CLINTON'S SCIENCE POLICY DOCTRINE; LOFTY GOALS BUT A LESSER REALITY

Edgy about its future, the scientific community was cheered by the white paper on science policy that the Clinton Administration produced on 3 August. The 31-page document, "Science in the National Interest," pledges the Administration to maintain "world leadership in basic science, mathematics and engineering" and calls on scientists to link their research more closely to the "core" concerns of the country, from strengthening the economy to "ennobling the human spirit" through deeper understanding of the natural world.

The Administration believes the pronouncement is the most important science policy statement since Vannevar Bush's report *Science—the Endless Frontier*.

Just short of 50 years after Bush issued the first declaration of US science policy, the Clinton Administration has created a new policy for the times. The White House Office of Science and Technology Policy claims the policy is necessary now to respond to the questions raised by the end of the cold war and the fear that American science is in danger of losing its international preeminence. The Bush statement remains sensible enough in part but its *raison d'être* is no longer valid. Bush was convinced that the US after World War II would be the dominant political, economic and military force in the world. His document was an eloquent declaration of independence from European science. It established the rationale for government support of research, gave birth to the National Science Foundation and set the tone for US science to become preeminent.

The Clinton position paper is a significant departure from Bush's report. The white paper offers science serving policy, not a policy serving science. In the foreword to the report, President Clinton and Vice President Gore express their often-stated position that fundamental research is an investment "to solve many of the uniquely human problems we face—feeding and providing energy to a growing population, improving human health, taking responsibility for protecting the environment and the global ecosystem and ensuring our own nation's security." Clinton and Gore see science as the essential fuel for technology, which they term "the engine of economic growth." Their Administration, they write, "is committed to making today's investment in science a top priority for building the America of tomorrow." By putting it this forcefully, the document has the ring of a Clinton science doctrine.

The doctrine does not call for such specific scientific feats as voyages to Mars or explorations to determine the structure of the Earth. Instead, it lays out the Administration's vision for the conduct and purpose of scientific research in the post-cold-war era.

The Administration has high expectations: "US scientists must be among those working at the leading edge in all major fields in order for us to retain and improve our competitive position in the long run. This means that US scientists and engineers must continue to make a significant share of the most important scientific advances. They must maintain our tradition of scientific excellence, produce a scientific, engineering and technical workforce educated at the highest levels in all important disciplines and technologies, and create an infrastructure able to capitalize on and advance key discoveries no matter where they occur. . . . Breadth of scientific excellence is necessary to maintain the enterprise at the appropriate standard. Different areas of science and their associated cutting-edge technologies are tightly interconnected. Advances in one area often have unanticipated major benefits in totally different areas.

"Furthermore, nature yields her most precious secrets in surprising ways, to those who are well prepared and persistent, and with a schedule not often amenable to detailed planning. Thus, although we can and must do more to identify and coordinate research thrusts aimed at strategic goals, we must not limit our future by restricting the range of our inquiry."

Clinton's Goals for Research

In its white paper on research the Clinton Administration sets five goals for "our stewardship of science in the national interest." The document states that the agenda is "a broad one and will require the resources of government and the creative participation of industry and academia." The five goals:

- ▷Maintain leadership across the frontiers of scientific knowledge
- ▷Enhance connections between fundamental research and national goals
- ▷Stimulate partnerships that promote investments in fundamental science and engineering and effective use of physical, human and financial resources
- ▷Produce the finest scientists and engineers for the 21st century
- ▷Raise scientific and technological literacy of all Americans

The Clinton doctrine promises that long-range planning and stable research budgets "will be important ingredients in this Administration's strategy." It observes that some countries—notably Japan and Germany—now possess world-class research capabilities largely as a result of "deliberate and successful long-term investment strategies." Thus, "if US researchers are to sustain leadership and strengthen participation in collaborative scientific endeavors, we must increase our level of interactions with colleagues in other countries"—particularly in such fields as high-energy physics, space exploration and nuclear fusion. In this type of big science, "it is only sensible to share with other countries both the benefits and the costs of constructing and operating . . . facilities."

The white paper calls for the US to increase government and industry support for R&D by 15%, which would

US research and development funding, FY 1993

	Development	Applied research	Basic research	Total
Funding source		(billions of dollars)		
Federal government	36.1	15.5	16.5	68.0
Industry	57.8	21.1	4.6	83.6
Universities and colleges				
Other nonprofits	0.9	3.1	5.1	9.2
Total	94.9	39.7	26.2	160.8
Percentage of GDP				
Total funding	1.54	0.64	0.42	2.6
Federal funding	0.58	0.25	0.27	1.1

All entries from 1993 Science & Engineering Indicators, National Science Foundation, tables 4.4–4.7. The GDP of $6172 billion is from table 4.1. Individual entries have small uncertainties because of differences in the definitions of basic research, applied research and development. Total entries may have roundoff errors of 0.1. Table includes both civilian and defense R&D. Of the Federal R&D total, defense R&D accounts for $41.5 billion (including $1.3 billion in basic research). The civilian R&D total of $119.3 billion represents 1.9% of GDP.

put it on a par with current levels of R&D in Japan and Germany when figures are given as a percentage of the gross domestic product. The report argues that GDP "provides the benchmark for total economic activity and thus the most meaningful measure of the R&D investment." Currently, US funding of nondefense R&D is about 1.9% of GDP, which puts it well below Japan's 3% and Germany's 2.5%. Even after defense R&D funding is added to the US account, the nation's R&D budget allocations equal 2.6% of GDP, or a total of $160.8 billion. (See the table on page 80.) The Clinton doctrine seeks to raise all R&D spending someday to 3% of GDP.

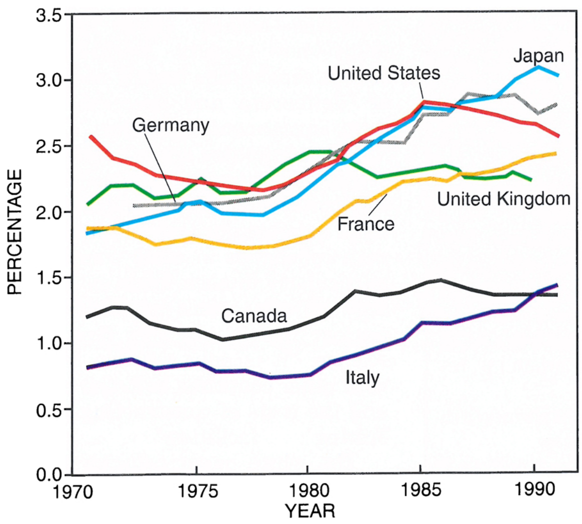
The report states that better advisory and accounting systems are necessary "to evaluate our investment strategy and to make changes as later evaluations and future conditions demand. This Administration's strong emphasis on shifting the character of defense R&D towards dual civilian-military use will help focus our overall R&D investment much more on the marketplace." The President's National Science and Technology Council, the Cabinet-level group headed by Clinton (see PHYSICS TODAY, August, page 49), is directed by the policy document to examine how to balance the funding of civilian and defense R&D. While the Administration already has won large increases in funding for such agencies as the National Institute of Standards and Technology, the new report is cautious about setting a timetable for steering Federal dollars away from defense and into the government's civilian agencies. In fact, the report treads warily in speaking about the role of Congress in scrutinizing and allocating the Federal government's R&D budget. In the Senate, for instance, Barbara Mikulski, the Maryland Democrat who leads the chamber's appropriations subcommittee that rules on NSF, NASA and the Environmental Protection Agency, has caused a furor in the scientific community by attempting to control how the agencies spend their money. Mikulski claims she wants to keep the agencies accountable to the taxpayers; the scientists respond that they don't need Congress micromanaging the agencies and meddling in research programs.

Investment in R&D by the private sector, the report says, will be driven by the global marketplace, to be sure, "in a technology-based society, with government fiscal and regulatory policies enabling and stimulating investment. As the private sector is likely to remain heavily weighted towards shorter term applied research and development, properly so, the Federal investment must further strengthen fundamental research, rebuild the science infrastructure and strengthen longer term applied research and development, thereby providing the seed funds for long-term health of the R&D enterprise."

The cost of repairing and modernizing the research infrastructure and upgrading the scientific instrumentation at research universities and Federal laboratories sorely troubles the Clinton Administration. NSF estimated a few years ago that the total cost of repairing and renovating the existing academic research facilities and buildings would amount to between $7 billion and $8 billion. In addition, academic department heads reported to NSF that their needs for high priority scientific equipment amounted to about $3 billion. The Clinton document argues that the "primary justification for the highest priority needs was that of making important frontier experiments accessible to academic researchers, both faculty and students."

At a hearing on the white paper before the House science subcommittee on 4 August, Representative George Brown Jr, the California Democrat who heads the full committee, seized on the 3% figure, saying it would be "highly unrealistic" to expect the R&D budget to grow that much in the next few years. He offered what he called some "back-of-the-envelope calculations" to show that a 3% increase would require spending $252 billion on all R&D in 1998, with total Federal outlays at $106 billion. If Clinton succeeded in reducing the Defense Department's current spending of 58% of Federal R&D funding to 50%, funding of civilian R&D by the government would need to double in fiscal 1998 to $132 billion.

At the same hearing Peter Likens,



Nondefense R&D: The graph shows total expenditures adjusted for purchasing power and monetary rates and converted to constant 1987 US dollars in the G7 nations. (Sources: NSF *International Science and Technology Update*, 1993 and Organization for Economic Cooperation and Development.)

president of Lehigh University, complained that while the report is "properly focused and consistent with what I regard as the general consensus in the science policy community," it contains an "unstated premise" about "the kind of robust growth in national prosperity that will make it politically feasible to commit the resources required" to fulfill the goal of devoting 3% of GDP to R&D.

Despite this glitch in the Clinton doctrine, the science and academic communities praised the document. "It's an outstanding statement, one that's right in timing, tone and content," said Cornelius Pings, president of the Association of American Universities, whose members receive most of the Federal support for research.

Burton Richter, director of SLAC and president of the American Physical Society, said many scientists had feared that short-term economic pressures would force cutbacks in basic research, which has had a flat budget the past three years. But, said Richter, the Clinton policy "goes directly at this question and reaffirms the need for long-term research, both to increase our understanding of our world and the immense practical benefit that such work can bring."

—Irwin Goodwin

CLINTON'S SCIENCE ADVISORY COUNCIL LEAVES PHYSICS A CASUALTY OF TIMES

The same day the science policy white paper was issued, the White House released the names of President Clinton's 19-member Committee of Advisers on Science and Technology. The appointment of this advisory group fulfills a campaign promise by Clinton and continues a tradition that goes back to 1957, when President Eisenhower, reacting to the Soviet sputniks, established the position of science adviser and shifted the Science Advisory Committee in the Office of Defense Mobilization to the White House, where it was renamed the President's Science Advisory Committee.

Like ODM's advisory committee, which was created by President Truman and headed for a time by I. I. Rabi of Columbia University, the early PSACs were made up mostly of leading academic physicists who had taken part in the Manhattan Project or MIT's Radiation Lab. Under Eisenhower's science advisers—James R. Killian Jr, the former president of MIT, and later George B. Kistiakowsky, a Harvard physical chemist—the PSAC members were expected to spend at least one week each month in committee deliberations and panel studies. The studies mainly concerned military technology, nuclear weapons and missile defense. PSAC members were chosen not only because they were knowledgeable about defense technologies, space propulsion and telecommunications but also because, as one of the early members, Harvard's Harvey Brooks, once put it, they had "some degree of political sophistication and a tendency to avoid rash or relatively extreme positions."

Clinton's science advisory committee will have an agenda far different from those set before PSACs in the cold war era. In President Kennedy's time, PSAC needed experts in geophysics, biology and medicine to advise on arms control issues, and in later Presidencies a scattering of members came from medicine, microbiology and even environmental sciences.

Today the departments and agencies dealing with science and technology throughout the Federal government each have advisory committees of their own. The White House has its National Security Council for defense issues, and it can tap into the Defense Science Board, Defense Policy Advisory Committee and the Jason group among the expert advisory panels at the Defense Department. But more important, the scope and significance of science and technology in American society no longer centers on military capabilities. Accordingly, Clinton's PCAST is broadly representative of today's most pressing issues, including pre-college education, medical care, atmospheric pollution and nuclear proliferation.

Unlike science advisory committees in every previous Administrations, the new PCAST has only four physicists, if the President's science adviser, **John H. Gibbons**, is counted. Gibbons serves as cochairman of PCAST with **John A. Young**, an electrical engineer and former president and CEO of Hewlett–Packard Co. Young is an ardent Clinton supporter. He and John Sculley, a founder and former president of Apple Computer, organized a contingent of corporate CEOs to campaign for Clinton's election in 1992.

Following are the other members of the restyled PCAST:

Norman R. Augustine, an aeronautical engineer who is chairman and CEO of Martin Marietta Corporation and has served twice in the Pentagon—as assistant director for research and engineering in 1965–70 and as undersecretary of the Army in 1975–77;

Francisco J. Ayala, a former Roman Catholic priest who is professor of biological sciences at the University of California at Irvine and a highly regarded geneticist and ethicist;

Murray Gell-Mann, professor emeritus of theoretical physics at Caltech, Nobel laureate in 1969 for "discoveries concerning the classification of elementary particles and their interactions" and, having acquired an intense interest in environmental matters, cofounder of the World Resources Institute in Washington, DC;

David A. Hamburg, president of the Carnegie Corporation of New York, former professor of psychiatry and human biology at Stanford University and one-time president of the Institute of Medicine;

John P. Holdren, an environmental physicist, professor of energy and resources at the University of California at Berkeley and chairman of the National Academy of Sciences's Committee on International Security and Arms Control and the Executive Committee of the Pugwash Conference on Science and World Affairs;

Diana MacArthur, chairwoman and CEO of Dynamac Corporation, an environmental sciences consulting company in Rockville, Maryland;

Shirley M. Malcom, director of education and human resources programs at the American Association for the Advancement of Science and an ecologist more widely known for her work in improving pre-college educational opportunities for under-represented minority students;

Mario J. Molina, professor of environmental sciences at MIT, who is internationally recognized for his work in determining the causes of stratospheric ozone depletion;

Peter H. Raven, director of the Missouri Botanical Garden, professor of botany at Washington University in Saint Louis and home secretary of the National Academy of Sciences;

Sally K. Ride, a former astronaut who is director of the California Space Institute and professor of physics at