they were used. Canaries are no longer employed to monitor the air in mines; rabbits (and later frogs) are no longer needed to discover pregnancy. As Donald Kennedy, former FDA head, said recently, "compared with most other contemporary biological techniques, animal testing is crude, cumbersome and expensive." But there is still nothing like an animal. To eliminate animals in testing, claims Hansch, "you would have to totally understand life in all its detail."

The extent to which the animal welfare movement is hastening the development of alternative methods is not clear. Certainly, the movement can claim responsibility for the new initiatives aimed at replacing the Draize test. But otherwise, it is far less of an influence than economic or scientific imperatives.

The movement is unquestionably affecting how many scientists view their work. Some see this as consciousness-raising for scientists who work with animals—just as physicists developed a new awareness about the implications of their work after the bomb, and more recently clinicians developed a new sensitivity toward the rights of human subjects. What frightens some scientists is that the current movement is gaining added force from America's streak of anti-intellectualism, which lends a flavor to the extreme wing of the animal rights movement reminiscent of right-to-life and creationist zealotry.

Leaving out the extremists on both sides of the question, scientists and animal welfare people do not appear to be much in conflict. Franklin M. Loew of Johns Hopkins University, head of the NAS laboratory animal group, believes there is really only a difference in priorities: the animal people see reduction of animal use as a desirable goal in itself; while to scientists, the goal is secondary to that of doing good science. There is greater disagreement over means, with one group pressing for more money while the other contends that development of alternatives is progressing as fast as the science will allow.

There are few who believe that all animals can some day be eliminated from research. In many areas, including disease modeling, experimental surgery, and many behavioral studies, the only substitute for an animal would be a human being. Otherwise it is difficult to predict the future since both the science and the ethics are in flux. Says William Raub of NIH: "There is the possibility that 10 years from now our current views of the ethics and morality of research will be labeled as being biologically naïve."—CONSTANCE HOLDEN

Small Business R & D Bill Approved 90 to 0

A bill designed to channel almost 1 percent of the federal government's R & D budget into a new program to spur innovation by small businesses swept through the Senate last month by a vote of 90 to 0. The bill's chief sponsor, freshman Senator Warren Rudman (R–N.H.), is understandably pleased with his first legislative triumph. But he says he is so disturbed by the "avarice" displayed by university officials in opposing some aspects of the bill that he is planning an investigation of the way basic research is funded.

Undaunted, critics of the legislation, who argue that it will divert funds from basic to applied research at a time when basic research budgets are already under stress (*Science*, 27 November, p. 1003), are planning a major lobbying effort in the House. Although a similar bill, sponsored by Representative John J. LaFalce (D–N.Y.), has been approved unanimously by the House Committee on Small Business, there is still time for opponents to get a hearing. Three other committees—Armed Services, Energy and Commerce, and Science and Technology—have been granted jurisdiction and they have until 1 March to propose amendments. This will be the first time that committees directly concerned with science budgets have had a chance to consider the impact of the legislation.

Although the Rudman and LaFalce bills differ in some important respects, they would both require federal research agencies to set aside a portion of their R & D funds for so-called Small Business Innovation Research (SBIR) programs. The focus of the lobbying effort, which is being spearheaded by the Association of American Universities (AAU), will be to exempt basic research budgets from this proposed set-aside. Another objective will be to secure an exemption for the National Institutes of Health (NIH).

The argument is that since the SBIR programs will involve mostly applied research and development, the money should not be taken from support of academic science. But the bills' sponsors do not agree. Rudman, for example, argues that "if basic research gets its exemption, it will give bureaucrats a chance to emasculate the bill." They would simply classify an unwarranted fraction of their programs as basic research, he says. Moreover, the universities have benefited from "the grandest set-aside of all," Rudman claims, because until recently businesses have been excluded from competing for NIH grants.

In any case, Rudman argues that basic research is sufficiently protected by an amendment, proposed by Senator Harrison Schmitt (R–N.M.), which was included in the Senate bill. It simply states that basic research funds cannot be reduced by more than 1 percent to pay for SBIR programs.

Lobbyists for the universities are not appeased by the amendment, however. "It doesn't stop the highway robbery, but it limits the damage," says Newton Cattell of the AAU. Support for a total exemption for basic research has also come from one of the legislation's most prominent backers, the Federation of American Scientists (FAS).

Testimony by a former FAS official, Philip Speser, in support of both the Rudman and LaFalce bills has been widely publicized by the bills' backers as evidence of approval by the scientific community. But in a statement issued on the eve of Senate passage of the legislation, FAS executive director Jeremy Stone urged that basic research funds be exempted. "It would be an ironic and counterproductive effect of the bill if it were to encourage innovation in small businesses only at the cost of depleting the new ideas which small businesses might apply," he argues. Stone explains the FAS's apparent change of mind by asserting that he had always assumed that the money for SBIR programs would come from applied research and development budgets.

In the meantime, Rudman, a man who does not mince his words, says he is disgusted with the university lobbyists, who he says are simply out to protect their turf. "I have encountered greed and avarice from the basic research community that I would have expected from the oil companies," he told *Science* in an interview. "The ivory towers are getting gray in my opinion," he said. Suggesting that "there is an old boy network in the basic research community" that influ-

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ences the way research is funded, Rudman said that he will conduct an investigation of the way research support is parceled out. It may be no idle threat, for Rudman is a member of the appropriations subcommittee that handles NIH's budget.

–Colin Norman

A Reprieve for Planetary Science

NASA's planetary exploration program may not be grounded after all. The White House's Office of Management and Budget, which recently told the space agency to drop the program (*Science*, 18 December, p. 1322), has given NASA verbal permission to include funds for the Galileo orbiter/probe mission to Jupiter in its fiscal year 1983 budget proposal.

The OMB's change of heart came after NASA officials lobbied intensively on behalf of the planetary program. Planetary scientists had warned that cancellation of Galileo, the only American deep space mission currently under development, would mean the dispersal of engineering and science teams and perhaps the closing of NASA's Jet Propulsion Laboratory, which manages most of the planetary missions.

There appears to be little likelihood, however, that NASA will be able to fly the Venus Orbiting Imaging Radar, which had been scheduled for a new start in 1984. Because of the imminent peril to Galileo, the agency was unwilling to fight for VOIR at this time.

Prospects for Galileo are still clouded by questions about how the spacecraft will get to Jupiter. The space shuttle will only be able to carry the spacecraft into low earth orbit. An upper stage of some kind will be needed to launch it into a trajectory toward Jupiter.

According to current plans, that upper stage will be General Dynamics' liquid-fueled Centaur rocket, modified slightly to fit into the shuttle bay. At this writing, however, the OMB plans to cancel NASA's Centaur program. If so, it would come as a disappointment to the Air Force, which finds the Centaur upper stage so worthwhile for its own purposes that it is willing to help NASA pay for the program.

If the Centaur *is* canceled, Galileo will have to be launched with the already developed Inertial Upper Stage, a solid-fuel device with considerably less thrust. This in turn implies a lower launch velocity and a longer transit time. Assuming a launch date of 1985, the spacecraft's arrival at Jupiter would thus be delayed from 1987 until 1989. According to one NASA estimate, the extra cost of ground operations during that delay would amount to some $300 million (on top of Galileo's present cost of about $700 million). The cost of modifying the Centaur and adapting the shuttle to carry it is estimated at about $450 million; NASA officials point out, however, that the Centaur would then be available for any number of military, commercial, and scientific missions.***—M. Mitchell Waldrop***

Keyworth Says Cuts May Be Good for Science

A period of stringency in federal support for science and technology is not only inevitable but it may actually be beneficial, George A. Keyworth, President Reagan's science adviser, told the House Committee on Science and Technology on 10 December. "My own experience leads me to believe that the best overall quality of research may not occur in times of accelerating support but in times of moderate restraint," he told the committee.

Keyworth's message was hard to miss, it was stated so bluntly and repeated so often in his testimony. With the exception of defense R & D, science budgets are in for a tough time. But if cuts are applied selectively, with the axe falling on areas that "have passed the days of their most important and exciting work," the quality of American research can be maintained. Indeed, said Keyworth, "just as the occasional pruning of a tree can promote, rather than retard, its health," so the pruning of research budgets can benefit science. He did not propose any candidates for the shears, however, nor did he suggest how to identify areas of research that have passed their prime.

It is not the first time that Keyworth has sounded this theme, but it is given added urgency by the fact that the fiscal year (FY) 1983 budget is now being finalized. With record deficits being forecast, even by some of Reagan's own advisers, the Administration is looking for deep cuts in many domestic programs. Research and development has already been pruned in FY 1982—though not as severely as many other areas of the federal budget—and it will clearly be cut back again next year.

"To those who may still hope for constantly growing budgets across the board, let me say this—that time has passed and we need the scientific community's best and most thoughtful judgment and advice to maintain the health of our science and technology base," Keyworth said. "To those who object to such undertakings . . . I must say that if scientists do not make such choices, others will, but with less acuity."

As for science and engineering education, Keyworth acknowledged that there is a serious shortage of qualified people in some fields and that the universities are facing difficulties in recruiting and retaining faculty members in some disciplines. But this situation, he said "is primarily one of the marketplace working as it should, and does not require a massive Federal response." Part of the solution, he argued, will come from increased support for higher education from the private sector. "This is a problem that can and must be worked out by those who supply scientific and engineering manpower and those who utilize it," he said.

The quality of facilities and instruments in universities is another area that Keyworth acknowledged presents serious problems. According to one estimate, $1 billion may be required to upgrade facilities to a reasonable level. But again, Keyworth made it clear that the federal government should not be regarded as the source of such funds. "I believe that the communities themselves, working with their supporting agencies, must decide which of their needs are most important and how best those needs can be met," he said. For example, a university may have to decide whether its need for new equipment is important enough to justify an offsetting reduction in some other category of support, he warned.

—Colin Norman