Social Change (Oxford Galaxy Book, New York, 1966), p. 28.
3. Melvin Kransberg has made this same point in *Virginia Quart. Rev.* **40**, No. 4, 591 (1964).
4. I deal extensively (albeit in a different context) with the making of new possibilities and the preclusion of options by making choices in my *How Language Makes Us Know* (Nijhoff, The Hague, 1964), chap. 3.
5. One such case is described by E. Z. Vogt, *Modern Homesteaders: The Life of a Twentieth-Century Frontier Community* (Harvard Univ. Press, Cambridge, Mass., 1955). The Mennonite sects in the Midwest are another example.
6. J. H. Steward, *Theory of Culture Change: The Methodology of Multi-linear Evolution* (Univ. of Illinois Press, Urbana, 1955), p. 37. Steward is generally critical of such fellow anthropologists as Leslie White and Gordon Childe for adopting strong positions of technological determinism. Yet even Steward says, "White's . . . 'law' that technological development expressed in terms of man's control over energy underlies certain cultural achievements and social changes [has] long been accepted" (p. 18).
7. See L. White, Jr., (*2*, pp. 44 ff. and 28 ff). Note especially White's contention that analysis of the influence of the heavy plow has survived all the severe criticisms leveled against it.
8. K. J. Arrow, "Public and private values," in *Human Values and Economic Policy*, S. Hook, Ed. (New York Univ. Press, New York, 1967), p. 4.
9. R. L. Heilbroner points up this unforeseeable element—he calls it the "indirect effect" of technology—in *The Limits of American Capitalism* (Harper and Row, New York, 1966), p. 97.
10. J. Dewey, *Theory of Valuation*, International Encyclopedia of Unified Science, vol. 2, No. 4 (Univ. of Chicago Press, Chicago, 1939). The model of the ends-means continuum that Dewey developed in this work should prove useful in dealing conceptually with the value changes implicit in new technology.
11. D. Bell, *The Public Interest*, No. 6 (winter 1967). See also R. E. Lane (*12*) for evidence and a discussion of some of the political implications of this development.
12. R. E. Lane, *Amer. Sociol. Rev.* **31**, No. 5, 652 (Oct. 1966).
13. E. G. Mesthene, *Technol. and Cult.* **6**, No. 2, 226 (spring 1965). D. A. Schon also has recently recalled Heraclitus for a similar descriptive purpose and has stressed how thoroughgoing a revolution of attitudes is implied by recognition of the pervasive character of change [*Technology and Change* (Delacorte Press, New York, 1967), p. xi ff.]
14. In addition to Bell and Lane (*11*), see also L. K. Caldwell, *Publ. Admin. Rev.* **27**, No. 3 (June 1967); R. L. Heilbroner, (*9*, pt. 2); and A. F. Westin, *Columbia Law Rev.* **66**, No. 6, 1010 (June 1966).
15. See "Social goals and indicators for American society," *Ann. Amer. Acad. Polit. Soc. Sci.* **1**, **2** (May and September 1967).
16. R. K. Merton, *Social Theory and Social Structure* (Free Press, Glencoe, Ill., 1949), p. 348. Hessen's analysis is in "The Social and Economic Roots of Newton's Mechanics," *Science at the Crossroads* series (Kniga, London, no date). The paper was read at the Second International Congress of the History of Science and Technology, 29 June to 3 July 1931.
17. Quoted in *Graduate Faculties Newsletter* (Columbia University, March 1966).
18. E. Z. Vogt, *Amer. Anthropol.* **62**, 1, 19, 20 (1960).
19. The structure-process dualism also has its familiar philosophical face, of course, which a fuller treatment than this paper allows should not ignore. Such a discussion would recall at least the metaphysical positions that we associate with Aristotle, Hegel, Bergson, and Dewey.
20. P. Wheelwright, *Heraclitus* (Atheneum, New York, 1964). In his commentary on fragments 28 to 34, Wheelwright makes clear that the element of fire which looms so large in Heraclitus remains a physical actuality for him, however much he may also have stressed its symbolic character (pp. 38–39).
21. D. K. Price, *The Scientific Estate* (Harvard Univ. Press, Cambridge, Mass., 1965), p. 15.
22. J. K. Galbraith, *The New Industrial State* (Houghton Mifflin, Boston, 1967), p. 393.
23. I am indebted to conversations with John R. Meyer and to a personal communication from Robert M. Solow for clarification of this point.
24. These points are made and discussed by R. S. Morison, "Where is biology taking us?," in *Scientific Progress and Human Values*, E. and E. Hutchings, Eds. (Elsevier, New York, 1967), p. 121 ff.
25. Examples of such apocalyptic literature are: J. Ellul, *The Technological Society* (Knopf, New York, 1964); D. Michael, *Cybernation: The Silent Conquest* (Center for the Study of Democratic Institutions, Santa Barbara, Calif., 1962); and J. W. Krutch, New York *Times Magazine*, 30 July 1967.
26. See, for example, the sections "Science, politics and government" in L. K. Caldwell, *Science, Technology and Public Policy: A Selected and Annotated Bibliography* (Indiana Univ. Press, Bloomington, 1968).
27. For a more extended discussion, see E. G. Mesthene, *Publ. Admin. Rev.* **27**, No. 2 (June 1967).
28. S. M. Lipset, *Daedalus*, **93**, 273 (1964).
29. H. Brooks, "Scientific concepts and cultural change," in *Science and Culture*, G. Holton, Ed. (Houghton Mifflin, Boston, 1965), p. 71.
30. I thank my colleagues for comments during the preparation of the article, and especially Irene Taviss of the Harvard Program on Technology and Society.

NEWS AND COMMENT

Budget Cuts: Government Agencies Preparing To Reduce Spending

Donald F. Hornig, the President's science adviser, says, "It's not going to be as bad as some expect," but that is the most favorable forecast to be had on the budget-cutting preparations now underway in Washington.

The cuts are required by the newly passed tax bill, which granted the administration's long sought tax increase, but with the proviso that $6 billion be cut from the amount the administration planned to spend in the fiscal year that began 1 July. The bill also requires a $10 billion reduction during this fiscal year in new obligational authority—that is, in commitments to spend, regardless of the year in which the money is actually laid out. But since the new fiscal year is already underway, the pressing matter at this moment is the $6 billion. Just where all the money will come from is not clear, since Congress will account for some of the $6 billion through cuts in appropriations bills; then it is up to the administration to take care of the rest.

To accomplish this, the Bureau of the Budget has directed all federal agencies to draw up plans for reduced spending, though the vital question of how much remains unanswered. But, since the braking system on federal spending is fairly sluggish, Charles J. Zwick, director of the Bureau, directed the agencies, effective 1 July, to hold back on making new commitments until it is determined how much spending each will have to forego.

At the National Science Foundation, whose budget was vigorously chopped by the House several months ago—$500 million was requested and $400 million was voted—preparations for famine were underway prior to the Bureau of the Budget directive. On 26 June, NSF director Leland J. Haworth sent a notice to the heads of grantee institutions, advising them "to start planning for operating within an expenditure limitation." The phrasing of the notice did not make it altogether clear, but NSF officials confirm that, as things are now shaping up, it is likely that NSF grantees may not be permitted to use all the funds that had been allocated for their grants. For example, a grantee who last year was awarded a sum to be expended over a 3-year period may be directed to reduce this year's spending below the level that NSF had originally approved. NSF officials say that if this comes about, it would be the first time in the Foundation's 18-year history that its commitments have not been fully honored.

The Foundation's method for determining the size of the cuts in each grant is likely to have an enlivening effect on faculty politics. Each institution will be told how much to cut from its overall NSF receipts and grant-by-grant cuts will then be worked out within the institution. The National Institutes of Health, on the other hand, has decided to negotiate reductions with

NEWS IN BRIEF

● **NATIONAL EYE INSTITUTE:** The House Commerce Committee has passed a bill that would establish a National Eye Institute to study blindness and eye disorders and to sponsor training for eye specialists. The bill, sponsored by Representative Harley O. Staggers, (D.–W. Va.) would establish the National Eye Institute as a part of the National Institutes of Health, but would separate it from NIH's present National Institute of Neurological Diseases and Blindness (NINDB). The House Committee said that NINDB now devotes only 15 to 20 percent of its total program to vision defects, that a separate eye institute would help expand research in the field. A similar bill has been sponsored in the Senate by Lister Hill (D–Ala.), but no action has been taken. Major critics of the proposal are Health, Education, and Welfare Department officials who say that a National Eye Institute separated from NINDB is not necessary, that substantial eye research is now being conducted in NINDB, and that eye research is too narrow a field to justify a possible fragmentation of present research facilities. The House is expected to act on the bill before Congress adjourns next month.

● **ECOLOGY STUDIES:** The Ford Foundation has announced research grants totaling nearly $4 million to eight universities to promote academic development in ecological studies. The recipients are Stanford University, University of California at Davis, Colorado State University, University of Washington, Johns Hopkins University, Missouri Botanical Garden, Yale University, and University of British Columbia. A recently published report, *Ford Foundation Grants in Resources and Environment*, is available from the Ford Foundation, Office of Reports, 320 East 43 Street, New York 10017.

● **ROMANIAN EXCHANGE:** Donald F. Hornig, the President's science adviser, has announced a broader scientific exchange program between the United States and Romania. The new agreement provides that each government designate a science officer to its respective embassy in Bucharest and Washington. It also provides for a wider exchange of knowledge in commercial enterprises, an increased exchange program for scientists and scholars and greater cooperation in peaceful uses of atomic energy. The agreement is the result of meetings between Hornig and Alexander Birladeanu, Deputy Prime Minister of Romania, who has just completed a 3-week U.S. visit.

● **SOVIET–U.S. FISH EXCHANGE:** Despite recent disagreements over United States and Soviet fishing-vessel rights, the two nations have recently completed a fourth official cooperative fish exchange program to advance knowledge of marine life and to find ways to increase the world's food supply by studying breeding habits of fish. The exchange program began as a joint effort of the Interior Department and the Soviet All-Union Research Institute of Marine Fisheries and Oceanography. North Carolina striped bass have been flown from federal hatcheries to Russia, and, in exchange, American scientists have received the Russian Amur River pike, which scientists at Pennsylvania State University are studying.

● **CONSERVATION FUND:** The critical shortage of money available for the purchase of land for new national parks and other federal and state recreation areas will be eased by new amendments to the Land and Water Conservation Fund Act of 1965. Under the amendments, on which Congress completed action last week, part of the lease receipts from federal oil and gas lands on the outer continental shelf will be earmarked for the Fund during the next 5 years if necessary to bring its total revenues up to $200 million a year. The Fund's existing sources of revenue have been producing less than half that amount. Although the earmarking of continental shelf revenues for the Fund had been strongly opposed by some senators (*Science*, 28 June), final Senate passage of the Fund Act amendments came routinely, on a voice vote. The new legislation also includes provisions intended to combat rapid escalation of land prices; one gives government limited authority to take options when funds to buy land are lacking.

● **NEW PUBLICATIONS:** *Draft Facts for Graduates and Graduate Students*, a report by the Scientific Manpower Commission. Copies may be obtained for 50¢ from the Scientific Manpower Commission, 2101 Constitution Avenue, NW, Washington, D.C. 20418.

each grantee after it is determined how much will have to be cut from NIH's total expenditures. The Atomic Energy Commission, the Department of Defense and all other agencies are preparing to make their contributions to the $6 billion reduction, but at this writing, details were not available on the methods that will be employed.

Hornig and his staff, in close contact with the Bureau of the Budget and the various agencies that support research and education, say that in planning for reductions that will affect scientific activities, a high priority has been given to protecting graduate training. "We want to avoid catastrophes," Hornig said, "and we've concluded that one of the worst catastrophes would be an impairment of our future supply of scientists." Hornig's assessment is that federal support of science "is now on a plateau, but over the long pull, it's going to turn upward." In an interview with *Science*, Hornig did not sound happy about what may lie ahead in the federal agencies, but he also seemed equally unhappy about the way some scientists have been behaving in regard to the budgetary situation. "It is fair to say," he remarked, "that some of the reaction has been hysterical. In figuring out how to respond to the need to reduce spending, we need useful facts to help us decide where reductions can be made with the least damage. What we're getting from some quarters is simply hysteria."

Hornig would not say whether he was referring to the so-called "emergency meeting" that the New York Academy of Sciences called last month to assail cutbacks in federal support of research. But a member of his staff addressed that doleful meeting and spoke sharply against the crepehangers who maintained that American science is being seriously damaged by shortsighted economizing. For what it's worth, Hornig points out that even if the worst happens, which he does not think will be the case, the United States "will still have the highest per capita expenditure on research and development in the world," and the figure is even higher, he says, in the area of basic research. This is less than miniscule consolation for the researcher who is budgeted out of a project, but, contrary to the arrogant assumptions that prevail in some scientific circles, the scientific community does not merit automatic entrée to the nation's tax revenues, and those scientists who, in effect, contend that it does, are simply

feeding the skepticism that many politicians and federal administrators already feed toward this clamoring ward of government.

At the Bureau of the Budget, which will set the amounts to be cut from each agency after Congress passes all the appropriations bills (which is expected to be in early August, prior to the start of the Republican National Convention), officials reiterated Hornig's view about the importance of protecting graduate education. "We're all aware of the graduate school problem," one official said, "and we're going to do everything possible to protect the schools." How would this be done? "Well, we don't know precisely, but before we cut into the graduate schools, we'll cut down on equipment purchases, travel, and nonprofessional assistance."

Thus, at this point details are lacking, but throughout the federal establishment there is a uniform message for those who are dependent on government funds: prepare for less.

—DANIEL S. GREENBERG

Scientists in Politics: Humphrey Trails McCarthy in Support

Vice President Humphrey's efforts to enlist mass support within the scientific community appear at this point to be largely unsuccessful.

Whether such support matters is a separate question. But politicians behave as though they think it does. In recent months, the McCarthyites have been claiming that their man is heir to the spirit and many of the alumni of the 1964 campaign's Scientists and Engineers for Johnson-Humphrey, a nationwide organization that numbered some 50,000 members. On the basis of reports trickling in from chapters throughout the country, they say, they have signed up at least 5000 cash-contributing members within the scientific community—possibly as many as 10,000. These include many leaders of the 1964 Johnson-Humphrey organization, among whom is a generous sprinkling of key figures in the science-government relationship throughout the postwar period (*Science* 24 May).

Confronted with these claims, the Humphrey camp exuded confidence about the rolls of scientific supporters that it would produce, but no names. That is, until last week, when it listed some 60 persons, many of them academics, who will serve on advisory task forces for the Vice President,* plus two smaller groups that Humphrey aides said will serve as the nuclei of organizing committees of Scientists and Engineers for Humphrey and Physicians for Humphrey.†

However, amidst a fair amount of confusion, one of the alleged organizers, Philip Handler, who chairs both the Duke biochemistry department and the National Science Board, immediately disavowed any connection with the campaign on the grounds that scientists should not involve their profession in partisan politics.

Since it is now a well-established pattern for the scientific professions to involve themselves in presidential campaigning, Handler's disavowal has a ring of irrelevance. But if he was ever involved in the Humphrey campaign, and he says he wasn't, he is now clearly uninvolved.

Nevertheless, the episode is worth examining in some detail for several reasons. First of all, Handler views the role of scientists in elective politics with considerable personal experience, having served in 1964 as head of the North Carolina chapter of Scientists and Engineers for Johnson-Humphrey. At that time, he was vice chairman of the National Science Board; subsequently, he was elevated to chairman of the NSB and also became a member of the President's Science Advisory Committee. At present, Handler's name is frequently mentioned in connection with a number of top level positions that will open within the next few years, among them the presidency of the National Academy of Sciences, the directorship of the National Science Foundation, and head of the White House science office.

After a Humphrey aide listed Handler as a member of the organizing committee, an acquaintance of Handler told *Science* that the listing was in error. An inquiry to the Humphrey camp produced an insistence that Handler had accepted membership with enthusiasm, and this was supported by a copy of a letter, dated 4 June, that Handler wrote to a Humphrey aide in response to an invitation to serve on the organizing committee of Scientists and Engineers for Humphrey. Handler's letter stated, in part, "Shortly after President Johnson announced his plans, I wired Vice President Humphrey indicating my hope that he would enter the campaign, offering my services, and. . . .

"Recently," the letter went on, when called by a member of the Humphrey staff, "I happily agreed to his invitation to be among a small group of scientists, physicians, and engineers who would organize to support Mr. Humphrey."

Handler added, however, that "I am suggesting that Scientists, Engineers, and Physicians for Humphrey would do little or nothing to affect the outcome

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* Among those listed as task force members are: Doak Barnett, Emile Benoit, Zbigniew Brzezinski, Marshall D. Shulman, and W. Howard Wriggins, all of Columbia University; Robert Bowie, Hollis B. Chenery, John Dunlop, Otto Eckstein, Walter P. Falcon, Lester Gordon, Sam Huntington, Edward S. Mason, Richard A. Musgrave, Arthur Smithies, and James Q. Wilson, all of Harvard; Robert Baldwin, University of Wisconsin; George Brandow, Penn State; Kenneth Clark, City University of New York; Richard N. Cooper and John Montias, Yale University; Bayless Manning, Stanford; William Griffith, Everett E. Hagen, Paul McAvoy, Max Millikan, and Lucian W. Pye, MIT; Melvin Rothbaum, University of Illinois, and Seymour Worfbein, Temple.

† Members of the organizing committee of Scientists and Engineers were listed as: Wallace Brode, past president of the AAAS; David Z. Robinson, NYU vice president for academic affairs; James A. Van Allen, University of Iowa, and Sewall Wright, professor emeritus of genetics at the University of Wisconsin. Among those listed as members of the organizing committee of Physicians for Humphrey were John Rock, emeritus professor at Harvard; Helen Taussig, emeritus professor at Johns Hopkins; Elliott Corday, past president of the American College of Cardiology, and Robert Aldrich, professor of medicine at the University of Washington.