

include objects in different stages of evolution." (Halley is considered a much "fresher" comet, having made fewer trips around the sun.)

It would be possible to accomplish many of the dual mission's objectives with two separately launched spacecraft, said Cornell's Joseph Veverka, who headed the NASA Comet Science Working Group, but "there is no justifiable reason for choosing such an approach. It offers no technical or scientific advantage. It does delay the expenditure of \$15 million in FY 1981 funds [a revision of NASA's \$20 million request], but ... we will have escalated the cost of carrying out the desired comet exploration program by at least \$250 million." Existing approximate figures suggest that about \$200 million of this would be for the second spacecraft, \$40 million for its launching by the shuttle and \$10 million for an additional upper-stage booster engine.

It is quite possible, Cameron and Vever-

ka both believe, that NASA could start the development of SEPS with less than its initial \$20 million request. A still more constraining option open to Congress would be to approve a budget bill giving NASA the option of reprogramming some of its existing funds — if it could spare any. Next week, similar issues are likely to re-emerge at a hearing on the Senate side.

The dual-comet mission, however, may face other problems as well. On the flight past Halley, the spacecraft is to jettison a probe that would go all the way to Halley's nucleus, but some sources are now worried that the European Space Agency, which was to have built the probe, may be about to back out of the deal in the face of the overall mission uncertainty. More recently, on the other hand, there have been signs that an individual European country may take on the job. But even if SEPS and the probe survive, NASA will next year have to battle for funds for the main mission spacecraft itself. □

## The space race in manufacturing

The Space Race once referred to the competition for getting something — anything — from the earth into orbit around it. It meant sending animals, then humans, then being first to the moon, and more recently it has covered orbiting weapons and the scientific prizes of planetary space probes. Already underway, however, are the preliminary heats of a race for yet another prize: the economic, technological and political gains from manufacturing in space. Whether the ultimate goals be space colonies, solar power satellites, better microcircuits or medical advances, the contestants are on their way. But the Comptroller General of the United States has just warned, in a report to the Senate Subcommittee on Science, Technology and Space, that America is already starting to look a bit winded.

After consulting "nearly 100 scientists, program managers, economists, industrialists and government officials ... in this country and in Europe," the report concludes that "only limited success can be expected in the next 20 years due to low funding and limited backing by the Admin-

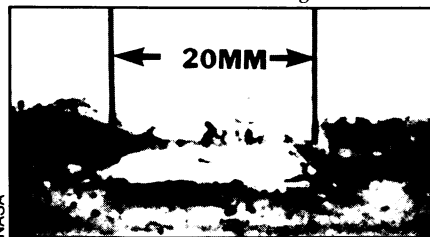
istration and the Congress."

The report identifies four central problem areas:

- A need for greater U.S. industry participation, currently hobbled by such issues as government restrictions on the use of government-held patents.
- Technology transfer to the private sector, for which present programs must be revamped to emphasize commercial potential.
- Basic research in materials science, which will require greater government investment if industry is later to consider high, long-term investment. "Current funding levels," says the report, "assure very slow progress."
- International cooperation. "The U.S.' conservative approach does not compare favorably to the specific, long-term plans of ... the European Space Agency ... nor to the plans of the Soviet Union and Japan."

"Whether the United States is to maintain its world leadership role in materials science as well as other areas of space development depends largely upon events of the next 15 to 20 years," the document notes. "The opportunity to be the world leader in space is still available if we choose to exercise this option." □

*Future space products could include large semiconductors such as the GeS crystal (below), made on Skylab, compared to earth-bound versions one-eighth its size.*



## Nuclear waste policy unveiled by Carter

Admitting that "past governmental efforts to manage radioactive wastes have not been technically adequate," President Jimmy Carter outlined for Congress on Tuesday Feb. 12 his plans for the nation's first "comprehensive" radioactive-waste management program. Born out of recommendations by a 14-agency federal review group (SN: 3/24/79, p. 183), the plan seeks generic solutions for the permanent disposal of all types of wastes from all types of sources. A draft of the plan detailing specific goals, research programs and timetables should be available for public and congressional review by year's end.

Among the more controversial aspects of the Carter proposal is termination of WIPP — the Waste Isolation Pilot Plant (SN: 7/21/79, p. 47) that was to have housed high-level radioactive transuranic wastes generated by the Defense Department. Though WIPP's underground salt caverns in Carlsbad, N.M., may provide adequate safety, its military role would have made it exempt from licensing requirements set by the Nuclear Regulatory Commission — something the President says runs counter to his policy. The Carlsbad site will remain a candidate, however, along with 10 or more others as a possible dump for high-level commercial wastes.

And in an attempt to stem growing local opposition to proposed waste sites, Carter has established a State Planning Council. It will permit local input on siting, licensing and management issues via a 14-member advisory panel to Congress and the Executive Department. □

## Benzyl esters as a desickling drug

The crisis in sickle cell anemia arises when a person's abnormal hemoglobin molecules take on a sickled shape after giving up oxygen to tissues. As a result, the red blood cells housing the hemoglobin molecules become sickled as well and clog blood vessels, causing excruciating pain and tissue damage. There are several tactics one can take to prevent such crises: Keep hemoglobin molecules from sickling, keep red blood cells from sickling, or both. The problem is to find an antisickling drug, particularly one that attacks at the molecular level, which has minimal toxicity for the rest of the body and which is easy and inexpensive to give. Now a class of compounds called benzyl esters of amino acids looks as if it might fulfill these requirements at least on the basis of test-tube and animal studies.

In 1977, Alexander Rich of Massachusetts Institute of Technology in Cambridge, Mass., and his colleagues