

FROM RHETORIC TO REALITY IN SCIENCE: BETWEEN LITTLE ROCK AND A HARD PLACE

Getting elected may have been the easy part. Now, as he makes the grand transition from candidate to President, Bill Clinton confronts the tougher job of transforming the lofty rhetoric of the campaign to the cold reality of political compromise and budgetary constraint. On the campaign trail and in his response to questions by *PHYSICS TODAY* (October, page 101), the Arkansas governor has pledged to shift funds from defense R&D to civilian R&D, to increase support for generic industrial technologies, to accelerate the efforts of the national labs in creating R&D partnerships with industrial firms and universities, and to improve pre-college schooling, especially in math and science, and make sure that America's college-bound are academically prepared.

Such an ambitious agenda is not likely to be completely achieved for years, mainly because of the nation's economic and cultural limits. Nonetheless, Clinton's proposed Presidential priorities suggest a significant change in the working relationships between the academic and industrial research enterprises and in their reliance on the government for sustained support for R&D. Clearly, putting the Clinton programs for science and technology in place will depend on the nation's economic strength and educational reformation, not on exhortations by the President or on expenditures by his new Administration.

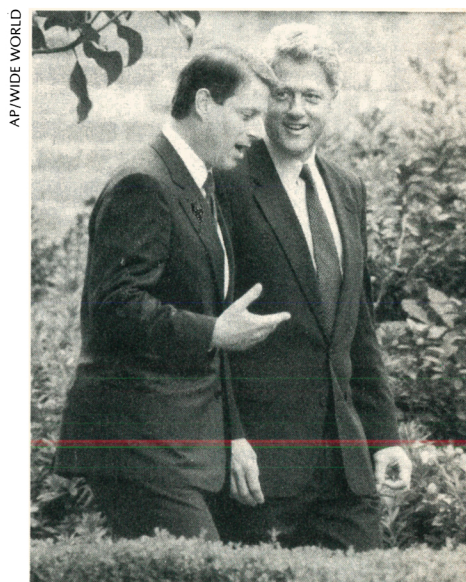
There is a paradox in this: To reduce the country's budget deficits by half in the four years of Clinton's term will most certainly require delaying many projects in science, space and technology and reducing many R&D programs. For all of fiscal 1992 the Federal deficit stood at \$290.2 billion—about \$100 billion less than was predicted, but a record nonetheless. During the campaign, Clinton said he would propose an investment tax credit and a big increase in public works projects to rebuild the nation's infrastructure, without widening the deficit. It is no small challenge to achieve the two goals of stimulating the economy now with less tax rev-

enues and more spending, while shrinking the deficit later with more taxes and less spending.

In some circles, Clinton's avowed science policy is viewed warily. To be sure, he made no promise about budget increases for basic research and he said almost nothing about ensuring the health of the research community. In an era of flat or diminishing budgets for academic and industrial research, Clinton's agenda could draw off funds from fundamental science—a possibility that causes those who rely on the National Science Foundation or the National Institutes of Health to think the unthinkable (*PHYSICS TODAY*, September, page 53).

Still, Clinton and his running mate, Senator Al Gore Jr of Tennessee, received the endorsement of a remarkable assemblage of researchers and educators. Organized by Marvin L. Goldberger (UCLA), Harold Brown (Center for Strategic and International Studies) and Sheila Widnall (MIT) into a 67-member Coalition of Scientists and Engineers for Clinton-Gore, the group boasts a dozen Nobel Prize winners, including Philip W. Anderson (Princeton), James Cronin (University of Chicago), Murray Gell-Mann (Caltech), Dudley Herschbach (Harvard), Leon Lederman (Fermilab), Arno A. Penzias (AT&T Bell Labs) and Steven Weinberg (University of Texas).

In late September Clinton designated Gore as point man in his Administration for coordinating science and technology policies—a role unlike any played by previous Vice Presidents. Lyndon Johnson, Hubert Humphrey and Dan Quayle had each been chairman of the National Space Council in their Vice Presidencies, but none was a leading actor on R&D issues. By contrast, Gore has worked hard as chairman of the Senate subcommittee on science, technology and space to establish his image as a conscientious and knowledgeable protagonist on science and technology matters, from biotechnology to fiber optics to greenhouse gases. He persevered with the idea of a high-speed "computer super-highway" linking universities, re-



Gore and Clinton: Agents of change.

search labs, schools, hospitals and businesses. The Bush Administration adopted the concept as its own, pushing legislation through Congress last year—and excluded Gore from the signing ceremony. This summer, while Quayle's Council on Competitiveness fought against clean-air regulations, Gore led the Senate delegation to the United Nations Earth Summit in Rio de Janeiro. He spent three years writing his best-selling book, *Earth in the Balance: Ecology and the Human Spirit* (Houghton Mifflin, 1992), which calls for stronger environmental controls by governments and argues that the environment will be the central organizing principle of the post-cold-war world.

A week before the election, seven members of the coalition of scientists, led by Goldberger and Widnall, met with Gore at the University of New Mexico in Albuquerque. The group included F. Sherwood Rowland of the University of California, Irvine, who conceived (with Mario Molina) how chlorofluorocarbons, bombarded by

Some Key Jobs in Science and Technology Policy

Since Franklin D. Roosevelt, Presidents have sought advice on scientific matters—rarely to understand events, usually to make political decisions. Roosevelt turned to three prominent academic figures of the time—Vannevar Bush, then engineering dean at MIT, Karl Taylor Compton, MIT's president, and James Bryant Conant, Harvard's president. They set up and ran the Office of Scientific Research and Development, the organization that mobilized the nation's scientific and technological communities for the express purpose of winning World War II. FDR's successors have relied increasingly on talented scientists as more departments and agencies focused on issues dealing with science and technology. Dwight Eisenhower had personal relationships with I. I. Rabi, the Columbia University physicist, and George Kistiakowsky, the Harvard chemist, in setting policy on scientific and military issues. Jimmy Carter, educated as a nuclear engineer, undoubtedly understood more about science and technology than any President before him, with the possible exception of Thomas Jefferson in his own era.

Few Presidents have actually been involved in choosing the people who occupy the top jobs in the various science and technology agencies—though Bill Clinton has indicated that he and his Vice President, Al Gore Jr, will have a hand in many of the prime appointments. Earlier this year, John H. Trattner, vice president of the Council for Excellence in Government, chronicled the functions and frustrations of Washington's 54 toughest science and technology positions in *The Prune Book* (Madison Books, 1992). Most involve developing budgets and defending before Congress how large amounts of money are spent. Each demands leadership qualities and policy choices. Almost all require Presidential nomination and Senate confirmation. By Trattner's count, over the last quarter century, the tenure of Presidential appointees in science and technology jobs has shortened from an average of three years in Lyndon B. Johnson's

Administration to two years in Ronald Reagan's. It appears to have increased somewhat in George Bush's Presidency.

What follows is a list of the choice Federal science and technology positions relating to the physical sciences:

Office of Science and Technology Policy. This post, now held by D. Allan Bromley, who also is the President's science adviser, is really at the commanding heights of the Administration's whole science and technology enterprise. In the past year, several think tanks, including the Carnegie Commission on Science, Technology and Government and the Brookings Institution, called for strengthening OSTP as a way of coordinating science and technology programs with the White House Office of Management and Budget and the Federal Coordinating Council for Science, Engineering and Technology. FCCSET, which had been moribund since Congress created it in 1976, along with OSTP, was invigorated by Bromley and now brings together several Cabinet secretaries and agency heads to discuss high priority programs. The President also names four associate directors.

President's Council of Advisers for Science and Technology. PCAST is the current version of the President's Science Advisory Committee, a group of some of the country's most distinguished scientists and engineers who provided advice to Presidents Eisenhower, Kennedy and Johnson respectively. In its recent report, "Enabling the Future: Linking Science and Technology to Societal Goals," the Carnegie Commission recommends that PCAST "should play a more extensive role in guiding the goal-setting process within the Executive office."

Office of Management and Budget. The program associate director for natural resources, energy and science, now F. Paul Gilman, an Earth scientist who once was a top aide to Senator Pete Domenici of New Mexico and later for Energy Secretary James D. Watkins, manages the budget process for NASA, the Department of Energy, National

ultraviolet radiation, destroy the ozone layer of the atmosphere. "During the campaign, Senator Gore had been labeled an environmental extremist by President Bush and called 'the ozone man,'" Goldberger recalled, "so the Senator got a real kick greeting Sherry Rowland as 'the real ozone man.'" Rowland has known Gore since March 1989, when they attended the "Saving the Ozone" conference in London, called by Margaret Thatcher, then Britain's Prime Minister. After discussing science and education issues for a half hour, the coalition scientists came away impressed with Gore. "Of course, that didn't surprise me," Rowland said in an interview. He has discussed scientific issues with Gore at Senate hearings, at meetings and by telephone. "Gore is accustomed to talking with scientists. He is perfectly capable of ad-libbing a 20-minute speech on the atmosphere to an audience of scientists without making a mistake," said Rowland. At the coalition's meeting with Gore in New Mexico, "it was apparent," Rowland remembered,

"that the science adviser for the Clinton Administration is really going to be Al Gore."

Gore's aides insist that he will not usurp the position of science adviser—a job they say will go to a scientist with experience in high-tech industry. By the end of November, the transition team had resumes of nearly 100 potential candidates for the job of Assistant to the President for Science and Technology—the official title for the science adviser, who doubles as director of the Office of Science and Technology Policy. One name on the list is Mary Good, vice president for technology at Allied Signal Inc, a chemist who got her PhD from the University of Arkansas and who has served as chair of the board that oversees the National Science Foundation and as a member of PCAST, Bush's science advisory council. A Republican, Good may not be offered the post in the Clinton Administration, but her background seems to be more in line with what Clinton wants than that of D. Allan Bromley, the current science adviser, who spent

most of his career at Yale University and worked for an electric utility company in Canada early on.

Clinton, for his part, is more comfortable among economists. His choice of Robert Reich of Harvard's Kennedy School of Government and an advocate of heavy-duty "industrial policy" to lead the economic transition team suggests the agenda of the new Administration. Reich has picked Laura D'Andrea Tyson, an economist at the University of California, Berkeley, and another proponent of industrial policy, to head a team looking at technology and manufacturing issues.

Because the news media abhor a vacuum, they tend to fill their broadcasts and columns with rumors and speculations during the interregnum between Presidents. Clinton aides have suggested that the President-elect will make some of his Cabinet-level appointments by mid-December—though it is unlikely that they can be on the job by Inauguration Day on 20 January because of the lengthy procedure of financial, security and

Science Foundation, Environmental Protection Agency and other science operations. In the past, this post was usually held by lawyers, MBAs or Wall Street types. Another associate director has budget and policy oversight for defense programs, foreign affairs and intelligence activities. This slot is occupied by Robert E. Howard, who has a PhD in physics from Oxford University and was a research physicist at the National Bureau of Standards in the 1960s.

National Science Foundation. Traditionally, NSF is an independent nonpartisan agency. Its director, now Walter E. Massey, has a six-year term, and, as such, does not turn in his resignation when the President changes. Even so, the deputy director serves at the pleasure of the President. NSF, unlike the Defense Department, say, or EPA, is not a "mission" agency, so it does not specify the research it supports but instead responds to the proposals submitted by scientists and engineers (see the news story on page 70).

National Science Board. The board consists of 24 members of the science, engineering, educational and industrial communities who normally meet once each month to decide on major programs, projects and policies. Each is appointed by the President for six-year terms. The board has only one vacancy, which Clinton could fill. In 1994 terms will be up for eight of its members. While it acts like a board of directors for NSF, in recent years the board has toyed with the idea of enlarging its portfolio to consider and speaking out on science and technology policies for the rest of the Federal establishment.

DOE's Office of Energy Research. A legacy of the civilian science and technology functions of the Atomic Energy Commission, this agency supports most of the country's high-energy and nuclear physics. In recent years it has expanded its coverage to R&D on nonfossil fuels, to environmental sciences and to supercomputer networks. Its current director, William Happer, a former Princeton physicist who provided expert advice on many Pentagon programs, also serves as the energy secretary's adviser on defense and nondefense research policies.

Department of Defense. The Pentagon has several slots

requiring Presidential appointment—among these the director of defense research and engineering and the director of command, control, communications and intelligence. In the Clinton Administration the Defense Advanced Research Projects Agency, now headed by Gary Denman, a member of the senior executive service, is certain to be elevated in importance for transferring defense R&D to industrial firms and for pursuing "precompetitive" advanced technologies such as massive parallel processing, artificial intelligence, high-energy lasers and new types of ceramics.

National Aeronautics and Space Administration. Only the administrator is nominated by the President. The incumbent, Daniel S. Goldin, was confirmed by the Senate in March and since then has initiated a turbulent reformation of the agency, which was criticized by at least two commissions in 1990 for its lackluster approaches to exciting research and advanced technology. Though the space program is still highly popular among the public, NASA has lost much of its glamor for Congress and the media, which have criticized its inability to perform the sensational feats of the 1960s, when it sought to outdo the Soviet Union.

Department of Commerce. The administrator of the National Oceanic and Atmospheric Administration, the undersecretary for technology, the administrator of the National Telecommunications and Information Administration and the director of the National Institute for Standards and Technology all require Presidential appointment and Senate confirmation. Clinton has already indicated that he wants top scientists or engineers with industrial experience for all these posts, in keeping with his agenda to promote new technologies for industry and provide more high-paying jobs for workers. Commerce's Technology Administration was created by Congress in 1989 to improve the competitiveness of American industry. Its first undersecretary is Robert M. White, a Stanford physics PhD who held management posts at Xerox Palo Alto Research Center, Control Data Corp and Microelectronics and Computer Technology.

—IRWIN GOODWIN

other background checks they would need to undergo. As for the rest of his Administration, Clinton has named people to head so-called cluster groups, which are charged with evaluating individual agencies and gathering information on their structure, organization, budgets, staffing and problems. These panels are likely to have a hand in picking political appointees below the agency head and in altering the way the agency operates. Among those Clinton has named to direct the cluster groups are Sally Ride, an astrophysicist at the University of California, San Diego, and the first American woman astronaut, who will direct the group for science, space and technology; and James Gustave Speth, who recently announced his retirement as president of the World Resources Institute and once served as chairman of the Council on Environmental Quality in the Carter Administration, to head a cluster group dealing with natural resources, energy and agriculture.

The press also is high on the chances of John A. Young, Hewlett-

Packard's former CEO and a lifelong Republican, to become Commerce secretary. Young engineered a sweeping management reorganization at H-P, challenged it to get products out the door faster and urged employees to rethink every process from product development to distribution. Other names that have been bandied about are Tim Wirth, the Colorado Senator who decided this summer not to run for reelection, to head the Department of Energy or Department of Interior; and either Alice M. Rivlin, the original director of the Congressional Budget Office who is now with the Brookings Institution, a halfway house for Democrats-in-waiting, or Representative Leon Panetta of California, chairman of the House budget committee, to direct the important Office of Management and Budget.

As it happens, the Federal budget for fiscal 1994, which begins on 1 October 1993, is being prepared by the lame-duck Bush Administration, but the budget will be rethought and recreated by the Clinton Administration after it takes office. The 1994

budgets for such science agencies as DOE, NASA and NSF were submitted to OMB just after Labor Day and returned to the agencies with comments and corrections in October.

By law and tradition, budgets are to be sent to Congress around 1 February, just 12 days after Clinton's swearing in. In consequence, the budget that goes up Capitol Hill is almost certain to call for the status quo under current economic restraints. Richard Darman, President Bush's budget director, has instructed his staff to prepare one-page "snapshots" of each key subject, which would give Congress a mere peek at significant agency programs. Thus it is likely to be a standpat budget that provides for constant services plus inflation and contains footnotes and appendices explaining any unusual or additional items. It will not include any new starts, because the Bush OMB prefers to allow Clinton's team to submit the budget it wants. In 1981, the last time a different party took over the White House, President Reagan submitted his budget on 10

March. Clinton's budget is bound to reveal better than his answers to questions by the news media how

much buying power he will give science and technology agencies.

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COMMISSION ON NSF'S FUTURE ENDORSES THE PAST—ORACULARLY

When the Commission on the Future of the National Science Foundation issued its report on 20 November, the 11-page document brought sighs of relief from academic scientists who had feared that the foundation was going to change its purpose. But the report contained enough Delphic statements to satisfy those who would expand the foundation's mission into more applied research and thereby help to improve the nation's industrial competitiveness.

For starters, consider the commission's main conclusions:

Society's support for the NSF and for university research is based on the confident expectation that the generation of new knowledge and the education of a skilled workforce are necessary (though not sufficient) investments to achieve our national goals of a high quality of life in a productive and growing economy. In accepting society's support, the scientific community naturally assumes an obligation to be both responsive to national needs voiced by society as well as the intellectual priorities solely initiated by the scientist or engineer.

Concern over technology application and competitiveness sometimes conjures a choice that budgeting is decided on either the criteria to please the scientist or to serve the public need. In reality these criteria and interests are congruent. The history of science and its uses suggests that the NSF should have two goals in the allocation of its resources. One is to support first-rate research at many points on the frontiers of knowledge, identified and defined by the best researchers. The second goal is a balanced allocation of resources in strategic research areas in response to scientific opportunities to meet national goals. It is in the national interest to pursue both goals with vigor and in a balanced way. The allocation of resources should be reviewed regularly with those two goals in mind. Positive responses to both will enhance the standing of science.

So it appears the commission would

have it both ways: NSF should continue to fund basic research, largely directed by the ideas of creative individual scientists and engineers, and increase its support, in a balanced way, of "strategic research areas" that have some payoff for society, possibly in such practical fields as computer networking, biotechnology and new materials for better houses, electronics and transportation.

The commission was formed last summer in an effort to quell the tempest that swirled through the academic science community after the Senate appropriations committee directed NSF to face up to the "new reality" of global economic competition in today's post-cold-war era by helping to transfer the results of basic research into industrial applications. Walter E. Massey, NSF's director, stepped right into the maelstrom in August by issuing a public memo to the National Science Board advocating "an expanded portfolio of programs that would be integrated with ongoing activities and closely aligned with industry and other government agencies" (PHYSICS TODAY, September, page 53).

That sent NSF clientele to their word processors and fax machines, afraid that the programs Congress and Massey were proposing would shortchange the traditional investigator-initiated basic research. At that point, the board decided to appoint a special commission to look carefully at the foundation's present condition and future mission.

The commission, consisting of 15 members under the cochairmanship of William H. Danforth, chancellor of Washington University in St. Louis, and Robert W. Galvin, former chairman and CEO of Motorola Inc, held three public sessions over the three months it was allotted to produce the report. There were remarkably few arguments over the conclusions and recommendations. NSF and the academic researchers it supports, says the commission's report, "should complement rather than replace the roles of those engaged in technology development. Redirecting the NSF's activities from research and education would have little or no effect on the US competitive position in the near term, but would severely restrict pros-

pects for the long term. Research and education activities offer ample opportunity to increase the potential contribution of scientists and engineers to society." Commission member John Armstrong, IBM's vice president for science and technology, forcefully expressed the implications of the commission's statement when the report was presented to the science board. Changes are needed in NSF, he said, but "saving industry is not one of them."

Indeed, the commission warns Congress and the public about expecting too much from NSF, which accounts for a paltry 3% of the Federal government's R&D spending. In fact, it questions the very premise behind the argument for more direct involvement by NSF in industrial research: "Failures in the marketplace have not been the result of slow transfer of academic science to industry. . . . All manner of other more prominent factors, including the stewardship by American business, far outweigh whatever could be traced to the technology itself or the technologists."

Accordingly, the commission ignored the demands of Congress that NSF needs to become more relevant to the nation's economic and social needs. This view comes from some who are NSF's most devoted friends on Capitol Hill. "There are many Americans who think they are paying more and getting less from research," says Representative George E. Brown Jr, chairman of the House Science, Space and Transportation Committee. Some in the business world are calling for more practical research as a way of contributing to US industrial competitiveness. "I don't think pumping money into basic research and keeping your fingers crossed is adequate for this new world," says John Rowell, vice president of Conductus, a superconductivity startup firm in Sunnyvale, California.

Those who benefit from NSF's largess think differently, not surprisingly. Most of the 800 scientists, engineers and university administrators who sent letters and e-mail to the commission said, in effect, "if it ain't broke, don't fix it." The report, said Danforth, "is in line with the vast majority." Massey, however, received a somewhat different message: He interprets the commission as endorsing "a greater integration of science and engineering research into society, and the public's increasing expectations for the results of this research" as well as "more active use of partnerships, especially with industry . . . in strategic research areas."

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