scientists, be the planned growth over a reasonably short period of the NSF budget to a billion dollars. The billion dollar figure, which would mean a doubling of the present NSF funds for academic research and graduate education, might alleviate the crisis that is threatening the careers of many scientists, particularly younger ones, and might in fact salvage the prevailing federal support system.

But the talk of new machinery and more money diverts attention from what Ezrahi calls the "cultural and institutional crisis" afflicting science. The relationship between government and the university is obviously the key issue. The scientists who negotiated the original postwar arrangement with the government sought to ensure the independence of the university. The confrontations of the 1960's shattered the idea of the campus as a cloister. However overheated the rhetoric and extreme the current readiness to use science as an all-purpose scapegoat, it is nevertheless evident that many students and young scientists believe that universities played Faust to the federal Mephistopheles.

That the relationship between government and the universities is changing has been evidenced in recent years by the altered behavior of university scientists commenting on public issues in Washington and elsewhere. In the past, scientists tended to serve as technical experts, but in recent years an increasing number have acted as critics, often quite antagonistic critics, of government policy. Their impact has been particularly pronounced on environmental issues and in the recent debates on the ABM.

Science policy until recently meant a somewhat parochial analysis of institutions, programs and funding, and discussion of who in science should get how much. Science policy, however, is no longer something that can be settled by the scientific community's ambassadors to Washington. What will really count more is not changes in science policy machinery but change in the universities.—JOHN WALSH

Last weekend, the report of the President's Task Force on Science and Technology, chaired by TRW president Ruben F. Mettler, was released by the White House. Copies of the report were not available at the time of the Science *deadline. The report* Science and Technology: Tools for Progress *is likely to further stimulate the present discussion on science policy.*

Contraceptive Technology: Advances Needed in Fundamental Research

A decade ago, birth-control technology leaped forward with the development of the oral steroid pill and the plastic intrauterine device (IUD). The pill and the IUD gave rise to hopes among some population specialists that the search for an ideal means of contraception might be drawing to a successful conclusion. But this was not to be. Today the search continues, and both basic and applied research in the fields of reproductive biology and contraception and abortion are receiving increasing support from the federal government and leading foundations.

Concern about the "population explosion" in the less-developed countries has caused Congress to earmark substantial foreign aid funds for birth-control programs. And, although neither the Administration nor Congress has yet pressed the Department of Health, Education, and Welfare to mount a maximum effort in contraceptive research, HEW's program in this field is expanding and soon may become somewhat more "product oriented" than it has been in the past.

Furthermore, "zero population growth" is now being advocated as a goal for the United States by environmentalists, a number of members of Congress, and even some high-ranking Nixon Administration officials such as HEW Secretary Robert H. Finch and Science Advisor Lee DuBridge. While an effort to attain such a goal would pose complex questions of motivation and possibly require major changes in life styles, the development of better and simpler contraceptive methods is a part of the problem. In the short run, the budgetary stringencies now affecting nearly all federal agencies may impede growth of support for contraceptive research, but, in the longer term, the prospects seem bright.

The "ideal contraceptive," as defined by specialists such as Philip A. Corfman, director of the Center for Population Research at the National Institutes of Health, is one that would be effective, safe, inexpensive, reversible, easy to use, and acceptable to a diversity of people and cultural groups. This ideal is far from being attained, and the prevailing view is that development of a contraceptive meeting all of these criteria is unlikely.

The problems involved in the use of the pill and the IUD have been pointed up by events in the United States and overseas. The health risks and side effects associated with the pill were widely publicized at the hearings conducted early this year by a Senate subcommittee chaired by Senator Gaylord Nelson of Wisconsin. And, even though it appears that a woman using the pill takes far less risk than one who undergoes pregnancy and childbirth (especially in the less-developed countries), there has been considerable official and unofficial resistance to the use of oral contraceptives in the family-planning programs of India and a number of other nations. The IUD has been officially promoted in countries such as Taiwan, South Korea, India, and Pakistan, but many women who accepted IUD's initially no longer use this contraceptive method, frequently because of side effects which, while not dangerous, are annoying.

In fiscal 1969 funds from United States sources totaling $45.5 million were committed to contraceptive research and development, with $19.9 million provided by federal agencies, $8.4 million by voluntary agencies (chiefly the Ford and Rockefeller foundations and the Population Council), and $17.2 million by the drug industry. In addition, $5.4 million was committed to research on the side effects caused by contraceptives. Most of the basic

research in contraceptive biology was, and is, done in university-based laboratories and clinics in the United States and abroad.

The federal government has only recently become the leading source of support for contraceptive research and development. As late as 3 years ago the National Institutes of Health and the Agency for International Development (AID), the agencies principally involved in contraceptive research, were providing relatively little support and the foundations and the drug industry were the mainstays of work in this field. Among foreign nations, Sweden has been a leader in supporting such work. The Swedish government is now reported to be considering plans for a foundation to be known as ACORD (Agency for Contraceptive Research and Development). It would have a 5-year budget of $15 million to be funded by Sweden's International Development Authority, the overseas assistance agencies of other countries, and private foundations.

Basic Science Is Weak

Oscar Harkavy, director of the Ford Foundation's population program, and John Maier, associate director for medicine at the Rockefeller Foundation, recently analyzed the present state and future needs of research in reproductive biology and contraceptive technology. Their views, developed jointly for an international conference, probably represent the thinking of most contraceptive researchers. They regard the "basic science infrastructure of reproductive biology [as] surprisingly weak" and believe that no technological breakthrough in contraception comparable to that which has occurred in food production is imminent. In their view, increased research efforts, much larger than those currently under way, should proceed simultaneously in reproductive biology and contraceptive technology. "Much is known about the complicated series of events leading to reproduction, but there are great gaps in our knowledge in many areas, and the unknowns loom larger than the knowns," they said.

Biologists are not yet sure how the IUD achieves its contraceptive effect and their understanding of the hormonal relationships controlling the menstrual cycle—the process with which the oral steroid pill interferes—is far from complete. The pills presently in use upset the entire hormonal system in addition to stopping ovulation. Their contraceptive action has been compared by Harkavy and Maier to "using a sledgehammer to kill a mosquito," although some specialists in contraceptive research would regard such a comparison as overdrawn.

In supporting research in reproductive biology, agencies such as the Ford Foundation and the Center for Population Research seek to identify ways to achieve contraception without drastic intervention in other bodily processes. The following observation by Harkavy and Anna Southam (also of the Ford Foundation) offers an insight into a major part of the current research strategy:

> The female reproductive system includes an "upper" hormone feedback circuit, consisting of the central nervous system, the pituitary, and the ovary, controlling a "lower" system involving the Fallopian tubes, uterus, and cervix. Most of the research activity by high-prestige investigators is directed toward understanding the central nervous system–pituitary–ovary circuit. However, most of the potentially interesting new methods of fertility control are directed toward the "lower" system, since interference with natural processes at this level represents a less drastic intervention in bodily functions than intervention at the higher levels. The present generation of contraceptive pills interferes with the central nervous system–pituitary–ovary circuit and is theoretically less desirable than, for example, a method which selectively affects one or more lower circuit links without significant systemic effect.

Short- and long-term approaches to improvement in contraceptive methods were recommended in a report prepared last October by a Committee on Population Research chaired by HEW Assistant Secretary Roger O. Egeberg (for scientific affairs). The Egeberg committee was made up of the principal federal and foundation officials concerned with contraceptive development. Its report, which is still under review and has not yet been made public, can be taken as indicative of prevailing opinion in this field. Short-term approaches are defined in the report as those having to do with contraceptive methods which are near the development stage and which, with three or four more years of work, can be proved feasible.

One example of such a method is use of the "minipill," which provides small doses of progestogen each day as an alternative to conventional steroid pills containing both progestogen and estrogen analogs. The minipill does not inhibit ovulation in most users and it may be safer, if somewhat less effective, than conventional pills. However, the Syntex Corporation recently gave up further testing of its particular formulation of low-dose progestin after finding, in the toxicological studies required by the Food and Drug Administration, that breast tumors began to appear in the beagles used as test animals. Extended clinical testing will be necessary to establish the safety and value of the minipill. Another method of administering low-dose progestin that is being explored is the use of injections or implants under the skin.

Other short-term approaches include efforts to perfect easier and better methods of sterilization; to inhibit sperm function by administering low doses of steroids to males; to increase the effectiveness of the rhythm method by developing a simple and accurate way to predict the time of ovulation; and to improve the IUD, of which there are already at least 50 configurations (AID has given $1.5 million to the Pathfinder Fund over the last 3 years for evaluation and development of IUD's; this year Battelle Northwest will receive $645,000 from AID for IUD development).

Long-term approaches to contraceptive development are those looking to new methods that require much more fundamental research before development can proceed. The "once-a-month" pill or injection, to be used by a woman to induce menstruation, is attractive to family-planning specialists in that they believe that women would have no difficulty remembering to take the drug and would be pleased to have their menstrual cycle follow a more regular schedule.

The Once-a-Month Pill

The Center for Population Research (CPR) at NIH and AID's Office of Population are supporting research on the prostaglandin compounds in the hope that a once-a-month pill can be developed. It has been found in experimentation with animals that the prostaglandins produce degeneration in the corpus luteum, the progesterone-producing structure which forms on the ovary shortly after fertilization. In a number of animals, and possibly in man, the corpus luteum is essential to maintaining early pregnancy. The research advisory committee at AID recently recommended approval of a $3-million contract research project proposed by the Worcester Foundation, which would use most of this money for an intensive exploration of the potential of the prostaglandin compounds.

Last year, AID transferred $1.5 million to the Center for Population Re-

search to be spent on research relating to the corpus luteum. AID also has given $3 million to the Population Council for research on a once-a-month hormonal contraceptive method. R. T. Ravenholt, director of AID's Office of Population, and his chief of research, J. J. Speidel, regard recent reports of prostaglandins having been used successfully (by intravenous injection) to terminate pregnancies as encouraging evidence that these compounds may ultimately offer something approaching an "ideal" means of fertility control.

Another long-term approach to contraception regarded as promising is through research on "releasing-factor inhibitors." Releasing factors are hormones produced by the hypothalamus, a part of the brain, and these control the secretion of the anterior pituitary hormones, including those responsible for ovulation and development of the corpus luteum. AID's Office of Population is now moving toward a $2.3-million contract award to the Salk Institute for research on the chemical structure of the gonadotropin-releasing factors.

Once the chemical makeup of these releasing factors has been determined, it will be possible to try to synthesize chemicals which will inhibit their activity and thus prevent conception or possibly disrupt early pregnancy. Office of Population officials believe that these chemicals could be administered orally once a month and hope that they would cause few of the systemic side effects of the present oral contraceptives. The principal investigator on this project would be Roger Guillemin, a specialist in neuroendocrinology, who has done important pioneering work on releasing factors. Guillemin is now a professor at Baylor College of Medicine but in June he will be going to the Salk Institute, accompanied by several senior members of his present staff. The Salk Institute's program in reproductive biology also is receiving substantial support from the Ford Foundation.

The draft report of Assistant Secretary Egeberg's advisory committee recommends that financial support for contraceptive research—$45.5 million from all U.S. sources in fiscal 1969—be increased nearly fourfold by the end of calendar 1974, which even then would not approach the current level of support for cancer research. A doubling of support to almost $90 million is recommended for calendar 1970.

At the present pace, the 1974 goal, which when viewed in the context of all medical research and health care needs may reflect a bit of special pleading by the population specialists, will not be met even though agency contraceptive research budgets are growing substantially. Carl S. Shultz, director of HEW's Office of Population and Family Planning, estimates that the actual commitment in 1970 will be somewhere between $55 million and $60 million, although here some $7 million for research on the side effects of contraceptives is included.

In fiscal 1970, the commitments of AID's Office of Population and NIH's Center for Population Research to contraceptive research will total about $7.5 million and $9.4 million, respectively. AID's population program has been an expanding enterprise within a shrinking agency (the foreign aid budget declined from $2.6 billion in fiscal 1961 to $1.4 billion in 1970), in part because such lobbyists as General William H. Draper, Jr., of the Population Crisis Committee have been highly persuasive with Congress. Congress earmarked $75 million for AID's population program for 1970 and probably will earmark $100 million for 1971. The agency expects to continue spending about 10 percent of its population funds for biomedical research.

The CPR program now has a high priority in NIH, but some people in

House Bill Hits Campus Unrest

The House Armed Services Committee has come up with its own definition of "academic freedom," which includes the absence of student disruptions. It has announced that it does not want any more research funds from the Defense Department granted to schools at which "academic freedom is not permitted."

The military authorization bill for 1971 contains a provision that signalizes the committee's concern. Section 402 bars Defense research funds from schools at which recruiting personnel for the armed services are barred or hampered, unless the funds are a renewal of a project that makes a "significant contribution" to defense.

The bill was passed by the House last week, with this provision slipping by almost unnoticed in the heat of the debate about Cambodia. Now the bill goes to the Senate, which is still holding hearings on the subject but which in the past has resisted such provisions.

According to the House committee's chief counsel, the committee intends to be sterner than the provision would indicate. In its report, the committee declared that it will require a listing by the Defense Department of all research funds granted to institutions where student disruptions have taken place and that, next year, it will consider restrictive legislation unless the Secretary of Defense can implement a procedure to deny funds to those campuses.

The committee is particularly concerned with those institutions "where administrators have condoned, and in some cases approved, heckling, interruptions of lectures, picketing, and other forms of disruption, violent or nonviolent."

The committee justified the denial of funds to these colleges on the grounds that complete academic freedom must be maintained. "Research in our colleges and universities must be allowed to proceed under an absolute assurance of complete academic freedom. . . . In this connection, 'complete academic freedom' means the freedom to present both the pros and cons of any issue without disruption by the proponents or opponents."

The Pentagon has not yet received a request to compile a list like the one mentioned. According to a Pentagon spokesman, about 680 grants for scientific research were given to schools and nonprofit institutions in 1969 by the Defense Department. These grants totaled $24.7 million.

There have been previous attempts in the House to include restrictive provisions such as this one in bills; these provisions have usually been opposed by the Administration and cut out by the Senate. Opponents in the House are relying on the Senate in this instance, as in previous ones, to moderate the bill, and they are hoping the provision will at least come up for full debate later this spring.—NANCY GRUCHOW

Congress and within CPR itself believe that its growth would be faster if it were not a new program competing within a tight NIH budget with older and better established medical research programs. Next year the CPR budget, if approved by Congress, will provide $16.4 million for contraceptive research, which, while representing an increase of nearly 60 percent from the current year, is not the kind of money Egeberg's advisers were talking about.

Senator Joseph D. Tydings (D–Md.) has introduced a bill to establish a national agency for population and family planning which would be outside of NIH and on the same level with it in HEW's hierarchy of health agencies. This measure, still in committee, has been opposed by the Nixon Administration, partly on the grounds that creating the proposed center would tend to separate contraceptive research from related research carried on or supported by NIH. Another objection cited is that the center would put contraceptive research under the same administrative roof with family-planning services, functions which HEW officials say should be kept separate. The existing Center for Population Research is part of NIH's Institute for Child Health and Human Development.

Shultz says that present trends point toward ultimately establishing an institute for population research within NIH. The Egeberg committee has recommended that such an institute be created within the next 2 years. Shultz says, however, that the establishment of such an institute now, when the CPR program is still relatively small, could lead to an unfortunate diversion of funds from research to the requirements of administrative overhead. This argument for delay in uplifting the program in the administrative hierarchy is questioned by some CPR people.

Important questions of research management can be considered apart from the type of administrative structure provided for the contraceptive research program. The general view appears to be that NIH should take a more "directed" or product-oriented approach and that this will in fact be encouraged by two new administrators who are soon to take office. One of these is Louis M. Hellman, until recently chairman of the department of obstetrics and gynecology at the State University of New York Downstate Medical Center; he will become Deputy Assistant Secretary of HEW for Population Affairs under Egeberg. The other is Eugenia Rosemberg, now chief of the Medical Research Institute at Worcester City Hospital who will become chief of the CPR contraceptive development branch under Corfman.

Hellman also is expected to try to strengthen the "lead agency" role for which the CPR was designated by President Johnson when this agency was established in 1968. One question likely to generate controversy will be concerned with the size of certain contracts awarded by the AID Office of Population Research. Several of these are larger than some scientists at HEW think can be justified. In their view, not enough is known yet about the matters under investigation to warrant large-scale programs of directed research.

Insofar as the complete development of marketable contraceptives is concerned, a major issue has been raised by Carl Djerassi, professor of chemistry at Stanford and president of Syntex Research (*Science*, 24 October 1969). Djerassi is concerned that the high cost of the toxicological studies required by the FDA for new contraceptive drugs will discourage pharmaceutical companies from developing such drugs. He has proposed that such studies be financed by the government, with the pharmaceutical company agreeing to repay the government through royalties if the drug should be sold commercially.

Much could be done to improve family planning and to lower birth rates if more people were more strongly motivated to use existing contraceptive technology. But many who are committed to contraceptive research believe that, while neither approach should be neglected, it is easier to change technology than motivation. This idea is at the heart of what seems a compelling argument in favor of the government's pressing harder for major new advances in this still underdeveloped field of biomedical research.

—LUTHER J. CARTER

RECENT DEATHS

Nicholas M. Alter, 77; retired pathologist, Johns Hopkins Hospital, Baltimore, Md.; 21 March.

Henry H. Baker, Jr., 63; professor of chemistry, U.S. Naval Academy; 19 March.

Seligman B. Bamberger, 74; retired vice president of the Delaware Chemical Company; 6 April.

Arlie R. Barnes, 77; retired chairman, board of governors, Mayo Clinic and former president, American Heart Association; 24 March.

Joseph T. Beardwood, 74; professor emeritus of medicine, University of Pennsylvania; 14 April.

Ralph E. Campbell, 72; professor emeritus of obstetrics and gynecology, University of Wisconsin; 25 March.

Robert C. Clothier, 85; former president, Rutgers University; 18 March.

Warren F. Draper, 86; former Deputy Surgeon General of the United States; 19 March.

Thomas F. Goreau, 46; professor of biological and marine sciences, State University of New York, Stony Brook and the University of the West Indies, Jamaica; 22 April.

Clair A. Hannum, 69; retired professor of zoology, Wichita State University; 5 April.

Amy Hewes, 93; professor emeritus of economics and sociology, Mount Holyoke College; 25 March.

Chester Hyman, 52; Birely Professor of Investigative Dermatology, University of Southern California School of Medicine; 19 April.

Paul MacClintock, 79; emeritus professor of geography, Princeton University; 23 March.

J. H. Mathews, 88; former chairman, chemistry department, University of Wisconsin; 15 April.

Loye H. Miller, 95; retired professor of biology, University of California, Los Angeles; 6 April.

Joseph C. Morris, 67; former vice president of Tulane University; 4 April.

J. J. Ochse, 78; professor emeritus of tropical horticulture, University of Miami; 21 March.

J. Earl Rudder, 59; president, Texas A&M University; 23 March.

Danely P. Slaughter, 58; former clinical professor of surgery, University of Illinois; 11 April.

Alfred H. Sturtevant, 78; Thomas Hunt Morgan professor emeritus of biology, California Institute of Technology; 5 April.

Benjamin D. Van Evera, 68; chemistry professor, George Washington University; 9 April.

Charles C. Wilson, 74; professor emeritus of education and public health, Yale University; 9 April.

David Wdowinski, 73; former assistant professor of psychiatry and psychology, New School for Social Research; 3 May.