Informatics Studies. ISSN 2320 – 530x. Vol. 4, Issue 4
Fourth Quarterly Issue. October – December, 2017. P 49-56

David Allan Bromley: The Early Champion of Information Super Highway and Open Access to Science

Randy Ray

Abstract

Having grown up as a small boy on a farm in Northern Canada without plumbing or electricity, David Allan Bromley went on to become the first sterling Professor of the sciences at Yale University, Chair of its Physics Department, and Dean of Engineering; at various times President of the American Association for the Advancement of Science, the Union of Pure and Applied Physics, and the American Physical Society; the first cabinet-level assistant to the President of the United States for Science and Technology with direct access to the President; and the Senate-confirmed Director of the White House Office of Science and Technology Policy. He was an early champion of high speed network which he called 'data superhighway' now known as the Internet and Information superhighway, as well as the concept of Open Access to Science. He was a leading figure in nuclear physics. In the area of public policy he will be remembered as one of the most effective Science Advisers to the President of the United States.

Keywords: United States, Nuclear Physics, Internet, Information Superhighway, Science Policy, Open Access

Introduction

It was a case of what the scientist saw. Or how, in just a few short hours, a Canadian physicist became an American citizen.

It happened one day in 1970 when Allan Bromley, then a nuclear expert from Yale University and later science adviser to the first President George Bush, was shown how to trigger the hydrogen bomb something that put his colleagues all in a panic.

"I had been shown the deepest, darkest secret known in the United States out at the Weapons Flats in Nevada," Allan Bromley; the farmer's son from the Ottawa Valley told the Toronto Star in 1992. "And just about the time it was all finished, someone said, 'Oh, my God, Bromley is not a citizen.' " He remembers: 'They had two choices. Either shoot and bury me and pretend that I had never been there or make me a citizen as rapidly as possible. Happily they chose the latter, but only after some discussion!' A judge was hurriedly sent out from nearby Las Vegas and Dr. Bromley was sworn in on the spot so that "it became legal for me to know that deep, dark secret." He became U.S. citizen in 1970.

The renowned nuclear physicist's rise to the pinnacle of American science began under circumstances considerably less odd than the event that saw him suddenly becoming an American.

Childhood

Allan Bromley was born in Ontario, Canada. His parents were farmers. He spent his

childhood in the family farm with meager facilities until he was 17. At his seventh year he joined a one-room public school. He walked eight miles daily to school and back. It was an unorganized school, which permitted to progress at his own pace, and it enabled him to skip many grades. Then he attended high school in Westmeath and Pembroke both nearby village towns. The family found it difficulty to purchase more than one set of cloth for him to go to school. By the time he reached grade 12 he was convinced that his future is in the sphere of science and technology. There was no other student except him in his class, So he was given textbooks and laboratory manuals for physics and chemistry. He held the key to the Lab and was free to do any experiment he wishes.

Education

After school he joined the university, which was 20 miles away. He took a room on rent and worked in a lumber camp to earn money to meet his expenses for study. He won scholarships for general proficiency for the highest score ever recorded in Canada up to the date for Grade 1 examinations, another one in English offered by Queen's University in Kingston, and also a four-year scholarship from the Canadian Woman's Christian Temperance Union for his article on the evils of drinking. With these he spent a year focusing on English at Queens. But he recognized that to continue with this major could force him to starve. So changed main subject of study to Engineering Physics, which contained the electrical engineering training, as well as undergraduate physics. This change required substantial catch -up but it was for him a life-determining decision.

He wanted to join Canadian Air force, but was found unfit. So he continued in physics and graduated in 1948. He got the Governor General of Canada's medal for the highest-grade score in four years of undergraduate study and also won the Shell Oil Fellowship, admissible for any doing graduate study. In the summer after graduation, he joined the National Research Council of Canada in Ot-tawa. There he built an ion source for use with a 600,000 V Accelerator. In Queens University, he worked with Eric Pickup his cosmic-ray studies. It was hi work during this period that convinced him to join for cosmic-ray physics research for his career objective. As he wanted to continue cosmic ray research he declined a scholarship to attend Oxford University and joined University of Rochester. Prof J. A. Gray was his research supervisor.

His first paper reporting his work on the reconstruction of a Wilson Cloud Chamber System was published in 'Review of Scientific In-struments' in 1948. His second paper, giving results of his measurements on the neutron spectrum in cosmic rays, got published in the Canadian Journal of Physics' (1951). He started research on cosmic ray under Harry Fulbright. With two dental researchers he originated the inclusion of fluorides in toothpaste for which they got gold medals from the Strong Memorial Hospital. Allan completed PhD in 1951. Work done by him for PhD was the earliest deuteron stripping reaction studies outside the Great Britain to prove that the parity of 14/N was in fact even.

Contributions to Nuclear Science Research

After completing his PhD he joined Rochester as faculty member and worked there for four years. Based on his PhD work, he published papers in Physical Review (1952). Numerous publications in reputed journals followed.

He shifted to Queen's University in 1955. Along with James Mackenzie he constructed test silicon detectors, which was patented. But at that time no one thought it to be of any commercial value. But they have become routine components of the major detectors in elementary particle and nuclear physics. They are now used in moat areas of medicine and commercial technology. The annual value of the silicon semiconductors acquired all

over the world for similar uses at present is over $1000 million.

Then Allan with his col-leagues began the heavy ion studies. Their invention and theoretical description of nuclear molecules became key stimuli for the development of the research area of heavy ion physics and has influenced the entire field worldwide ever since. But they were unfortunate at that time in getting collaboration of Canadian universities. So Allen shifted to a purely academic atmosphere.

Allan joined the Yale faculty as associate professor of physics in 1960. He was the founder and Director of the A. W. Wright Nuclear Structure Laboratory at the university from 1963 to 1989.

He participated fully in the planning and conduct of Kingston International Conference on Nuclear Physics of the same year sponsored by IUPAP with 400 scientists deputed by concerned governments from more than 25 countries. The 900-page proceed-ings of the conference published by the University of Toronto Press was fully screened and edited by him along with E. W. Vogt. Later he edited the eight-volume series on heavy ion science also.

He undertook the pioneering studies on both the structure and dynamics of atomic nuclei. He is considered the father of modern heavy ion science, a major field of nuclear science. From 1972 until 1993, he held the Henry Ford II Professorship in Physics at Yale University. From 1970 to 1977, he served as chair of the Physics Department of the university. Dr. Bromley was dean of Engineering at the university from 1994 to 2000

Leadership Roles in S &T Research and Development

Professor Robley Evans of MIT requested Allan in 1964 to become the chair of the National Research Council's Committee on Nuclear Science. Participation in this committee exposed him to the functioning of the U.S. Government, both legislative and executive. Allan came to know closely large most personalities who gave leadership to the American nuclear science community. In 1960s the National Academy of Sciences felt that it was time for a new overview of physics and asked him to chair the Academy's Physics Survey Committee (Greiner and Lane, 2009). Later he served the Academy in numerous capacities, as a member of the Executive Committee of the Assembly of Mathematical and Physical Sciences (1967-1978) and later as Chair of the Office of Physical Sciences (1975-1978).

Due to his initiatives and leadership in the physics and academic community, he was invited to serve (1973-1989) as confidential consultant to the Nixon Administration. He agreed and so became a member of the Science Policy Working Group. He also became a member of the U.S. delegation to the International Council of Scientific Unions (1976-1987). Afterwards he became member of its Executive Board (1982-1983).

During these assignments Allan become aware American presence is not there in the International Union of Pure and Applied Physics (IUPAP). He served as a member of U.S. National Committee for IUPAP (1965-1975). He was elected Vice President, and later President (1984-87). According to him one of the most memorable achievement as its President was including the People's Republic of China as well as Taiwan as two different members of IUPAP.

In 1975 a philanthropist of New Haven offered him $250,000 per year for research that was pertinent to the energy crisis that had become crucial. He utilized this amount to support graduate students under the title of Wright Fellows till 1989. Allan was hailed as an outstanding teacher. During 1965 to 1989, his lab at Yale university produced more doctoral students in experimental nuclear physics than any other institution in the world. Dr. Bromley published more than 600 papers in science and technology, and edited or authored 25 books and Reports.

Allan was offered many prestigious positions in different universities and government in 1970s and 1980s, but he without accepting them continued his work at Yale University. In 1970 he was appointed to Chair the Yale Physics Department. He held the position till 1977. In 1972 Yale President Kingman Brewster also appointed Allan the Henry Ford II Professor.

In 1988 President Ronald Reagan selected him for the U.S. National Medal of Science; the highest honor available to a scientist in the US. The citation reads: 'For seminal work on nuclear molecules, for development of tandem accelerators and semi-conductor detectors for charged particles, for his contributions to particle-gamma correlation studies, and for his role in founding the field of precision heavy-ion physics.'

In Yale University, he served on numerous boards of directors and also on many scientific advisory boards. He was also appointed to the National Science Board, the body of the National Science Foundation that advises and shares policy-making authority with the Director. Allan was elected Vice President of the American Association for the Advancement of Science, the world's largest scientific society in 1980, President in 1981 and its Chairman in 1982.

Allan also acted as an adviser to the Richard Nixon Administration. He was selected by President Ronald Reagan (1981-1989) to be a charter member of the White House Science Council (WHSC). His work on the Science Council was focused on international issues as well as higher education and the national research laboratories President Ronald Reagan appointed Allan to the National Science Board (1988-1989). But later he resigned when President George H. W. Bush selected him to join his White House team.

As Science Adviser of American President

In 1989 President George H. W. Bush made Allan his science adviser. He gave him the title of Assistant to the President for Science and Technology. He also nominated Allan to be Director of the Office of Science and Technology Policy (OSTP). He served in both these capacities until the end of the Administration in January 1993. It was the first instant in history when the President's science adviser had held the title of Assistant to the President also.

Before accepting the position Allan a seasoned negotiator made three requests: he will be given access to the President whenever he felt that it was important to see him; once he and the President had agreed on a policy action in the area of science and technology, he would have the President's full support for materializing it; and that the four OSTP associate directors also will be appointed by the President, as was permitted by the 1976 legislation that established OSTP.

Contributions to Public Policy

Allan was not only an outstanding nuclear physicist, he was also a model 'civic scientist', an individual who not only contributes significantly to the understanding of the natural world but who also devotes much of his career to public service. His career in public service culminated with his appointment as assistant to the President for Science and Technology Policy.

While in the White House, he revitalized the Federal Coordinating Council for Science, Engineering, and Technology and he achieved an unprecedented level of cooperation and communication among the more than 20 federal agencies that support U.S. Science and Technology (Greiner and Lane, 2009).

Allan was responsible for the first formal published statement of U.S. Technology Policy and played a central role in expanding cooperation between the federal government and the private sector toward effective use of technology in U.S society. One of his major accomplishments during the Bush Administration was the breaking down of the barriers that had existed between the

federal government and the private sector in the area of technology development, a change that was long overdue (Greiner and Lane, 2009).

During the Bush Administration, Allan often testified before congressional committees and delivered more than 400 addresses to major audiences across the country and the world as the senior representative of U.S. Science and Technology.

Allan began his public and community service involvement like most of the scientists by involving on various review and advisory committees of federal agencies or the National Research Council. He could quickly impress those around him—on his side of the table and especially those on the other side—with his knowledge of physics, command of important information, ability to communicate with different audiences, and when appropriate, his well-honed skill at tough negotiations. He was increasingly sought out to chair important committees, lead delegations, make the case for science to policy makers, and accept positions of leadership in the science community (Greiner and Lane, 2009).

The subject areas Allan dealt with include research and development; Superconducting Super Collider; K-12 and higher education; economic competitiveness; regulation; new technologies and technology transfer; computing and communications; environment and climate change; energy; nuclear waste; health, medicine, and quality of life; food safety; space science and exploration; national security and missile defense; weapons of mass destruction; transportation; international research cooperation; and many others.

Internet and Information Superhighway

Allan's aptitude for science would elevated him to a leadership role in the national and international science and science-policy communities on which President Bush has remarked: "In my view he was a truly great leader in the U.S. scientific community. I know I felt privileged to have him at my side when I was president."

As Mr. Bush's top science adviser from 1989 to 1993, Allan pushed for substantial increases in money for science and technology research in a race to keep U.S. manufacturing ahead of other countries like Japan and Germany. He supported the expansion of the high-speed network that became the Internet, and, after years of questioning the science behind global warming, he was credited with persuading Mr. Bush to attend a summit on the issue (Fleury and Iachello, 2006).

Serving as the president's science and technology adviser and as chairman of the Office of Science and Technology Policy, Dr. Bromley was seen as one of the most influential science advisers ever. "He gave the president his best advice rather directly. That made him a superb adviser on hard issues," John Sununu, Mr. Bush's former chief of staff, told the New York Times.

Dr. Bromley was an early champion of what he called the "data superhighway," now known as the Internet. "Ten years from now," he said in 1991, "I'd like it to be widely available and looked upon like the telephone network (Ray, 2005)."

Mr. Sununu said that Dr. Bromley "understood its value" both for global communication and exchanging information.

"Everyone in the area was very proud of his achievements," said says family friend Marie Zettler, a former editor at the weekly newspaper in Cobden, Ont., who had interviewed Dr. Bromley three times over the years. "It was my understanding that George Bush senior worked very closely with Dr. Bromley and took what he said very seriously."

Interagency Research Initiatives

One of his important accomplishments was the reinvention and strengthening of the

Federal Coordinating Council for Science, Engineering, and Technology (FCCSET) (Smith, 1992). He considered that to be effective the committee would need to be at the highest level, with agency officials who could commit to policy actions, including budget allocations. By getting the President's agreement he was able to raise the level of FCCSET and direct a significant portion of the federal funding toward specific presidential R&D initiatives, centered on strategic areas that addressed vital national needs which required substantially increased research investment (Smith, 1992). .

Six crosscutting initiatives were identified for the first three years of the Administration: Global Climate Change Research; High Performance Computing and Communication; Advanced Materials Science and Processing; Biotechnology; Mathematics and Science Education; and Advanced Manufacturing (Greiner and Lane, 2009).

With the strong support of the President and negotiating skills of Allan most initiatives were highly successful. Some were later modified and continued by the Clinton Administration, which adopted the coordination model of FCCSET but transformed it into the National Science and Technology Council (NSTC), chaired by the President. The council was of critical importance in the planning the National Nanotechnology Initiative (NNI). It continued to receive the strong support of the White House and Congress.

Research Budgets

Allan was a strong advocate for increased federal research funding. But he was well aware that policy makers required being able to connect research with potential benefits in a way in which things could be clearly understood. Strategic initiatives did the same, and by keeping them sufficiently broad in scope there was plenty of space for excellent basic research in all areas of science and engineering to be supported. In the first union address, President Bush promised to increase research funding for the National Science Foundation (NSF) to improve basic research. Allan's strategic approach continued after him also. He did not hesitate to speak out when he thought science policy was moving in the wrong direction. His early attention to the country's need for increased research funding for the physical sciences and engineering and his initiatives had contributed much for the positive developments that occurred in those spheres.

Federal Technology Policy

It is to be noted that 'technology was included, for the first time, in the name of the President's external committee of advisers. It signaled that the Bush Administration would be having an interest in technology as well as science. For Allan technology was a priority. He often remarked that he took seriously the 'T' in OSTP, and technology figured prominently in the agenda of the Bush Administration, which issued a report titled *U.S. Technology Policy*, with the presidential seal of a Republican President on its cover. This report addressed issues such as the workforce, financial environment, technology transfer, and legal matters. It provided a basis for the development of a number of initiatives, including the development of pre competitive and dual-use technologies in partnership with industrial sectors. Bush Administration was clear that technology policy was not the same as industrial policy. Even with all this, Allan got considerable resistance from others in the White House, which he cleared with the support of President Bush.

International Cooperation on S &T

On many occasions Allan expressed his frustration with the State Department's apparent disinterest in science and international cooperation on matters of science and technology (Greenberg, 2001). Failing to get help from the State Department, he proceeded by himself. Allan succeeded in getting private funding and with that founded the "Carnegie Group," a

non-governmental meeting of the science and technology ministers and their counterparts from the G-8 countries and Russia normally held two times a year in one of the host countries. Allan understood that to make progress with science and technology cooperation at the highest levels of government, concerned top officials would need to know each other and should have a chance for informal off-the-record discussions—with no staff, no official record, no press releases—well before any formal actions were taken. This was a powerful notion, and Allan achieved that with support from the Carnegie Foundation (Greiner and Neal Lane, 2009). The Carnegie Group continues to meet and has proven to be very effective.

'This nation has been well served by the many scientists who have advised the U S Government, including science advisers to the President. Each individual who serves in this way experiences unique circumstances set by the times, the most pressing needs of the nation, and the priorities and style of a particular President and Administration. Allan was the right person at the right time. Allan Bromley possessed just the right balance of intellect, insight, creativity, charm, and assertiveness that enabled him to be effective in Washington' (Fleury and Iachello,2006)

John Sununu, Chief of Staff in the White House, observed 'Allan was effective because he truly understood what the job of President's science adviser was and what it was not. The job is to give the President the best objective advice on any policy matter that relates to science and technology (e.g., global warming and climate change), summarize the state of scientific understanding—including all the uncertainties, and when appropriate recommend policy options. The job is not to be a representative of the science community or environmental community or any other group that might have a special interest in the policy outcome. Because most important policy matters involve not only science but also other issues (e.g., economic tradeoffs) the science adviser must work well with other advisers to the President and, whenever possible, reach agreement on policy recommendations before they reach the President's desk. Global climate change is a good example, where Allan's deep probing of the science and his ability to translate technical findings for nonscientists in the White House was enormously important in President George H. W. Bush's decision to sign the Framework Convention in 1992. (Fleury and Iachello, 2006)

President Bush remarked in at the 2005 Bromley Memorial Symposium 'I want you all to know that I held Allan Bromley in the highest regard. My respect for the job he did as Science Advisor to the President knows no limits. He was an especially effective advisor who advanced an ambitious agenda for science and technology…he helped me give science and technology a much-needed enhanced visibility among our nation's priorities. And, while accomplishing all of this, Allan Bromley remained a decent, nice man" (Fleury and Iachello, 2006).

John Marburger, science adviser to President Bush, stated 'Allan Bromley's willingness to dedicate much of his life to the improvement of science policy formation will make it easier for others to follow his example' (Fleury and Iachello, 2006).

Even though Allan got many offers from government and other organizations, when President Bush left office he went back to Yale University at the beginning of 1993. When he came back university recognizing his contributions created for him the first and only Sterling Professorship of the Sciences. Early in 1994 Allan agreed to become the dean of engineering at the university. .

In 1996 the members of the American Physical Society (APS) voted to elect Allan as Vice President, and President in 1997. Over a decade earlier Allan had helped to establish the APS Division of Nuclear Physics (1966). The APS awarded him its 2002 Nicholson

Prize in recognition of his roles as research scientist, outstanding teacher, supportive mentor and colleague, leader of the physics community in his country and worldwide, and adviser to governments.

After leaving the position of Dean of Engineering, he spent much time in the Wright Nuclear Structure Laboratory of his department. He wrote several books, including *A Century of Physics* (2001) and also his memoirs. In the beginning of 2001 he was invited to be the first Yale Sheffield Fellow.

In 2001, Allan found that Bush Administration's approach toward Science and Technology has become untenable. Forced by conviction, he wrote his views in detail for the *New York Times, which* was published on March 9, 2001. It contained the message, 'No science, no surplus.' This write up is a very important document, as it clearly reveals that Allan prioritized science and the future prospects of the world over any of his own political considerations.

A Unique Model

"What made him tick? It was his drive and his work ethic," said his brother John Bromley. "Whether he was coiling hay or working around the farm, no matter what he chose to do you knew he was going to do his best'(Randy , 2005).

Let us conclude this biographical Note by quoting his own words:

I have been extraordinarily fortunate to have lived during one of the most exciting and productive periods in science and in technology, my areas of primary interest, and I have had the opportunity to participate in my own research activities, in leadership in some of the most senior professional organizations in my field, and in the evolution of public policy toward making the new scientific and technological results available to, and important to, the lives of all humans Bromley, (Bromley, 2002).

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