The AAAS Celebrates Its 150th

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This year we are celebrating the 150th birthday of the American Association for the Advancement of Science (AAAS), which has become the preeminent professional society worldwide in interdisciplinary sciences, technology, and public policy. It was my honor to have been president of the AAAS during this special year of the 150th birthday celebration. Here I take the opportunity to present a few vignettes on the venerable history of the AAAS and their influence on the association today.

The birth of the AAAS took place 150 years ago on 20 September 1848 in Philadelphia, Pennsylvania, a city that has a strong tradition in science going back to colonial times when Ben Franklin carried out fundamental studies on electricity. The AAAS was organized to bring together a small number (certainly by today's standard) of scientists, who were scattered both geographically and among the various disciplines of science. The AAAS was the first permanent U.S. organization to promote the development of science and engineering at the national level and to represent the interests of all its various disciplines, as it still does today. In the early days of the AAAS, meetings were held in cities across the country, and the participants were truly a who's who of science (Fig. 1). The first president of the AAAS was William C. Redfield of New York (Fig. 2), a noted meteorologist and geologist who was professionally involved in promoting railroad and steamship development, but who for his avocation was a scientific scholar. Geology, which was well represented among the founding members of the AAAS, was also an important research field in the United States in these early days, perhaps because of the national emphasis on settling the land and exploring the vast resources of the nation. Indeed, the same geologists who founded the American Society of Geologists and Naturalists in 1840 were instrumental in forming the AAAS as an organization for all science within the United States, patterned after the British Association for the Advancement of Science, which dates back to 1831.

The initial purpose of the AAAS was to convene meetings among scientists working in diverse disciplines to present their most recent discoveries and discuss their concerns. This purpose was well reflected in the talks presented at the 1848 meeting, where naturalist Louis Agassiz presented his observations "On the Phonetic Apparatus of the Cricket" (*1*), physicist Joseph Henry discussed the organization and progress of the newly established (1846) Smithsonian Institution (*2*), and mathematician Benjamin Peirce reported "Upon Certain Methods of Determining the Number of Real Roots of Equations, Applicable to Transcendental as well as to Algebraic Equations" (*3*). Among the many papers read at that meeting were papers on the physical properties of light, the sediment of the Mississippi River, the properties of meteorites, and recent improvements in recording magnetic telegraphs.

Though small in size during these early years, the AAAS through its multidisciplinary meetings helped to establish the scientific agenda that guided the economic and intellectual development of the United States during the second half of the 19th century. The presentation of scientific papers remained central to AAAS activities during this period. Thus, the program for the 50th birthday of the AAAS in 1898 included talks ranging from the study of the heavens—"The Development of Photography in Astronomy" by astronomer E. E. Barnard (*4*)—to the study of human cultures—"The Survival of African Music in America" by ethnographer Jeannette Robinson Murphy (*5*). Many of the same broad topical areas were represented as in 1848, but the specific topics at the 1898 meeting reflected the advance in the frontiers of science that had occurred over the intervening 50 years. The 1898 meeting thus covered member interests across the scientific spectrum, including topics on the velocity of light, proteids in the brain, energy from the sun, glacial geology, and the problems of variation versus heredity. The physical sciences, biological sciences, and social sciences were all represented.

Even during this early period, the AAAS was active in the discussion of science policy, such as in the areas of conservation of forests, public health, and education, including the funding of scientific research. Regarding the latter, the AAAS during its formative years became a conduit of small funds to scientists to help support their research. In 1873, a $1000 gift from a wealthy Boston widow, Elizabeth Thompson, established the first AAAS fund for research grants. Thus we see in the 1898 AAAS program a report on studies of the velocity of light in a magnetic field by E. W. Morley and H. T. Eddy, who had received support for their work from this AAAS fund. Though modest in amount, these funds nevertheless had a tangible impact on the exploration of scientific ideas. A. A. Michelson and E. W. Morley received $175 dollars from the AAAS for research on the ether drift, work that in part led to Michelson's Nobel Prize in Physics in 1907. Another source of funds for scientists came from prizes administered by the AAAS and awarded in recognition of important contributions to science. In 1923, New York philanthropist Newcomb Cleveland anonymously supported a $1000 prize to reward research presented at AAAS meetings. H. J. Muller won this prize in 1927 for a paper on "The Influence of X-Rays on Genes and Chromosomes," work for which he later received a Nobel Prize in Physiology and Medicine. The AAAS Newcomb Cleveland prize continues to be presented annually to the author of a paper published in *Science*.

The AAAS has always been a membership organization open to anyone with an interest in science. This democratic principle has survived up to the present, along with the commitment of the AAAS to the promotion of the highest quality research and tech-

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nological innovation. Starting with 416 members who joined the AAAS during its first year as a professional society, it has grown to over 145,000 members today. The president of the AAAS during the 50th birthday year was Frederic Ward Putnam (1839–1915) (Fig. 3), an anthropologist at Harvard University who had served the AAAS as secretary from 1872 to 1897. As a secretary to the association, Dr. Putnam carried out the staff work for the AAAS, including correspondence, arranging for meetings, and managing the records, all while maintaining an active career in archeology and anthropology. We owe much to these early visionaries and dedicated members for their inspired and devoted service in establishing the foundation for the AAAS that we enjoy today.

Although annual association meetings were the first activity of the AAAS, scientific publications became an important activity of the AAAS during its formative period. *Science* was established in 1880 by the New York journalist John Michels, with backing from Thomas Edison. The magazine was sold to Alexander Graham Bell in 1883 and resold in 1895 to psychologist James McKeen Cattell (1860–1944). In 1900, *Science* became the official AAAS journal, an alliance that helped to increase the association's membership and to boost the magazine's revenues. It was not until Cattell's death in 1944 that the AAAS gained full editorial and publication ownership of *Science*. Since the time of Cattell, *Science* has had 12 editors, of whom Philip H. Abelson has had the longest tenure (1962 to 1984), and he continues in an emeritus status to make noteworthy contributions to the magazine.

Around the turn of the 20th century, new disciplinary science and engineering societies began to proliferate, thereby creating competition for the presentation of scientific discoveries. Nevertheless, scientific activity in the United States remained small enough that one could come to an AAAS meeting and continue to hear the original renditions of the great scientific discoveries of the time. For example, at the 1920 Chicago meeting, the African American embryologist Ernest Everett Just, a leading expert on egg cells and on the development of marine biology, presented a paper on "The Susceptibility of the Inseminated Egg to Hypotonic Seawater—A Contribution to the Analysis of the Fertilization Reaction" (*6*). At the 1934 Pittsburgh meeting, Albert Einstein, appearing for the first time before a U.S. audience, delivered a talk on "An Elementary Proof of the Theorem Concerning the Equivalence of Mass and Energy" (*7*), in which he gave additional proof to his 1905 theorem on the equivalence between matter and energy. At the 1941 Dallas Meeting, Edwin P. Hubble presented a talk on "The Problem of the Expanding Universe" (*8*).

Old records of the AAAS give many insights into the esteem in which the AAAS was held in its early days. For example, on the occasion of the first winter meeting of the AAAS, which was held in Washington in 1902, President Theodore Roosevelt received AAAS members at the White House. AAAS members were anxious to participate in the scientific activities of the association, but distances were large and travel was difficult and costly. Consequently, in 1916 a Pacific Division was formed, and in 1920, a Southwestern Division (now the Southwest and Rocky Mountain Division) was established to help meet the needs of western scientists.

In addition, the AAAS started taking on new activities, many of which continue to this day. The AAAS participated in efforts to popularize science by supporting the Science News Service, established in 1920, and by helping NBC produce radio programs, such as "Science in the News," in the late 1930s. These activities eventually led to current AAAS programs in support of public understanding of science. The membership of the AAAS exercised their support for the freedom of scientists when the AAAS Council in 1933 adopted a "Declaration of Intellectual Freedom" that condemned the "threatening inroads upon intellectual freedom" that appeared with the rise of fascism in Europe. This concern for the freedom of scientists is well represented in current activities of the AAAS Committee on Scientific Freedom and Responsibility, established in 1976.

Because of the big changes that took place in science and technology during the war years, and the changes that had occurred in the AAAS itself, a new constitution was adopted in 1946, which redefined the AAAS's objectives "To further the work of scientists, to facilitate cooperation among them, to improve the effectiveness of science in the promotion of human welfare, and to increase public understanding and appreciation of the importance and promise of the methods of science in human progress." This new constitution opened the door more widely for the AAAS to address larger science and society questions. The detailed reports of scientific discovery delivered at earlier meetings gave way to more syntheses, summaries, and socially contextualized discussions of the direction of scientific and technological research programs.

Edmund W. Sinnott (1888–1968), a botanist from Yale University, presided over the 1948 AAAS meeting, which celebrated the 100th birthday around the theme "One World of Science." The presentation of scientific papers remained a cen-

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Fig. 1. AAAS section officers, 1885. Seated, left to right: F. W. Putnam, Permanent Secretary; Charles S. Minot, General Secretary; T. Sterry Hunt, Past President; H. A. Newton, President; James Hall, Past President; W. H. Walmsley, Secretary of Section G (Microscopy and Histology); Erminnie A. Smith, Secretary of Section H (Anthropology); and C. J. Woodbury, Secretary of Section D (Mechanical Science).

tral activity, as in former meetings, reflecting the broad range of fields of the membership. Some of the papers (9) presented new scientific concepts and discoveries, such as the papers on "New Properties of the Electron" by physicist W. E. Lamb and "The Effects of Changes, Quantity, Combination and Position of Genes" by geneticist Curt Stern. Other lectures presented broader pictures of science, such as the talks, "Biological Problems of the Oceans" by Daniel Merriman, "Cultural Contexts of Nutritional Patterns" by anthropologist Margaret Mead, and "Technics and the Future of Western Civilization" by historian Lewis Mumford. As the atomic age dawned, S. L. Warren provided a look at "The Influence of Modern Developments in Nuclear Energy upon Public Health Problems."

Thus the 100th birthday of AAAS in 1948 occurred as a new era in science in the United States was born. World War II was over, and science and technology had played a major role in winning the war for the United States and its Western allies. It was clear that science would have a large impact on our future economic and technological growth. President Harry Truman, though not trained in science himself, recognized the importance of science to the country, and through his scientific advisors developed the framework that guided science forward during the second half of the 20th century. He chose the occasion of the 100th Anniversary AAAS meeting, which was held in Washington, DC, in September 1948, to deliver an historic speech that enunciated the basic principles that have guided U.S. science ever since (*10*). Because of the historic importance of this speech in its broadest context, it is appropriate to quote it here, 50 years later. First he expressed his appreciation for science and its impact on society: "In the 100 years since this Association was organized, science has helped transform the United States into the most productive Nation in the world. . . . The members of this Association know better than I what developments to expect in the years ahead in physics, in chemistry, in biology, and the other sciences, but I am certain of this—that science will change our lives in the century ahead even more than it has changed them in the hundred years just past."

President Truman also challenged AAAS members to think about the relation between science and national policy, and he made five recommendations for science policy reflecting his own priorities and those of his advisory board: "(i) First, we should double our total public and private allocations of funds to the sciences. We are now devoting, through Federal and private expenditure, little more than $1 billion for research and development per year. With a national income of more than $200 billion annually, the Board felt that we should devote at least $2 billion to scientific research and development each year. (ii) Second, greater emphasis should be placed on basic research and medical research. (iii) Third, a National Science Foundation should be established. (iv) Fourth, more aid should be granted to the universities, both for student scholarships and for research facilities. (v) Fifth, the work of the research agencies of the Federal Government should be better financed and coordinated."

The federal government and the science community have followed the first three recommendations. Current investments in nondefense R&D far exceed the 1% level recommended by President Truman, and the economic and intellectual benefits to this nation have been tremendous. For the year 1997, nondefense federal R&D investments were at approximately 2.15%, and some important contributions to scientific knowledge have received support from the Department of Defense (DOD). In the past 50 years, greater emphasis has been given to federal support of basic research and medical research. The National Science Foundation (NSF) was indeed established in 1950 and has had a dramatic impact on promoting U.S. scientific leadership. Progress has also been made to strengthen the U.S. research universities to make them preeminent in the world, although further effort is still needed in support of student financial aid and university research infrastructure. And the financing and coordination of the research funding agencies still remain significant challenges.

Truman spoke of the progress and promise of science, yet the making of the atomic bomb and the growing tensions with the Soviet Union in the late 1940s increased the perceived political need for secrecy in American science. The AAAS played a role in questioning such restrictions. In 1947, a AAAS Special Committee on Civil Liberties strongly condemned the use of loyalty tests for government scientists (*11*). Geologist Kirtley Mather used his 1953 AAAS presidential address to speak out on the problems of intellectual freedom and the freedom of scientists to travel (*12*). As the Cold War intensified, the AAAS Committee on Science in the Promotion of Human Welfare called for a "science of human survival" that incorporated scientific responsibility (*13*). This idea that the scientific community should take an active and responsible role in social issues was given new meaning in 1970, when the AAAS supported a commission to investigate the ecological effects of herbicides in Vietnam (*14*).

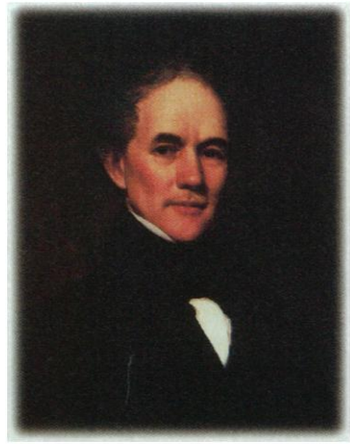

Fig. 2. William C. Redfield (1789–1857), first president of the AAAS.

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Twenty-three years after the 100th birthday of AAAS, Mina Rees (1902–1997) was the first woman to have been elected president of the AAAS, in 1971. Women members of the AAAS can be traced back to 1850, when Maria Mitchell the famous astronomer joined the AAAS. In the past 25 years, much progress has been made in increasing the opportunities for women in science and the visibility of women in the AAAS. I am the 9th woman AAAS president (1998) and have been followed by our 10th, M. R. C. Greenwood (1999). Mina Rees was a pioneer and role model for many women scientists and was particularly influential in my own early career. Recently, I had an occasion (on 8 December 1997) to speak at her memorial service in New York about her influence on me when I was a young student at Hunter College. Mina Rees was a champion of public investment in the education of young scientists and fostered programs to provide undergraduate and graduate education to students of limited means. My own undergraduate education at Hunter College cost me $5 per semester, which covered tuition, laboratory charges, and textbooks on loan. The taxpayers invested in me and in many others in the New York City University system with the understanding that the students would pay back in the future through service to society. I believe that the record shows that these investments in people have a high payback. Mina Rees is also widely known for her major role in mobilizing scientists to work for the war effort during World War II and in shaping policies and procedures of the Office of Naval Research (ONR) in support of basic research by the research community. Her vision and leadership of the mathematics program at ONR played a major role in early developments in the field of computer science. In her presidential address 26 years ago (*15*), she spoke about the important role of federal support of basic research in universities and the challenge of providing stable long-term support while

maintaining appropriate independence of the universities and the principal investigators. Mina Rees' analysis in her 1972 presidential address of the importance of federal investment in basic research remains relevant today.

Federal investments in research over the past 50 years have made U.S. research universities the envy of the world and have placed the United States in a strong position in the international research arena. Data from NSF (*16*) show that the United States is now contributing more than any country in the world to the literature in all fields of science and engineering, from about 20% to over 50%, depending on the field in question. Recent cutbacks in funding for the physical sciences and engineering (especially by DOD) have allowed other countries to narrow the gap between them and the United States and to surpass the United States in some areas. Because of the more restricted resources, many young people have had significant difficulties and delays in starting their careers as independent investigators. This group of younger scientists provides an especially important target for federal investment, now that the U.S. federal budget is operating in a surplus mode.

Since the end of World War II, science and technology have become more important to the U.S. culture, the number of scientists and engineers has greatly increased (especially since the launching of Sputnik in 1957), and the pace of scientific discovery has continued to accelerate. To address the needs of this changing environment, professional societies have proliferated, together with their numerous sponsored scientific meetings and more focused topical conferences and workshops. In this new environment, the focus of the AAAS has changed. Consequently, discussions on science policy, science education, issues of science and society, interdisciplinary scientific research activities, and outreach activities to AAAS members and to the population at large have gained in importance in recent years, as can be seen from the programs of more recent AAAS annual meetings, the contents of *Science*, and the popularity of focused conferences and symposia, such as the very popular Science and Technology Policy Colloquium (started in 1976) and the Congressional Science and Engineering Fellows Program (started in 1973). Even the format of AAAS meetings has changed over the years: Poster sessions were adopted in the 1920s (one of the first organizations to use this venue), and access to handicapped people (wheelchair users and the hearing impaired) has been provided in the sessions since the 1976 Boston meeting. The AAAS has also been able to work with its 275 affiliated professional societies in furthering the overarching goal of the AAAS to advance science.

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To me, the 1998 AAAS annual meeting in Philadelphia, the first event of the 150th AAAS birthday celebration, was a memorable and historic occasion. The meeting was opened by an entertaining and informative account of Ben Franklin's scientific exploits, enacted by Nobel laureate chemist Dudley Herschbach and a clone of Ben Franklin, who reappeared throughout the meeting at many of the public events. Harold Varmus, another Nobel laureate, who is currently the director of the National Institutes of Health, gave an inspired lecture on recent advances in the biomedical sciences, while emphasizing the interdependence of all the scientific and engineering disciplines. Justice Stephen Breyer of the U.S. Supreme Court spoke of the growing importance of the testimony of expert witnesses, discussing strategies for increasing the objectivity, accuracy, and usefulness of this testimony, stating "that in this age of science we must build legal foundations that are sound in science as well as in law." Justice Breyer expressed interest in an initiative by the National Conference of Lawyers and Scientists, a joint AAAS/American Bar Association committee, to respond to the need for science and engineering experts in the federal courts. In keeping with a long-standing policy to ban smoking at AAAS meetings (going back to 1972), the resounding condemnation of the tobacco industry that was expressed in the talk by C. Everett Koop, former U.S. Surgeon General, drew very high attendance and press coverage.

Fig. 3. Frederic Ward Putnam (1839–1915), president at the 50th birthday of the AAAS.

But the most memorable event of the 1998 annual meeting was the public address by President Bill Clinton (*17*) to an overflowing audience. President Clinton chose this occasion to announce two key science appointments: (i) Neal Lane, director of NSF, to the position of Presidential Science Adviser and director of the Office of Science and Technology Policy, replacing retiring Jack Gibbons; and (ii) Rita R. Colwell, a former AAAS president, as director of NSF, replacing Neal Lane and becoming the first woman to head NSF. From there, President Clinton went on to speak about the wonderful advances in both science and technology that have occurred in recent years or are now taking place in real time in terms of the information revolution. He emphasized that "the extraordinary promise of science and technology carries with it, as all of you know, extraordinary responsibilities for those who seek to advance the promise. It is incumbent upon both scientists and public servants to ensure that science serves humanity always, and never the other way around." Finally, the president concluded his speech with a futuristic vision, looking toward the 200th birthday of the AAAS and saying: "Your bicentennial meeting can convene in a world where climatic disruption has been halted; where wars on cancer and AIDS have long since been won; where humanity is safe from the destructive force of chemical and biological weapons, wielded by rogue states or conscience-less terrorists and drug runners; where our noble career of science is pursued and then advanced by children of every race and background and where the benefits of science are broadly shared in countries both rich and poor. That is what I pray it will be like, 50 years from now, when my successors stand here before your successors and assess how well we did with our time."

AAAS continued to celebrate its 150th birthday during 1998 with a weekly series of invited essays in *Science* written by visionaries looking into their crystal balls. The essays covered broad themes in science and society with the intention of painting a portrait of how the sciences are perceived today as well as thoughts about the future. The essayists are prominent scientists and nonscientists, including artists, politicians, religious leaders, science fiction writers, and philosophers. The first essay in the series was an article entitled "The Great Asymmetry," by the visionary Stephen Jay Gould (*18*), who will be president of the AAAS in 2000 in anticipation of the start of the next millennium. During 1998, an exhibit on the history of the AAAS was featured in the public spaces of the beautiful new and environmentally friendly AAAS building at 1200 New York Avenue, NW, in Washington, DC. A special AAAS anniversary public lecture series was also featured during 1998, with lectures by Mike Novacek on "Fossils of the Flaming Cliffs: the Age of Dinosaurs and Mammals in Central Asia," Federico Mayor on "Science and Power: A New Commitment for the Twenty-First Century," and Stephen Jay Gould on "Why Science Can't Predict the Future: A Millennial Perspective," to name a few.

During this very special year, I had the

opportunity to make my mark on the AAAS as every AAAS president who has gone before me since 1848 has done. Apart from my role in the 150th celebration, I sought to use my tenure to work on improving the annual meeting and to improve the governance of the AAAS by strengthing ties among the Board, the Board-appointed committees, and the AAAS program directorates. My colleagues on the Board and I also made efforts to use the Internet to strengthen ties between the Board and the AAAS membership through conversations on topics of importance to the AAAS, to science, and to society.

The AAAS Board was active in a number of areas of science policy. We devoted particular attention to federal science and technology funding, to interacting with Congressman Vernon Ehlers and his staff regarding his study of national science policy, and to strengthening the role of science and technology in the Department of State. In several of these activities, I was involved in facilitating coordination and cooperation between the AAAS and the National Academy of Sciences/National Research Council. We made efforts to encourage young people to study science and to facilitate their entry into scientific careers. We also made efforts to strengthen the ties of the AAAS to industry, to our affiliated societies, to our membership, and to the broader science and technology community. It was a very rewarding year, and it was my privilege to have had an opportunity to serve the science and engineering communities through the auspices of the AAAS.

In closing, let me return to President Harry Truman's address at the 100th anniversary of the AAAS and join him in looking to the future of science and society with a feeling of optimism and excitement. "Now and in the years ahead, we need more than anything else the honest and uncompromising common-sense of science. Science means a method of thought. That method is characterized by open-mindedness, honesty, perseverance, and above all, by an unflinching passion for knowledge and truth. When more of the peoples of the world have learned the ways of thought of the scientist, we shall have better reason to expect lasting peace and a fuller life for all."

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