21 April 1978, Volume 200, Number 4339 SCIENCE

# Science and Its Place in Society

Emilio Q. Daddario

When I was in the eighth grade at the William Barton Rogers Junior High School in the Boston suburb of Hyde Park, I wrote a theme on heating buildings by combustion, convection, and radiation. Although the school was named to honor one of MIT's outstanding presidents, I do not mean to give the impression that there was special emphasis on science. Our homeroom teacher, Miss Bishop, taught French as her principal subject, but she had to keep her own class under control, and she managed to do so for reasons of her own by keeping us busy on scientific and technical matters. I cannot recall whether she did this because of a special passion for science or because she had found over her years of teaching that it worked well as an alternative to other forms of discipline.

A few years later a group of us in our last year of high school went across the Charles River to visit MIT as part of an orientation program. Dr. Robert J. Van de Graaff was working then on his high voltage electrostatic generator, and I like to think that it was he, not one of his assistants, who conducted an exciting demonstration of his machine. I remain impressed to this day by the memory of flashing discharges of electricity jumping from one globe to another. Nevertheless, even then I knew somehow that the intracies of physics were beyond me, and I went off to Wesleyan University to study law.

All of us are creatures of our time, and I must admit that I accepted as normal that my college curriculum would include subjects in science over which I had not much choice. As is the usual case, these courses took more effort than my own major. However, I remember with affection rather than anguish such great figures as Drs. Walter G. Cady, Karl S. Van Dyke, and Vernet E. Eaton in physics and Dr. Frederick Slocum in astronomy. If they gave more attention to their own majors, they never showed it by approving laboratory work that was not well done; and because it took us longer, we got to know these teachers better.

It was only a small step from there to World War II. My generation was brought up on the diet of peace that followed the 1914–1918 War to End All Wars, and we were accustomed to the formal discipline that was strangely characteristic of the period that included the Roaring Twenties and the Depression Thirties. We quickly adjusted to the military regulations of the Second World War. Assigned to the Office of Strategic Services (OSS), those of us in Special Intelligence soon found that the enemy's strength was not limited to the identification, movement, and capability of its military units. The development of jet aircraft, the production of heavy water, and the V-L-rockets, the manufacture and distribution of the things that supported the war machine so depended on the men of science that we soon began to recognize and study how necessary was the part they played.

Moved by the force of these scientific and technical impressions, it was, perhaps, natural that I asked for membership on the newly formed Committee on Science and Astronautics when I was elected to the Congress. There, again, the pervasive impact of the contribution of scientists caused that committee to call on the representatives of the scientific community. The advisory roles of such men as Drs. James Killian, Detlev Bronk, George Kistiakowsky, Frederick Seitz, and Philip Handler revealed their commitment to the development of what might be referred to as a national involvement in science, if not the building of a national policy for science.

I hope you will excuse my reminiscing. Like that of many of you, mine has been an ordinary upbringing. A part of one immigrant group that places education at the top of its list of priorities, I had scholastic opportunities similar to those of other Americans. So many of us have experienced, to one degree or another, the influence of our men and women of science that, as a nation, we have come to respect our scientists and believe that they can do much for us. It comes as no surprise, therefore, that a recent Harris survey places "scientific research" at the very top of a list of major factors that will be more important in the next 25 years than in the past. Of those polled, 91 percent now believe this compared to 89 percent who believed it an important factor to past greatness. "Technological genius" is perceived by 78 percent as a key to future national greatness as against 75 percent in the past. Certainly related to the 75 percent who see "free, unlimited education to all qualified" as necessary to our future greatness are the 72 percent who see it as a past contributor. Despite that great well of regard, science is not now in the best of health. Since I have this platform, I would like to wonder a bit—as all of those others who have been affected, but who are not themselves a part of the scientific community might, if they were in my place. For my own involvement, which by chance led the membership of the AAAS to elect me as their president, is by itself an indication that bridges already exist across which scientists and laymen have long walked. The problems that exist for science may very well be—even though the bridges are already in place—that somehow the crossing of them has become difficult.

In recent years, scientists, concerned

The author is the retiring president of the AAAS. This article is the text of the AAAS president's public lecture which was delivered on 15 February 1978 in Washington, D.C., at the annual meeting of the AAAS.



0036-8075/78/0421-0263$00.50/0 

about our country's efforts in basic research, have tended to place the blame on a public disenchantment with science and technology. It would be unfortunate if that were the case for there would be nothing more difficult to turn around than a national antipathy toward science. Fortunately, we know that is not the situation. I expect that because of frustration, scientists are looking for a simple answer to a complicated problem, and perhaps some are feeling a little bit sorry for themselves in the bargain. If there has been any movement away from science as the glamorized activity to which government, scientists, and businessmen alike have responded to favorably during the nuclear and space engendered excitement of the postwar period, it is most likely related to the uses of technology of uncertain dimensions, induced by environmental, social, and educational factors. Certainly, the government's preoccupation with seeking immediate solutions to demanding crises such as unemployment, health, crime, welfare, urban decay, military, energy, and the like is tied to such specific efforts as those which have moved mission-oriented agencies away from basic research and toward a banner labeled "relevancy."

In today's world, with its rapid change, inordinate social pressures, and countless demands for a "quick-fix," the problems for science are compounded by the ways in which research funds are allocated among competing priorities. It has never been my belief that science must claim the center of the stage, but rather that it has an important role in many of our problems that require the application of science and technology for at least part of their solution. Even under the best of conditions—when we learn to explain how and when to apply science and technology and how and when not to as well—there will continue to be serious competition for resources. The greater problem now, and in any more hopeful future, is in the wisest division of those funds. If many of our brightest young people, who would otherwise enter our science arena, are passing it by without any real exposure to its attraction and potential, it may be because of uneven distribution within the setting of unpredictable science budgeting. When for several years, the Congress voted appropriations for fellowships and grants which our Chief Executive regularly refused to spend, graduate students had to postpone their education and they and their teachers often had to abandon their researches. If damage resulted from that decision, which I believe it did, we have also been able to see how important direct support is to our research professors and all those who work for them.

Recently, Dr. Francis D. Moore, chief of surgery at Peter Bent Brigham Hospital in Boston, said, "We think it's a mistake to target money for diseases like cancer. It's more important to fund the study of the cell wall or the cell membrane which in the long run may provide you with the clues you need to fight cancer." In placing our science bets, the lessons of the past would argue for the support of science teams headed by outstanding science leaders as a way to improve scientific research. Whatever our planning, however good our intentions, to overcome the problems that beset us, the improvement of our scientific research must necessarily precede the application of its results. Closely associated with this planning function is the idea of multiyear budgeting. I know of no field of human endeavor for which stable multiyear funding is more appropriate than that of research and development whose product is an expanded tax base and an improved ability of our society to pay its way.

The congressional leaders who culminated almost 20 years of effort in the passage of the National Science and Technology Policy, Organization and Priorities Act of 1976 were not lobbied into that endeavor, nor pushed by an energetic science community. Nor was President Ford convinced to sign it into law for any partisan political purpose. It was the simple evolution of a need which grew quite naturally from the recognition of "the profound impact of science and technology on society, and the interrelation of scientific, technological, social, political, and institutional factors." There was no attempt to favor scientists nor was it intended to force a scientific presence into the White House. The basic desire was to improve the decision-making process so that the President would have a better input of science at his level, to take or leave it as he wished. Those involved had come to recognize that improved science is valuable for its own sake and that from it could come practical gain, as well as the intrinsic promise that man could learn to live in harmony with the natural world around him. Having come to such terms philosophically, however, was one thing; making it work was another. It was necessary to recognize how things work with regard to priorities, the relationship between administrators and scientists, the problems of the poor univerisities versus the rich ones, the geographical distribution of federal research funds, the proper role of mission agencies in funding basic research, and, measured in political terms, what the government thinks of science and technology and how it intends to use and treat them. They also knew that though they had come a long way toward a recognition of the importance of science to society, the only place where it could be made to work was under presidential direction. They realized that would take unusual understanding in the Executive atmosphere where the day-to-day problems were so overwhelmingly those requiring immediate action.

We must recognize, of course, that it will always prove difficult to get money to spend now on future promises. The research dollar is extremely vulnerable whenever it is forced into direct competition with the defense dollar or the welfare dollar. Since anything with a humanitarian, security, service, or other popular appeal is likely to take priority over scientific research, there is the added tendency toward disruptive funding fluctuations. Although I cannot argue that this is always wrong, I do feel that steady and predictable funding will avoid inefficiency and waste, which are also the consequence of sudden changes, up or down, in research budgets. A policy that assures minimal fluctuations for an established period of time requires that the science and education provisions of the federal budget are looked at as an integral program of prime importance. As we examine the problems that face us, there is really no alternative. At the moment, inflation and unemployment are two demons that plague us, and the dilemma they offer—the improvement of the one worsens the other—is under constant examination. These and other symptoms of disorder in our society have different names—stagnating economy, a growing deficit in the balance of international payments, blight of the central city, declining tax base, slackening in the growth of the economy, and inability of capital to find reward for investment.

The consequences of these symptoms are a decline in that splendid generalization we refer to as quality of life. But the underlying cause is a narrowing of our options as a society. We keep pounding away at the same old cures for our diseases, not because they work—they rarely have—but because we do not know any better means, in keeping with a basic principle of our democracy. We depend on the patient understanding of our people while we look for solutions within a process of public education and choice even though we are often bewildered by the conflicting nature of the on-going dialogue on such subjects. This Administration, for example, has recently proposed a general income tax reduction which by its nature can only buy time. By giving us a little more take-home pay, it can relieve the pressures for wage and price increases, but only if all of the parts fall into place and all of the parties of interest behave accordingly. Yet economists, who often offer such temporary and shakey solutions, are among the President's most favored and visible advisers while scientists, who are specially qualified to develop adequate knowledge and understanding of the issues themselves, struggle to be heard and have little public exposure. Like economics or law, science is a way of looking at things, of studying and handling them. Despite that, and although we have long since identified law and economic theory as of sufficient importance to require the establishment of national priorities concerning them, we continue with regard to science to subgrade its policy structure and thus diminish its utilization as an equally important social tool.

Since the Legislative Branch has given impetus to such an effort, it would seem worthwhile for the Executive Branch to take up the challenge in full. The costs of doing so are relatively small, the risks are few, and the payoffs could be great.

As I see it, one important aspect of the AAAS responsibility is the assessment of the role of government in influencing the course and the conditions of science in our society. Another, perhaps equally important aspect is the role of science and technology in contributing to the goals and purposes of our national government. The present and prospective condition of American society makes both of these responsibilities perhaps more important and compelling of official recognition than in the past.

I am not speaking of the limited or parochial interests of the membership of the Association. True, we have a traditional concern for the health and stability of the scientific enterprise in the United States, and the condition of science remains of fundamental interest. I do suggest, however, that we must also have a larger mission today than the preservation and support of the scientific establishment in the United States. When President Carter came to the White House, he brought with him a list of declarations, promises, and policy positions. I do not think he should be faulted for this—and too often he has been. As the poet says, "Man's reach ever should exceed his grasp, or what's a Heaven for?"

Our aspirations ought to run ahead of our daily achievement, or life loses its joys, its excitements, its very meaning. When the President calls for a heightened efficiency of the Executive Branch of government, we certainly share his aspiration. When the President declares the intention of striving for a balanced budget by 1981—he should not be faulted for a hope that most of us share. We also share his recognition that a sound fiscal policy is essential to the control of inflation, the preservation of the value of the dollar, and the incentive for investment in America's future. What I suggest, before this forum of America's scientists and technologists, is that we not only share the aspirations for a better America, we also share the means for achieving progress toward them.

# Past Glacial Activity in the Canadian High Arctic

## For at least 30,000 years ice-free areas have existed between Greenland and Ellesmere Island ice sheets.

J. England and R. S. Bradley

Northeast Ellesmere Island and northwest Greenland are separated by only 20 to 40 kilometers along the lengths of Kennedy and Robeson channels (Fig. 1). In this area the present-day United States Range and Agassiz ice caps on Ellesmere Island are but 150 km from the margin of the Greenland Ice Sheet. The intervening landscape along both coastlines is characterized by dissected plateaus and mountains of low to moderate elevation (300 to 1200 meters above sea level). The topography of Ellesmere Island and its proximity to Greenland make it an ideal location for investigating the past interactions of their respective ice sheets. Recent fieldwork on the coastal areas between these ice sheets has provided new information on past glacial activity in the region that is directly relevant to both paleoclimatic and chronological interpretations of high-latitude ice cores (*1*).

In recent literature it has been generally assumed that the Greenland Ice Sheet was contiguous with an ice sheet over the Canadian Arctic islands during the last glaciation (*2*). More specifically, it has been proposed that from at least 59,000 to approximately 13,000 years before present (B.P.) there was a substantial ice ridge over Nares Strait (Fig. 1) built up to a width of about 700 to 800 km (*3*). The altitude of this ridge was estimated to be 2500 to 3000 m, and the ridge presumably joined the northwest Greenland Ice Sheet on Knud Rasmussen Land to the hypothesized Innuitian Ice Sheet over the Queen Elizabeth Islands. Evidence in support of such a major ice mass has been provided by the analysis of the total gas content from the Camp Century ice core, which suggests that the northwest Greenland Ice Sheet was about 1300 m thicker than today toward the end of the last glaciation (*4*).

By contrast, however, several authors have cited stratigraphic evidence for a restricted ice cover over northern and northwest Greenland during the late Quaternary (*5–7*). In general, the outermost glacial deposits in this region are considered to predate the last glaciation, on the basis of associated "old" radiometric dates, advanced rock weathering, and subdued moraine morphology (*8*).

J. England is an assistant professor of geography in the Department of Geography, University of Alberta, Edmonton, Alberta T6G 2H4, Canada, and R. S. Bradley is an assistant professor of geography in the Department of Geology and Geography, University of Massachusetts, Amherst 01003.


0036-8075/78/0421-0265$01.25/0 