to the art of medicine, not science," Gale remarks. "We took all the bits of data and gave them weights based on our personal impression."

The physicians ended up performing 19 bone-marrow transplants, six of which were fetal liver transplants. All of those who received fetal liver transplants have died because they were so severely burned by the radiation. "We would have expected one to two to survive at best if they were average patients," Gale says. Because they died of the effects of the radiation, "we can't evaluate the success of the transplants."

Of the remaining 13 transplant patients, five are still alive and are now out of immediate danger. The Soviet physicians, who had done only about 20 bone-marrow transplants in all of Russia before the Chernobyl accident, got an education in the latest techniques for this procedure. For example, they had had no experience giving the antirejection drug cyclosporine intravenously, yet this drug of choice for bone-marrow transplant patients cannot be given orally because, says Gale, "you can't be sure of absorption in irradiated patients. Our mission was not only to do but to teach."

Gale plans to return to the Soviet Union on 20 July to continue following the Chernobyl victims. There can be major complications 3 months after a transplant, he notes.

For the future, Gale wants very much to see an international scientific effort to follow the 100,000 to 200,000 Soviets who received 15 to 30 times the background level of radiation when the radioactive plume from Chernobyl passed over Kiev. It is impossible to estimate the likelihood of cancer or birth defects in this population, he says. Moreover, he continues, "the actual danger to any individual is small and if an individual gets cancer, they can't know if it was caused by radiation or other factors."

"One of our jobs is to reassure," says Gale. "We don't want to cause more harm than Chernobyl. We don't want 100,000 people to live their lives in fear of cancer. Yet we want to follow them medically."

Gale signed an agreement with the Soviets committing both countries to cooperating in the long-term follow-up of this population. "Now we are focusing on what we can provide," he says. "We are calling on advice from radiation specialists and specialists in cancer, genetic disorders, and birth defects. There is a lot to be said for cooperation. And we lend an air of credibility to Soviet publications."

So the consequences of Chernobyl remain to be determined. But there is at least the hope that some scientific knowledge may be gained from all the suffering. ■

GINA KOLATA

Briefing:

NASA Terminates Centaur Development

Citing continued concern about flight safety in the space shuttle program, James C. Fletcher, administrator of the National Aeronautics and Space Administration (NASA), has terminated development of the Centaur upper stage for use aboard the shuttle. The Galileo mission to Jupiter and the Ulysses mission to the polar regions of the sun, both of which had been scheduled to be launched using the Centaur, may now be delayed into the 1990's. They were already facing at least a 2-year delay because of the Challenger explosion last January. Also affected are a number of classified Air Force payloads that depended on the Centaur.

Fletcher's decision came on 19 June, and was not unexpected. The Centaur being developed for the shuttle was a modified version of a booster that has long been used as an upper stage for conventional Atlas and Titan rockets. Its advantage was power: starting from the shuttle payload bay it could place a spacecraft on a trajectory to giant outer planets such as Jupiter and Saturn, or to a rendezvous with a fast-moving comet. The Centaur's disadvantage was the way it produced that power: its liquid hydrogen/liquid oxygen fuel made it an exceedingly hazardous and complex cargo. Because of the possibility of a launch abort, for example, the shuttle had to be equipped with emergency vents so that the Centaur's fuel could be dumped—in mid-air—before the pilot attempted a landing.

After 4 years of development and some $700 million of investment, NASA engineers were still struggling to make this system work in an acceptably safe manner. The agency intensified its safety reviews of the project in the wake of the Challenger disaster, and an independent study was carried out by the House appropriations subcommittee on HUD-independent agencies under Representative Edward P. Boland (D–MA). On 19 June, when it had become clear that the Centaur was not going to meet the safety criteria being applied to the rest of the shuttle system, Fletcher ordered the effort terminated.

Rear Admiral Richard H. Truly, head of the shuttle program, is in charge of NASA's efforts to find alternative ways to launch Galileo, Ulysses, and the other Centaur-dependent payloads. One alternative would be to launch the spacecraft on the shuttle as planned, but with the Centaur replaced by a less powerful solid-fueled booster such as the Air Force's Inertial Upper Stage. The flights could then take place as early as 1989. However, Galileo would then require some 4½ years to get to Jupiter, versus 2½ years with Centaur. Furthermore, the shuttle/Intertial Upper Stage combination offers very little capacity for doing planetary missions beyond Galileo and Ulysses.

The other major alternative is to use the shuttle-modified Centaurs as upper stages on the heavy-lift Titan 34D7's being developed for the Air Force. Such a Titan launch would technically be possible by 1990. Moreover, the Titan/Centaur combination seems adequate for doing all the planetary missions that NASA is currently considering. On the other hand, the new Titans will cost in the neighborhood of $150 million to $200 million apiece, not counting any modifications required for the Centaurs and the spacecraft themselves. At this point, however, agency officials say that they can do no more than guess at what any of the alternatives will cost. ■

M. MITCHELL WALDROP

House Appropriations Committee Kind to Physics

The Department of Energy's proposed 1987 budget for high-energy and nuclear physics has emerged from the House Appropriations Committee almost unscathed. Just a few months ago it seemed that the operations of upgraded accelerators at Fermi National Accelerator Laboratory and the Stanford Linear Accelerator Laboratory (SLAC) might be delayed because of budget restraints imposed by Congress. Both facilities require significant increases in funding to cover higher operating costs associated with the revamped particle colliders.

The Appropriations Committee approved a $213.4-million operating budget for physics facilities, exactly what the Administration requested. Physics research, at $111.6 million is up only $5.3 million, $7 million less than the department request. DOE officials say university-based research and international collaborations may be pinched as a result.

The committee also stripped away $20 million that DOE had identified as potentially available in 1987 for research on the Superconducting Super Collider if a decision is made to start constructing the facility in 1988. Stating that it was "concerned by the lack of commitment by the Administration," the committee directed DOE to submit a separate appropriations request for 1987 should it decide to go forward on the