important the technique has become to the practice of astronautics by listing some of its successes: Mariner 10 to Venus and Mercury, the first interplanetary spacecraft mission to employ a gravity assist; Voyager; Vega, the two Soviet spacecraft that flew past Venus on their way to Halley's comet last year; and, of course, ICE.

Dr. Robert Farquhar, of the Goddard Space Flight Center and Flight Director for the ICE mission, spoke on "The Three Lives of ICE". The first life was its task of monitoring the solar wind at a libration point between Sun and Earth – the task for which it was launched in 1978 as the International Sun Earth Explorer (ISEE-3). The second life was lived as an explorer of the Earth's geomagnetic tail, and, finally, reborn as ICE, it completed the first *in situ* study of a comet. Farquhar hopes that the spacecraft will indeed be able to spend its after life as a resident of the National Air and Space Museum.

Farquhar also provided interesting glimpses into the "selling" of the cometary mission to the scientific community and to NASA. It was first his desire to redirect the spacecraft to Halley's comet, but analysis by Dr. Joel Smith, of JPL showed that the distance would be too great to support an adequate telecommunications link.

As an afterthought, Farquhar proposed Giacobini-Zinner, half the distance from Earth at intercept, and the rest is history. His actual proposal was made prior to working out the details of the complex gravity-assist process to move the spacecraft from the Earth-Moon system to the comet; some anxious moments were encountered before proof of the viability of the mission was in hand.

Your correspondent presented the third paper, "Voyager and the 'Grand Tour.'" Interested readers can consult the November 1986 issue of *Scientific American* for the substance of this presentation.

Dr. Roger Diehl, of JPL, addressed "The Galileo Mission to Jupiter." Some of the contents of this talk are contained above.

Finally, Chauncey Uphoff spoke on "Solar Sailing," a technique complementary to that of the gravity assist. His historical prologue ascribed to Tsiolkovsky, the Soviet pioneer in astronautics, the first advocacy, in 1924, of the use of solar photons to propel spacecraft. Uphoff went on to describe some future applications of solar sailing, including The World Space Foundation's solar sail project.