Science Policy in the United States: The Legacy of John Quincy Adams

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THE FRAMERS of the United States Constitution laid out the powers of the President, Congress and the judiciary without mentioning, except indirectly, the policies and institutions by which the new government might foster or use either technology or science. The word "science" actually appeared once in the patent clause, and several provisions—such as those for setting standards of weights and measures, the exclusive right to coin money, and a census—imply highly technical operations. Nevertheless, the several discussions during the convention of a national university and of rewards for the promotion of agriculture and commerce, did not reach the final document. This silence made the early attempts to formulate a science policy very hesitant.[1]

John Quincy Adams's Role in Shaping Science Policy

The lead in defining a place for science in American culture fell to the same persons who carved out diplomatically a place for the new republic in the transatlantic family of nations. Thomas Jefferson, Benjamin Franklin and John Adams had drafted the Declaration of Independence, and had immediately gone on to establish the American presence in the major capitals of Europe. All three were in Paris in the mid-1780s, acting as scientific and cultural observers as well as diplomats. John Quincy Adams, who spent most of his life from the age of ten in Europe with his father, had ample opportunity to be an understudy of the founders, especially of Jefferson. As a 14-year-old boy he talked to Jefferson often, not so much about science as about literature and art.

The American scientific establishment did not originate in the wilderness completely isolated by a wide ocean from the European centres of learning. Instead, the first steps towards establishing a national science were taken in Paris in the mid-1780s by the American delegation, made up of Franklin, Jefferson and the two Adamses. From that time on, an American science policy also took shape.

In 1825, in spite of his ambiguous position as a minority president, John Quincy Adams put forward in his first annual message to Congress a

[1] Dupree, A. Hunter, *Science in the Federal Government: A History of Policies and Activities* (Baltimore and London: Johns Hopkins University Press, new edn 1986), pp. 3–6.

fully developed version of the founders' vision, the only comprehensive and explicit science policy in the history of the federal government. He assumed that action to promote knowledge, like other internal improvements, was both constitutional and obligatory. He called for a national university, a national observatory, explorations and surveys, a naval academy to add to that for the army already established at West Point, an efficient patent office, and a new executive department to plan and supervise internal improvements, especially including the proposed scientific institutions. Adams's message was disparaging of the actual accomplishments of American science in comparison with Europe, which had 130 "lighthouses of the skies" compared with no observatories worthy of the name in the United States.[2]

Adams had developed his ideas on weights and measures and on astronomy while minister to the court of the tsar from 1809 to 1814. He was in close touch with the developments in astronomy there that led in a few years to the founding of the Pulkovo Observatory and a shift of eminence in astronomy to Russia.[3] To the common men who supported his rival Andrew Jackson and who mistrusted a grand, magnificent, monarchical government, Adams's proposals were dangerous and ridiculous—the building of "lighthouses in the skies". At the end of his one term as President, Adams was defeated by Andrew Jackson; his programme for American science and technology seemed to be doomed forever. The election of 1828 was a warning to all future presidents not to place science policy as a whole as a major issue before the electorate.

In 1830 John Quincy Adams returned to the Congress as a representative of his home district in Massachusetts. By the time of his death on the floor of the House in 1848, the whole array of institutions and programmes that he had unsuccesfully proposed as President had come into being. Without a constitutional amendment and with careful avoidance of philosophical debate, the United States government had learned to support science with public funds in a way that respected the freedom of the scientist to follow the path along which his research led him, whether or not he was working on practical or fundamental problems. The federal government had learned to appropriate money for research over several years without explicitly admitting that it was creating permanent institutions.

The bill which revived the Coast Survey contained a specific prohibition against an astronomical observatory, thus enabling a survey that was not intended to become a permanent institution. Nor was the Naval Observatory intended to be what it became; it evolved from a depot of charts and instruments in the navy, in spite of the prohibition against it.

[2] *Ibid.*, pp. 39–41.

[3] Adams, John Quincy, *An Oration Delivered before the Cincinnati Astronomical Society, on the Occasion of Laying the Cornerstone of an Astronomical Observatory* (Cincinnati, 1843), pp. 56–59, reprinted in Cohen, I. Bernard (ed.), *Aspects of Astronomy in America in the Nineteenth Century* (New York: Arno, 1980), pp. 1–72.

With a permanent source of funds clearly in view, however, Congress could come to grips with the fundamental power of the government under the Constitution to support science, as in the case of the unexpected Smithsonian bequest. After a decade of wide-ranging debate, the Congress, of which John Quincy Adams was an important member, passed in 1846 an organic act for a research institution that set a major precedent for the support of science. Normally only a very few congressmen interested themselves in each project—as John Quincy Adams did in astronomy and in the Smithsonian Institution—and only occasionally in the nineteenth century did debate extend beyond specific appropriations for particular objects.[4]

A wide variety of institutional forms for the conduct of scientific studies gradually grew up, inside and outside the military services. Instead of a national university, federal funds could on occasion flow to private universities as a transaction between independent partners. The many schemes for a federally supported national university in this period envisaged a single institution in the District of Columbia, which had been set aside for the capital city. By contracting for a special set of scientific data, as in the case of the home observations for the Wilkes expedition undertaken by the Harvard Observatory, the federal government could avail itself of scientific expertise in colleges and universities wherever they were established by the initiative of others throughout the several states. The President did not look at science policy as a whole, but rather through discrete appropriation bills scattered through the various departments. Authority depended on many different provisions in the Constitution. Andrew Jackson had defeated Adams in what might be considered an anti-science referendum. His public criticism of powerful central institutions such as the Second Bank of the United States, and his shameless practice of the spoils system in dealing out governmental appointments to his political supporters without any thought of technical competence, all made the electorate consider him unfriendly towards the support of science. Yet Jackson and his followers ended up fulfiling most of Adams's hopes.[5]

Adams, Hassler, and Governmental Science

To illustrate how the system developed in John Quincy Adams's own time, we can follow briefly the career of the first director of the Coast Survey, Ferdinand Rudolph Hassler, and note his intermittent relations with Adams. A native of Switzerland, Hassler was a highly trained geodesist skilled at astronomical observations and surveys by triangulation. He came to the United States as part of a land speculation scheme,

[4] Jones, Bessie Zaban, *Lighthouse of the Skies: The Smithsonian Astrophysical Laboratory. Background and History 1846-1955* (Washington, DC: Smithsonian Institution, 1965).
[5] Dupree, A.H., *Science in the Federal Government, op. cit.*, pp. 44–65.

and brought with him a very authoritative set of French standards, including a metre bar.

When the Swiss private venture fell through, Hassler undertook the survey of the coast for President Jefferson. There was enough of a science policy even in 1807 to enable the President, in spite of qualms on constitutional grounds, to appoint the best qualified scientist available and give the appointee sufficient power and money to purchase instruments.[6] As an early order of business, Hassler went to London, the centre of astronomical instrument-making, to oversee the construction of a transit circle by the greatest craftsman of the day, Edward Troughton.[7] Hassler spent the whole of the War of 1812 in London and Paris.

Most of the history of American science has been written as if scientists and their theoretical operations came first, and only later did they obtain their instrumentation and other equipment. In the early years, most theory was embodied in literature emanating from the major European centres, leading many scholars with a theoretical and European bias to the conclusion that there was no science in America before the twentieth century. The actions of Hassler and others clearly indicate that the first order of business in setting up scientific institutions in a new state was to build up a stock of instruments and equipment of the highest quality, as well as a corps of highly skilled operators. Instruments for the United States Coast Survey were the best in the world at that time.

John Quincy Adams and Hassler made an informal team. When Adams came to London as American minister in 1815, Hassler provided him with an introduction to the Astronomer Royal at Greenwich. Although Adams went on to become secretary of state under Monroe, he could not help Hassler much when in 1818 the Swiss scientist, then under the treasury department, was effectively dismissed from the Coast Survey by an act of Congress providing that only military and naval officers could be employed. This was supposedly a measure of economy, but the chaplain of the navy, with no known scientific qualifications, was actively seeking appointment to the post.

Hassler was separated from his work, his salary and his instruments for 12 years, from 1818 to 1830. During that period, including Adams's whole presidential administration, the science policy of the government was at a standstill, with no way open to support the single most obvious and already approved project. Without scientific direction for the work, the

[6] For policy on instrumentation, see Stine, Jeffrey K. and Good, Gregory A., "Government Funding of Scientific Instrumentation: A Review of U.S. Policy Debates since World War II", *Science Technology and Human Values*, XI (1986), pp. 34–46. On the development of the survey, see also Turner, Stephen P., "The Survey in Nineteenth-Century American Geology: The Evolution of a Form of Patronage", *Minerva*, XXV (Autumn 1987), pp. 282–330.

[7] See Bennett, J.A., *The Divided Circle: A History of Instruments for Astronomy, Navigation and Surveying* (Oxford: Phaidon Christie's, 1987).

navy accomplished nothing.[8] Hassler's letters to Adams during this period show a number of proposals almost in modern form, including *curricula vitae*.[9] The correspondence from Hassler to Adams in the archives of the Massachusetts Historical Society contains research proposals for projects such as the period of the pendulum. The chief obstacle to their acceptance was that Adams had no power as secretary of state or as President to do anything with these proposals. Only in the surveying of the northern boundary and in a memorandum on standards of weights and measures could Adams make use of Hassler's talents.

When Andrew Jackson became President and Adams had taken his humbler place in the House of Representatives, the way opened for Hassler to return to government service as a scientist. He came in as a contractor to make the standard weights and measures for distribution to customs houses and to the states; he made the vessels, the weights and the metre bars. This move was entirely consistent with John Quincy Adams's great report on weights and measures of 1821, to which Hassler had contributed his memorandum as a crucial appendix.[10]

Hassler thus came back to build a specific set of instruments, a task for which he was uniquely qualified. This small beginning gave the government an office of weights and measures, but it required much less than Hassler's full time. His scientific business was to calibrate instruments against the most accurate copies of European standards available. The office, soon incorporated within the Coast Survey, lasted almost without change until 1900, when the Hassler–Adams principles were incorporated into the Bureau of Standards.

With the revival of the Coast Survey, Hassler—at least in his own mind—became director by contract. He could appoint civilians, receive military and naval officers on detached duty, set standards of performance, and equip a carriage to take him and his instruments into the field. He demanded the unheard-of salary of $3,000, plus $3,000 in expenses.

When this "outrage" came to the attention of President Jackson, it touched off an unusual conversation, of which an account has been preserved.

Jackson: "So, Mr. Hassler, it appears that the secretary of the treasury and you cannot agree on this matter."
Hassler: "No sir, ve can't."
Jackson: "Well, how much do you really think you ought to have?"
Hassler: "Six thousand dollars, sir."

[8] Cajori, Florian, *The Chequered Career of Ferdinand Rudolph Hassler, First Superintendent of the United States Coast Survey: A Chapter in the History of Science in America* (Boston: Christopher, 1929), pp. 85–89.

[9] Letters from F.R. Hassler to J.Q. Adams, Adams Papers, Massachusetts Historical Society.

[10] Adams, John Quincy, *Report of the Secretary of State upon Weights and Measures* (Washington, DC: 1821), Dupree, A. Hunter (ed.) (New York: Arno, 1980), pp. 153–170.

Jackson: "Why, Mr. Hassler, that is as much as Mr. Woodbury, my secretary of treasury, himself receives."

Hassler: (rising from his chair) "Mr. Voodbury! There are plenty of Voodburys, plenty of everybodys who can be made secretary of the treasury, but there is only one, *one* Hassler for the head of the coast survey."[11]

Jackson sympathised with a character who had so many traits in common with his own, and Hassler was granted the $6,000 he sought. Jackson himself told this story.

The Coast Survey came into existence as a full-blown scientific agency that still can be identified in the structure of the United States government. A civilian institution, its charting and mapping activities were of essential importance to the military. At the same time, similar institutions could grow up within the services themselves, as in the case of the Wilkes expedition in the navy and the corps of topographical engineers in the army. The Naval Observatory, while administered by the department of the navy, was a fully scientific institution. The responsible scientists sought long-term support, flexibility in objectives, freedom to publish, access to the international scientific community, and they tried to get remuneration and conditions of work which would match their conception of themselves as scientists and make their research possible.

Only a few months before Hassler's death, he asked Adams to introduce him to the new secretary of the Treasury. The old statesman recorded in his diary:

I introduced him [Hassler] to Secretary Spencer, and almost immediately left them together, but not without perceiving the seeds of conflict already germinating between two proud spirits, which bodes no good to the progress of the Coast Survey. The recent act places Hassler under the control of a board of officers and the whole operation under the superintendency of the secretary of the treasury. Hassler, already restive under the yoke fitting to his neck, said that the work, being scientific, must be conducted on scientific principles. The potentate answered in a subdued tone of voice, but with the trenchant stubbornness of authority, "The laws must be obeyed."[12]

Policy for the Scientific Establishment

The United States President dealt with each unit of this highly pluralistic scientific establishment separately. In addition to the projects coming to him from different parts of the government and under different powers of the Constitution, the scientific establishment involved non-governmental institutions such as universities and also the professional societies of those who were beginning to call themselves scientists. From the earliest days of the republic, the American Philosophical Society—founded by Franklin and of which Jefferson had been president—and the

[11] Cajori, F., *Hassler, op. cit.*, pp. 206–207.
[12] *Ibid.*, p. 229.

American Academy of Arts and Sciences—of which both John and John Quincy Adams had been presidents—provided focal points for the whole world of learning of the United States. By the 1840s, the scientists were beginning to organise themselves, as the American Association for the Advancement of Science bears witness. By 1851, the president of the association was already discussing the need for a central scientific organisation to adjust the relations between the government and the larger scientific community.[13]

One can argue that the comprehensive programme that Adams put forward in his first annual message, with its reliance on an active state, was a variant of the mercantilist policies of the French and British monarchies of the seventeenth and eighteenth centuries.[14] However confidently the succeeding period after 1830 has been called one of *laissez-faire* in the economic history of the United States, the science policy which obtained after 1830 and which Adams bequeathed to posterity, was neither an abandonment of governmental science to the blind competitive bidding for procurement contracts, nor an abdication of governmental powers to the whims of popular passion.

John Quincy Adams was a deep student of Adam Smith. He would have agreed with the interpretation of Smith that distinguished sharply between doing away with many impediments to free trade, and withdrawing government completely as a matter of principle from its traditional roles. For example, weights and measures could not be left entirely to the invisible hand of the free market. The government as a guarantor of just measure had to verify both the units and the instruments that made the market trustworthy. That was the position of both Adam Smith and John Quincy Adams.

In addition to *The Wealth of Nations*, Adams pondered Smith's "The Principles which Lead and Direct Philosophical Enquiries; Illustrated by the History of Astronomy". Adam Smith wrote this history of astronomy, which is almost unknown, when he was a very young man at the University of Glasgow. It was published posthumously in 1795. Scholars at the University of Glasgow do know about the "History of Astronomy", and have pointed to it as an important ingredient of *The Wealth of Nations*.[15]

[13] Dupree, A.H., *Science in the Federal Government, op. cit.*, pp. 115–119.

[14] Williams, William Appleman, *The Contours of American History* (Cleveland: World, 1961), pp. 214–215, is eloquent on Adams as a major theorist of the age of mercantilism.

[15] Smith, Adam, "The Principles which Lead and Direct Philosophical Enquiries; Illustrated by the History of Astronomy", in Wightman, W.D. and Bryce, J.C. (eds), *Essays on Philosophical Subjects* (Oxford: Clarendon Press, 1980), pp. 31–105; D.D. Raphael and A.S. Skinner, in their "General Introduction" (pp. 1–21) provide an excellent analysis; they conclude that "Adam Smith's view of science appears more perceptive today than it will have done in the eighteenth century". For another analysis of Smith's history of astronomy, see Skinner, Andrew S., "Science and the Role of the Imagination", *A System of Social Science: Papers Relating to Adam Smith* (Oxford: Clarendon Press, 1979), pp. 14–41.

John Quincy Adams had read Smith on astronomy in 1810 or 1811. Near the end of his life, in 1843, Adams went to Cincinnati and delivered an address at the dedication of the observatory there. The 26,000-word oration turns out to be a version of Adam Smith's history of astronomy and a celebration of the place of science in the American government.

Science policy is not simply an offshoot of an economic policy of *laissez-faire*. It is a set of ideas and arrangements which were already functioning by the 1830s. This science policy is a very different sort of thing from "procurement contracting". A research contract is not a simple commercial transaction, but a statement of institutional relationships between government and science.

The Living Legacy Since the Second World War

The legacy of John Quincy Adams continues in American science policy. From 1940 to 1946, the temporary National Defense Research Committee and the Office of Scientific Research and Development were linked to the government largely by the emergency powers of the President. The director of the Office of Scientific Research and Development, Vannevar Bush, realised that these extraordinary agencies devoted to selecting research problems that might improve weapons and medicine needed for the prosecution of the war, should cease to exist as they were then constituted. In other words, the system of John Quincy Adams should reassert itself once the war was over.

Beginning in 1945 with public hearings in Congress and widespread discussion, a whole set of new institutions was superimposed by law on the pre-existing establishment to adjust governmental policy to the new situation created by the results of war-time research. The agencies created at that time were the Atomic Energy Commission, the Office of Naval Research and the National Science Foundation. These organisations were a return to the principles of the system that had existed before the war. The contracts of the Office of Scientific Research and Development in medical research were transferred to the National Institutes of Health in the Public Health Service, the roots of which go back to the administration of John Adams. By 1953 the research establishment was the wonder of the world, but no one could define for the United States a national science policy by which this establishment operated.[16]

Even before the flight of the Soviet satellite sputnik in 1957, it was beginning to be recognised that the pluralistic system of support for scientific research gave the President both new power and new problems. At no level below that of the president could the full ramifications of the unprecedented flow of research results in all fields of knowledge be seen. President Eisenhower fulfiled the legacy of John Quincy Adams by

[16] Dupree, A.H., *Science in the Federal Government, op. cit.*, pp. vii–x.

appointing a science adviser, James R. Killian, Jr, and by making him chairman of the President's Science Advisory Committee.

Dr Killian was a student of the history of science policy and carried with him into the White House an understanding of the principles of Adams's legacy.[17] An immediate consequence of this structure of presidential advice was the creation of the National Aeronautics and Space Administration as a civilian agency, outside the military services that had developed work on space research in the United States. The new agency's position in the government in some ways strikingly resembles that of the Coast Survey under Hassler.

The Decline of Adams's Legacy under Presidents Nixon and Reagan

After the election of President Richard Nixon, the legacy of John Quincy Adams began to erode; by the time of President Nixon's re-election in 1972, its explicit rejection began to be evident. The office of science adviser on the President's staff and the President's Science Advisory Committee were abolished; the Atomic Energy Commission went out of existence; the partnership between government and the universities ran into difficulties; and the weapons laboratories at Livermore and Los Alamos drifted into a limbo, being firmly under the regime of neither partner.

The Reagan administration proved that the whole concept of science policy had almost disappeared from the presidency. Only after a long delay was a science adviser appointed. Dr George Keyworth, a weapons scientist at Los Alamos, recommended by Dr Edward Teller and largely unknown to the scientific community, participated only in a minor way in the decision to launch the "Star Wars" project—officially named the Strategic Defense Initiative. He soon took up the role of its advocate.

The question of misssile defence should surely have been referred to the Department of Defense—which was already doing research on the subject—to the State Department—which had responsibility for the Anti-Ballistic Missile treaty and the demilitarisation of space—and to the Office of Management and Budget to arrange adequate financial support. Mr Edwin Meese of the White House staff organised a very small task force, including only one scientist, Dr Teller. As late as the evening of the President's speech in March 1983, Mr Meese said that only six persons, including a stenographer, knew about the decision. The way was open to let many billions of dollars worth of procurement contracts, without any preparatory adjustment in the budget and without competent

[17] Killian, Jr, James R., *Sputnik, Scientists, and Eisenhower: A Memoir of the First Special Assistant to the President for Science and Technology* (Cambridge, Mass.: MIT Press, 1977), pp. 56–57.

discussion of whether to proceed with the programme at all.[18] A line item of a trillion dollars had been opened without even talking to Congress, from which the budgetary items to supply funds for research contracts had originated, ever since the Coast Survey.

Dr Teller either was ignorant of the traditional pattern of American science policies, or chose to ignore it. It is likely that he was simply unfamiliar with them. Dr Teller had spent his whole career in the United States mainly as a professor, first at the University of Chicago and then at the University of California. He proceeded as an independent scientist outside the government because of the convenient historical circumstance that Los Alamos National Laboratory and Livermore National Laboratory, the places where the hydrogen bomb that he advocated became a reality, were legally a part of the University of California. He was able, therefore, to take his plans for ever more powerful thermonuclear weapons directly to the highest circles of the government or to the president himself, disregarding diplomatic, military and scientific advisory channels completely. In the course of advocating the hydrogen bomb, he developed a set of principles—which were to extend beyond research in physics to a comprehensive policy for success in the Cold War—based on overwhelming nuclear power. He prevailed over the general advisory committee of the Atomic Energy Commission, under the chairmanship of J. Robert Oppenheimer, to win presidential approval for a crash programme for a "super bomb".[19]

By March 1965, Dr Teller had turned his back on the partnership between the universities and the government, and proposed that precedence be given to applied research related to the Cold War and that responsibility for graduate education be shifted to the national laboratories.[20] He later became the advocate of space-based defence against incoming missiles, and he remains its foremost proponent in the scientific

[18] For accounts by participants in decisions on "Star Wars" during the Reagan administration, see Ramo, Simon, *The Business of Science: Winning and Losing in the High-Tech Age* (New York: Hill and Wang, 1988), pp. 171–175; Anderson, Martin, *Revolution* (San Diego: Harcourt Brace Jovanovich, 1988), pp. 80–99; Stockman, David A., *The Triumph of Politics: Why the Reagan Revolution Failed* (New York: Harper & Row, 1986), p. 367. Lakoff, Sanford and York, Herbert F., *A Shield in Space? Technology, Politics, and the Strategic Defense Initiative: How the Reagan Administration Set Out to Make Nuclear Weapons "Impotent and Obsolete" and Succumbed to the Fallacy of the Last Move* (Berkeley and Los Angeles: University of California Press, 1989) is the leading account of the whole Star Wars episode.

[19] Rhodes, Richard, *The Making of the Atomic Bomb* (New York: Simon & Schuster, 1988), pp. 766–773; York, Herbert, *The Advisors: Oppenheimer, Teller and the Superbomb* (San Francisco: W.H. Freeman, 1976).

[20] Teller, Edward, "The Role of Applied Science", *Basic Research and National Goals: A Report to the Committee on Science and Astronautics, U.S. House of Representatives by the National Academy of Sciences* (Washington, DC: US Government Printing Office, March 1965), pp. 257–266.

community. In his *modus operandi*, Dr Teller has been clearly outside the Adams–Hassler tradition.[21]

The Persistence of the Tradition: The Careers of Herbert York and Glenn Seaborg

The tradition of John Quincy Adams has persisted nevertheless. Its persistence is illustrated by the careers of two major scientist-administrators of the post-war period. Herbert York as the first director of the Livermore Laboratory presided in the 1950s over the rapid consolidation of the technology for producing thermonuclear weapons. Dr York saw his revered mentor, Ernest Lawrence, spend the last period of his life negotiating with the Soviets in Geneva in 1958: "Lawrence . . . made a strong plea for continuing the talks, reminding the Soviets of the international nature of science and the necessity to avoid nuclear war, appealing to them to rise above narrow, nationalistic considerations, and noting that Nobel prize-winners sat on both sides of the table."[22]

In leaving Livermore to go to Washington, Dr York moved steadily into the institutional pattern governed by the tradition which originated with John Quincy Adams. When James Killian created the President's Science Advisory Committee following the launching of the Soviet sputnik, Dr York became a member. He was 35 years old. From there he became the chief scientist of a new agency in the Department of Defense, the Advanced Research Projects Agency. By the end of 1958, he was appointed the director of defence research and engineering. Ever since the Corps of Topographical Engineers in the army in the three decades before the Civil War, and the Wilkes expedition in the navy between 1838 and 1842, science had been a major activity within the armed services, and Adams would have recognised instantly the propriety of a civilian scientist such as Herbert York within the Department of Defense. However, Dr York's drift away from the development of weapons and towards arms control became pronounced during the 1960s and 1970s after he left the Department of Defense. Science as a function in the military services has a continuity from weapons to diplomacy, and Dr York's career demonstrates it as surely as does that of Adams himself.

Dr Glenn Seaborg was awarded a Nobel prize for the discovery of plutonium. He came out of the Manhattan Project after the war to do research and teach at Ernest Lawrence's radiation laboratory at Berkeley. Unlike its offspring at Los Alamos and Livermore, the Lawrence Radiation Laboratory has always had integral ties with the campus of the

[21] Herken, Gregg, "The Earthly Origins of Star Wars", *Bulletin of the Atomic Scientists*, XLIII (October 1987), pp. 20-28; Blum, Deborah, "Weird Science: Livermore's X-Ray Laser Flap", *ibid.*, XLIV (July–August 1988), pp. 7–13.

[22] York, Herbert F., *Making Weapons, Talking Peace: A Physicist's Odyssey from Hiroshima to Geneva* (New York: Basic Books, 1987), p. 163.

University of California at Berkeley where it originated. In 1958, Dr Seaborg became the chancellor on that campus. As a member of the President's Science Advisory Committee, he was responsible in 1960 for a major report, *Scientific Progress, the Universities, and the Federal Government*. For him, the kind of university which participated fully in the partnership was a university with biology and the humanities and the social sciences, as well as major research programmes in physics and chemistry.

In 1961, Dr Seaborg was chosen by President John F. Kennedy to serve as chairman of the Atomic Energy Commission, and he served through the administration of President Johnson and into that of President Nixon. His chief accomplishment at the Atomic Energy Commission was the test-ban agreement, which was clearly a turn away from the arms race with the Soviet Union.[23] Even before he became chairman, Dr Seaborg supported the writing of the history of the Atomic Energy Commission by professional historians, who were given the widest possible freedom. According to the authors of the history, his "sense of history and his commitment to the value of historical research provided the kind of stimulus that few government historians have experienced."[24] This historical work has had an active influence in the shaping of policy.

Drs Richard G. Hewlett and Oscar E. Anderson, Jr, in *The New World 1939-1946*, developed the technique of writing history for the reading public from classified sources. Their work has put the bulk of the story of nuclear energy into the public domain decades before it would otherwise have become known.[25] These histories were written by scholars with doctorates in United States history from the departments of history of Harvard University and the University of Chicago. The Atomic Energy Commission was one of the most creative experiments in the mutual adaptation of American democracy to science and technology. The understanding of the strengths and the weaknesses of the commission is no less a national necessity because the commission no longer exists.

It has, over a long period, gradually become apparent that science policy is very hard to promulgate in formal documents. Nobody really wants a formal science policy written down, and if documents do get written, they usually disappear into the files. The historian has an advantage by getting beyond the desperate necessities of the responsible

[23] Seaborg, Glenn T., with Loeb, Benjamin S., *Kennedy, Khrushchev, and the Test Ban* (Berkeley and Los Angeles: University of California Press, 1981).

[24] Hewlett, Richard G. and Duncan, Francis, *Atomic Shield 1947-1952*, Volume II of *A History of the United States Atomic Energy Commission* (University Park: Pennsylvania State University Press, 1969), p. xvi.

[25] Citations of the volumes mentioned are: Hewlett, Richard G. and Anderson, Jr, Oscar E., *The New World 1939/1946*, Volume I of *A History of the United States Atomic Energy Commission* (University Park: Pennsylvania State University Press, 1962); Hewlett, R. G. and Duncan, F. *Atomic Shield, op. cit.*; Hewlett, Richard G. and Duncan, Francis, *Nuclear Navy 1946-1962* (Chicago: University of Chicago Press, 1974).

actors and their speech-writers and consultants. The history of the Atomic Energy Commission is a prime example of the way in which an historical work can serve to guide science policy. These volumes are too long and detailed to be effective as literature, and their official origin and the process of review mean that many interpretations cannot be spelled out. However, the existence of this first interpretation has made possible the writing of history that is informed by a vast body of primary sources much more quickly than if they had not been available.[26]

Dr Anderson, the co-author of *The New World*, left the writing of history to become a diplomat in the service of the National Aeronautics and Space Administration. In the present age, the United States must have a science policy as a part of its international position, even as it did in the age of John Quincy Adams and the other founders. Dr Anderson was one of the most distinguished historians of American diplomacy and technology in his generation, as the chapters on the Baruch plan and on the negotiations with the British government and its atomic scientists during the Second World War amply attest. Shortly before his death in 1976, he followed the path of Adams to Russia; there he worked on the American–Soviet joint docking in space, the Apollo–Soyuz project. The "lighthouses in the skies", so much derided in 1825, had now become a reality. Co-operation and negotiation with the Soviet Union, not warfare, are a continuation of Adams's policies of 1809 to 1814. Since the Second World War, a direct line has run from the Baruch plan, through the test-ban agreement negotiated by Dr Seaborg, to Apollo–Soyuz, to the demilitarisation of space.

[26] York, H.F., *Making Weapons, Talking Peace, op. cit.*, p. 341.