APS AND THE WIDER WORLD

Founded a century ago, the American Physical Society not only has played a leading role in advancing and diffusing knowledge and understanding of physics, but has widened its influence and importance by speaking out on public issues.

Harry Lustig

Early America was not a fertile land for physics. Benjamin Franklin had been virtually alone in practicing physics in colonial times, and for nearly a century after him the seeds of physics hardly sprouted.

It was Joseph Henry, the first head of the Smithsonian Institution, who began cultivating a physics community after the Civil War. In discussions leading to the organization of the American Association for the Advancement of Science (AAAS) in 1847, Henry had insisted that physics should have a professional section of its own. Then, after taking part in founding another science organization, the National Academy of Sciences, modeled upon Europe's older academies, Henry reorganized it between 1867 and 1872 to recognize and advance "original research."[1] The academy's early members were principally from the physical sciences, but few members of the physics community, Henry lamented, were doing significant work. At that time, the publication rate per physicist averaged about one article every three years.[2]

When Henry died in 1878, not more than 75 Americans called themselves physicists. By the early 1890s, the number of Americans who identified themselves as engaged in physics had risen to 200, and about one-fifth of them were publishing their research results with some regularity. Much of the research was pedestrian and inconsequential, but three American physicists already had excelled by worldwide (meaning European) standards and earned respect and acclaim for their achievements. The three were Henry A. Rowland, Josiah Willard Gibbs, and Albert A. Michelson, who later became the first American to win a Nobel Prize in Physics (in 1907).

America's painfully small contributions to physics troubled Arthur Gordon Webster of Clark University.[3] A Harvard University graduate who earned his PhD at Hermann von Helmholtz's illustrious laboratory in Berlin, Webster was respected in the US for his wide-ranging research in electromagnetism, acoustics, ballistics and pure mathematics. (A photo of Webster appears on page 29.) He was mentor to 27 doctoral candidates and regarded as an outstanding lecturer and textbook author. (See Melba Phillips's article on Webster in PHYSICS TODAY, June 1987, page 48.) Disillusioned with the National Academy of Sciences, to which, in his opinion, "few of us can hope to belong,"[2] and believing that the AAAS no longer met the needs of the growing number of physicists, Webster began proselytizing for a professional association of physicists.

Other scientific disciplines had recently formed organizations of their own—the American Chemical Society in 1876 and the American Mathematical Society in 1894. With these precedents, Webster found it irresistible to launch the American Physical Society. He lined up Rowland and Michelson to serve as the first president and vice president, respectively. (Gibbs, chary of such organizations, had earlier declined to help found the American Mathematical Society, and Webster, aware of Gibbs's reluctance, apparently did not invite him to join in establishing APS.) Webster served as APS's third president, after Michelson, and, in fact, was elected to the National Academy during his term of office in 1903.

Although Webster played an indispensable role in organizing APS, other early participants in the society's affairs provided more impressionistic recollections of its origins in accounts written years later. Michael I. Pupin, one of six prominent cosigners of Webster's call to create the society, thought that the great European discoveries of the new physics had inspired the society's start. Wilhelm Röntgen had discovered x rays in 1895, Henri Becquerel saw the first radioactive elements in 1896, and J. J. Thomson isolated the electron in 1897. "Needless to say, the physicists in the United States were excited by these revelations and the new views disclosed by them," Pupin recalled. "The first visible effect of this thrill was the organization in 1899 of the American Physical Society."[4]

Founding the society

To be sure, physics discoveries had been made in rapid succession in the decade before 1899. Still, it seems unlikely that enough time had elapsed for those events to have impressed American physicists sufficiently to lead them to organize APS only a few years later. Indeed, a different view was held by Frederick Bedell, who had joined Edward L. Nichols and Ernest Merritt as an editor of the *Physical Review* shortly after its birth in 1893 and was to become an early member of APS. In a reminiscence entitled "What Led to the Founding of the American Physical Society," and presented as an invited paper at the 50th anniversary of APS,[5] Bedell credited the remarkable technology on display at the 1876 Centennial Exposition in Philadelphia and the 1893 International Electrical Congress in Chicago for pointing to the importance of physics in industry and the opportunity for a physics society to serve and strengthen the physics community by disseminating reports on ideas and innovations. Among the many scientists, engineers and inventors who attended the 1893 congress were Thomas Edison and Alexander Siemens. As for physicists, there was the aged Helmholtz and, perhaps more to the point, Rowland, Nichols and Webster. No one could neglect to notice the public's awed reaction to the products wrought by physics.

In any case, whether Pupin's or Bedell's historical accounts of the reasons for forming APS are reliable, the 1899 invitational call to the organizational meeting does not mention them as a motivation for creating the society. Instead, it refers to the American Mathematical Society,

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the (British) Physical Society and the Deutsche Physikalische Gesellschaft as prototypes of what APS could accomplish in furthering the "interchange of ideas among American physicists and for learning of one another's work."[6] And, significantly for the future of the society, the call emphasized that "an organization like the one proposed could not fail to have an important influence in all matters affecting the interest of physicists, whether in connection with work done under government auspices or otherwise."

The first organizational meeting of APS in Fayerweather Hall of Columbia University on 20 May 1899 was attended by 36 physicists in response to Webster's invitation. Most came from major eastern universities—notably, Pupin and William Hallock of Columbia, Bedell, Merritt and Nichols of Cornell, Benjamin O. Peirce of Harvard, Carl Barus of Brown, Joseph S. Ames of Johns Hopkins, William F. Magie of Princeton and Henry A. Bumstead of Yale. (All but Pupin and Hallock became presidents of the society after Webster.) The founding group included two women, Isabella Stone of Vassar College (who was the first woman PhD in physics, from the University of Chicago, having worked with Michelson) and Marcia Anna Keith, the head of physics at Mount Holyoke College. Not all the founders were academics. Cleveland Abbe of the US Weather Bureau, a pioneer weather forecaster and a well-known promoter of research in atmospheric physics, represented the one-sixth of America's physicists then employed by the Federal government. Elihu Thomson was a highly respected physicist at the General Electric Co. Contrary to some current impressions of the society's early days, industrial and government physicists attended meetings and were active in APS from the start, though they rarely took prominent parts in its leadership.

At that first meeting, a representative council of four officers and seven elected members (soon to be increased to eight members) was established and a draft constitution was put forward. It also accepted Henry's proposed name for the society. The word "Physical" has occasionally caused some misunderstanding. It has led to assumptions about the society's concerns with intestinal disorders or strenuous exercise. As early as 1893, a firm of druggists offered to exchange its magazine for the newly founded *Physical Review*. (The name may also have been the reason for more recent approaches by venture capitalists seeking to buy the society.)

Holding to an objective

From its beginning, APS has maintained the original objective: "the advancement and diffusion of the knowledge of physics." Two aspects of this phrase have led to some soul-searching and controversy. One is the question, To what extent should the society promote the advancement and welfare of physicists, rather than that of physics? In spite of Webster's observation that the organization could not fail to have an important influence in all matters affecting the interests of physicists, APS has traditionally eschewed the orientation of some other professional societies, not to mention that of trade associations or craft unions, to promote the economic welfare of its members. Instead, APS has always acted in the belief that physicists are necessary so that physics gets done, not that physics is necessary so that physicists will have something to do.[7]

A reason for this outward-looking approach is provided by the Caltech historian Daniel J. Kevles in his important book *The Physicists: The History of a Scientific Community in Modern America*.[2] "Although physicists, like other Americans, have embraced political engagement in arenas of technological policy such as arms control," Kevles writes, "they have tended to resist it on behalf of their science, fearing that it would undercut their social authority, not to mention their self-image, if they behaved like just another interest group in American society." Kevles's explanation would have been even more on the mark if he had written "themselves" instead of "their science."

To be sure, this distinction (undoubtedly fine to some) has not prevented the society, in recent years, from arguing for better funding of physics, for the creation of large research facilities that will help provide jobs for society members and for sponsorship of a placement service and, *faute de mieux*, when new jobs for physicists have been scarce, for retraining programs for young physicists. However, even social outreach programs, such as those to improve opportunities for and recognition of women and minority physicists, have been accommodated under the rationale that they would be good for physics, rather than for the individuals who would benefit.

The second issue arising from the APS objective is whether all uses of physics should be promoted or even tolerated. That has been a more divisive issue. In 1971, in an effort by the activist wing of APS to get the society to take stands on controversial public issues, a proposal was put before the membership to amend the society's objective, ". . . the advancement and diffusion of knowledge to increase man's understanding of nature and to contribute to the enhancement of the quality of life for all people. The society shall assist its members in the pursuit of these humane goals and it shall shun those activities which are judged to contribute harmfully to the welfare of mankind." Many who were otherwise sympathetic to the amendment objected to the phrase "which are judged to contribute harmfully" (asking, Who will judge?) and the amendment failed by a vote of 4388 to 3579. Only in 1997 did the APS council and membership adopt a modification to the mission statement. With a preamble now intended more to motivate public support for science and to create a positive image for physics than to encourage taking stands on public issues (a dispensation that no longer needs to be made explicit), APS's mission statement now reads: "In the firm belief that an understanding of the nature of the physical universe will be of benefit to all humanity, the society shall have as its objective the advancement and diffusion of the knowledge of physics."

The scope of physics and the calling of physicists had been the topic of Rowland's presidential address, "The Highest Aim of the Physicist," delivered at the second APS meeting in 1899. Rowland, who was descended from a line of Yale-trained ministers, had decided while in college to devote himself to science and to the kind of research that brought "not . . . filthy lucre but good substantial reputation."[2] His talk was a magnificent *tour d'horizon* of the physical world as it had been elucidated by the end of the 19th century, as well as a review of the open questions likely to be confronted during the 20th.

But he also sounded many of the themes that would resonate, albeit sometimes controversially, to this day: the assertion that there is no such thing as absolute truth, but that physicists must nevertheless act in this real world on the basis of the knowledge they have accumulated thus far; that "we [physicists] form a small and unique body . . . whose views of what constitutes the greatest achievements in life are very different from those around us"; that pure research is superior to applied ("He who makes two blades of grass grow where one grew before is the benefactor of mankind, but he who obscurely works to find the laws of such growth is the intellectual superior as well as the greater benefactor of the two"); and that scientific research in the US was shamefully underfunded.[8]

Not every physicist agreed with Rowland's "best science elitism" and his position on utilitarian research. In

1890, T. C. Mendenhall, whose career included the presidencies of two polytechnic institutes and the superintendency of the US Coast and Geodetic Survey, had excoriated the "unfortunate and perhaps growing tendency among scientific men to despise the useful and practical in science. . . . The arrogance of genius is no less disagreeable than that of riches."[2] Mendenhall apparently had little use for APS (or, perhaps, it for him), and he never became a member. The sins of the father, however, were not visited upon his son, at least in this case. C. E. Mendenhall, a professor of physics at the University of Wisconsin, was elected to membership at the second meeting and served as the society's 14th president in 1923–24.

CLARK UNIVERSITY ARCHIVES

ARTHUR GORDON WEBSTER: Drawn irresistibly to found APS.

Despite Rowland's argument about the superiority of basic research, the pages of the *Physical Review* in its early decades were heavily devoted to applications, and industrial and government research were well represented at the society's meetings. Thus, at the 1925 meeting at Columbia University (arbitrarily selected for this analysis) 14 of the 37 contributed papers came from industrial and government laboratories. They included not only the Bureau of Standards and the American Telephone and Telegraph Co, but also the Westinghouse Lamp Co and Eastman Kodak Co.

Indeed, Kevles characterizes APS leadership in the early years, even after the triumphs of Max Planck and Albert Einstein, as continuing to live in the 19th century and to be either unwilling or unable to "stimulate young physicists into confronting the increasingly theoretical issues of the 20th."[2] The dominance of the society by this conservative, scientifically backward oligarchy could hardly have worked to the detriment of the practitioners of classical, applied physics. Nevertheless, as time went on, APS evidently did not meet the needs of all physicists. Whether it was elitism or, more mundanely, a Darwinian evolution of the species, physics-based associations spun off from APS, beginning with the Optical Society of America in 1916, and followed by the Acoustical Society of America and the Society of Rheology, both in 1929. (The American Astronomical Society had been founded in 1899, the same year as APS.) Still, in 1930, a committee on applied physics within APS informed the society's council that the issue continued to rankle. "Dissatisfaction exists on the part of many physicists who feel that the activity of the American Physical Society is mainly confined to quantum physics and is not representative of physics in its broadest scope," the committee reported.[9]

Another criticism of APS concerned teaching. Webster recognized the problem early on. "I have often tried to get the Physical Society to take up pedagogical questions, but without success," he wrote in 1905.[6] Two years later, the council adopted a policy that "all pedagogical matters lie outside of the Physical Society."[9] However, Webster and his like-minded colleagues must have continued to raise the issue, for, in 1915, the council appointed a committee, with Webster on it, to consider "how the society can be made useful to teachers in colleges and secondary schools."[9] Of the committee's three recommendations, the only one carried out promptly called for the appointment of an APS representative "for the purpose of presenting various items of research in physics" to the editorial board of *School Science and Mathematics*, then the most influential journal for physics teachers. The chosen representative was Homer L. Dodge, who at one time had been Webster's assistant at Clark.

In 1920, an APS committee was appointed to formulate a comprehensive plan "whereby the society can give adequate consideration to the teaching of physics."[9] Between then and 1927, the committee issued several reports, including one entitled "The Teaching of Physics with Especial Reference to the Teaching of Physics to Students of Engineering" and another on "Physics in Relation to Medicine." The reports were printed in the *Bulletin of the American Physical Society* and published as pamphlets. But apparently not enough came of these initiatives to satisfy the needs of teachers, for, in 1930, the American Association of Physics Teachers was formed for "the advancement of the teaching of physics and the furtherance of appreciation of the role of physics in our culture." Its first president was Dodge.

Despite some turf battles, fought when APS later decided to become more active in precollege and undergraduate education, AAPT and APS have had an increasingly cooperative relationship. The collaboration has included a joint annual meeting and, in the 1990s, a successful $5 million fund-raising effort for education, the Campaign for Physics.

As physics research proliferated in the 1920s and 1930s and as membership in the society grew, especially after World War II (see the graph on page 31), specialized divisions of APS were organized. The first, then called electron and ion physics and now called atomic, molecular and optical physics, was established in 1943. There are now 14 divisions and seven smaller topical groups. At first the divisions had no role in the governance of the society, their main function being the organization of invited papers in their respective specialties at APS meetings. Not until 1967, after a revision of the APS constitution, did the divisions gain representation on the council. Had the demands for autonomy by the practitioners of the subfields of physics not been granted, it is likely that the society would have split apart. This seemingly inevitable evolution has had a significant effect on the number and character of APS meetings, on the society's governance and actions and on the unity of physics.

The scientific meetings of the society—originally its chief, if not sole, *raison d'etre*—have indeed played a vital role in the advancement and diffusion of physics. The programs of the early scientific sessions already reflected a multiplicity of interests and a range of sophistication, as they do today, and, because they were all general meetings, a much greater variety of interests. In spite of

the routine nature of many papers delivered, the programs also included illustrious names and important papers. In December 1901, Ernest Rutherford, then at McGill University, gave two papers on radioactivity, and a year later, Rutherford reported the discovery of (what were only later called) alpha particles, under the title "The Magnetic and Electric Deviation of the Easily Absorbed Rays from Radium." A paper by Rutherford and H. L. Cook, bearing the title "A Penetrating Radiation From the Earth's Surface," and another by John McLennan and E. F. Burton were in effect among the earliest papers on cosmic rays.

At the Washington meeting in 1939, papers on nuclear fission were given by Eugene Booth, John Dunning and F. G. Slack, and by Niels Bohr and John Wheeler. The papers ignited a debate on the likelihood of separating large quantities of uranium-235 from uranium-238 and of producing a chain reaction. The *New York Times* colorfully summarized the differing views: "Tempers and temperatures increased visibly today among members of the American Physical Society as they closed their spring meeting with arguments over the probability of some scientist blowing up a sizable portion of the earth with a tiny bit of uranium, the element which produces radium."[10]

In the decades after World War II, APS meetings were regularly the venue for announcements of important new discoveries. Though the meetings were generally staid, some of them had elements of high (and occasionally low) drama. Following the discovery by Georg Bednorz and Alex Müller of high-temperature superconductivity, the New York meeting in March 1987 turned into what was dubbed a "Woodstock of Physics," a droll reference to a week of raunchy round-the-clock rock concerts and nudity displays in 1969 that had no connection at all to scientific research. So many physicists wanted to report on their high-T_c discoveries and theories that a session that began on the evening of 18 March did not end until 3:15 the next morning, though some were still carrying on their discussion in the hotel lobby when others arrived for breakfast.

Sometimes, APS meetings also served to expose erroneous claims of new phenomena. That occurred most dramatically at the 1989 meeting in Baltimore, when a report on "cold fusion" was mercilessly and convincingly debunked by a score of experimenters who had tried and failed to reproduce the results claimed by two researchers at the University of Utah. In addition, several theorists demonstrated the lack of plausibility of the so-called discovery.

Adopting a public mission

Although participation in public affairs was not a major mission of the society until comparatively recent times, and is still contested by some members, the possibility figured in Webster's original invitation (as noted above). In fact, at the meeting in 1900, the council created a committee to "draw up a memorial to Congress . . . favoring the establishment of a bureau of weights and measures." Such a government agency, the Bureau of Standards, was created, with the added support of other scientific societies, in 1901. The event was a speedy triumph of scientific lobbying. (The word "lobbying" was not admitted to the APS lexicon until the mid-1990s.) Perhaps in gratitude, the bureau was host to the annual spring meeting of the society every year from 1906 until well after World War II. An APS effort in 1906 urging Congress to enact the use of the metric system in all government agencies has been less successful so far.

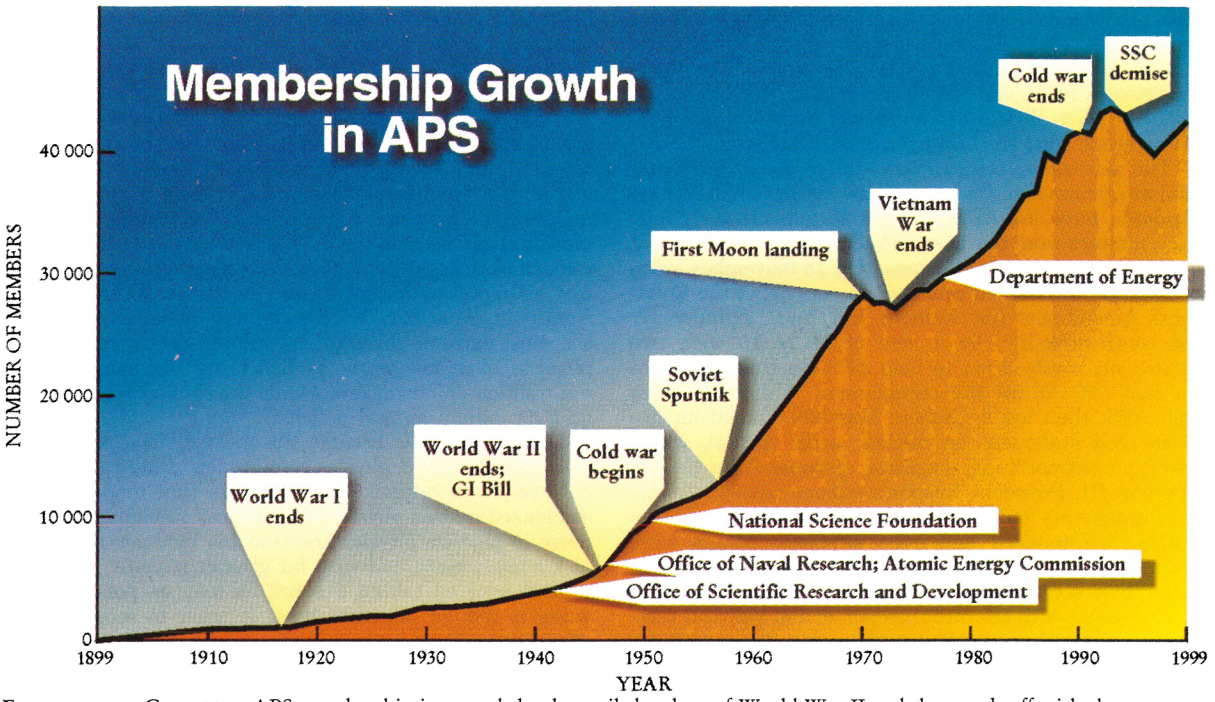
APS was again to come to the support of the Bureau of Standards in 1953, when the secretary of commerce in the Eisenhower Administration forced the resignation of the agency's head, Allen V. Astin, a respected physicist, who had been there since 1930. Astin had defended his agency's finding that a battery additive, marketed by a California company under the name of AD-X2, added nothing to the life expectancy of lead storage batteries. In successfully calling for Astin's reinstatement, the APS council maintained: "It is the duty of a scientist to investigate scientific and technical problems by openly stated objective methods without shading its conclusions under political or other pressures. . . . We never doubted that the work of the Bureau of Standards has been conducted in this spirit."[9]

The most recent intervention by APS on behalf of the bureau, or rather its successor, the National Institute of Standards and Technology (NIST), occurred in 1995, when the society was instrumental, in concert with others, in preventing the decimation of NIST's advanced technology program by a conservative majority in the House of Representatives that opposed using government funds to benefit industry, even though companies shared in the cost of the collaborative research.

The society's defense of Astin was among its early stands on scientific freedom. But it was not its first. In 1946 the APS council affirmed that the restoration of freedom of scientific research and publication as it existed before World War II was an urgent national necessity. And in an assertion of its belief that physics and physicists were not limited by national boundaries, the council, on 10 November 1945, three months after V-J day, decided to treat German and Japanese scientists in the same way as other foreign members whose participation and publication in the field had been interrupted by the war.

Another milestone in APS's defense of scientific freedom is dated 20 November 1952, when the council approved a statement pointing out the damage to science and to the country from the denials of visas to foreign scientists, including P. A. M. Dirac, then the Lucasian Professor of Mathematics at Cambridge University, who was seeking to attend conferences in the US. Dirac had been refused entry under a section of the Immigration and Naturalization Act that covered categories of undesirables, including vagrants and stowaways. Among the factors contributing to the State Department's denial of Dirac's visa application was Washington's thrall with McCarthyism, which had tarred some scientists with accusations of disloyalty and espionage.

Perhaps the most traumatic event involving physicists took place in 1953, in the early stages of the cold war, when the Atomic Energy Commission's special security board, headed by Gordon Gray, president of the University of North Carolina and formerly secretary of the army, investigated J. Robert Oppenheimer, the celebrated and even revered leader in developing the atomic bomb at Los Alamos a decade earlier. After the Gray board ruled Oppenheimer to be loyal but a security risk, Hans Bethe, APS's president at the time, issued a statement on behalf of the council, deploring the decision. The council noted that many APS members had known Oppenheimer for years and had great confidence in him as a loyal public servant and then conceded that for obvious reasons it was not in a position to render a judgment whether Oppenheimer met the security conditions laid down by the AEC. What the council found particularly disturbing were the charges against Oppenheimer arising from his opposition to building a thermonuclear (or H) bomb that had been advocated by Edward Teller and Luis Alvarez. "This question was a very difficult technical and policy matter on which opinions widely differed, with many men of assured loyalty and competence sharing Dr. Oppenheimer's views. . . . If a man whose advice is sought must fear that his potential utility to the government may be challenged because his recent recommendations later be-



ELLIOT PLOTKIN, PHYSICS TODAY

EXPONENTIAL GROWTH: APS membership increased slowly until the close of World War II and then took off with the US–Soviet nuclear weapons and space races, despite recessions and job losses in 1969–72 and 1989–91.

come politically unpopular, he may be tempted to give advice that is politically safe rather than technically valid." (See part of statement in Bethe's telegram on page 33.)

Neither the APS council's position nor appeals by others dissuaded the Gray board from affirming on 29 June 1954 that Oppenheimer would no longer have access to restricted information. Only one of the five commissioners, former APS president Henry DeWolf Smyth, a Princeton physicist, voted to reinstate Oppenheimer's security clearance. (Both Oppenheimer and Alvarez served as APS presidents, in 1948 and 1969, respectively.)

A decade after the Oppenheimer case, major change came to APS with the increase in political radicalism on university campuses—in particular, as a consequence of opposition to the Vietnam War and the sponsorship of physics research by defense agencies. Then, in the wake of the violent suppression of antiwar protests at the Democratic national convention in Chicago in 1968, many physicists petitioned APS not to hold its 1970 meeting in that city. But after polling the membership, the council turned down the petitioners.

In February 1969, a group of activist physicists, led by Martin Perl (who later became a Nobel Prize winner and council member), and Charles Schwartz, organized Scientists and Engineers for Social and Political Action (SESPA), which urged APS to conduct sessions on politically charged defense issues. Two months later, at the April meeting in Washington, DC, an APS session was held at which Bethe, Donald Brennan, George Rathjens, and Eugene Wigner debated the Nixon Administration's proposed antiballistic missile system. The following day, SESPA gathered some 250 physicists to take part in an orderly march from the meeting hotel to the White House and to call on members of Congress.

One significant response to those members who worried about the social and political implications of physics was APS's decision, after much controversy, to set up the forum on physics and society as a membership unit analogous to the scientific divisions. Viewed with suspicion at first by some council members, the forum soon contributed to the advancement and diffusion of knowledge by sponsoring sessions at APS meetings, conducting studies and publishing a newsletter, *Physics and Society*. The society created four additional forums—on the history of physics, on education, on international physics and on industrial and applied physics.

The change of attitudes at the grass roots level and in the leadership towards involvement in social, economic and political issues resulted in the creation of many public affairs and outreach actions. Committees were formed on women, on minorities, on international affairs, on the worldwide freedom of scientists, on education and on the concerns of applied physicists. Each of these committees advises the council on society initiatives in its respective purview.

The most important of these committees was the Panel on Public Affairs, established in 1975. One of POPA's main achievements has been its studies on issues at the intersection of physics and society on behalf of the council and the subsequent preparation of policy statements for adoption by the society. POPA's perhaps even more important contribution has been the initiation of major studies by panels of external experts and with external financing. Topics have included the technical aspects of more efficient use of energy, the safety of nuclear reactors and the prospects for directed-energy weapons (see complete listing on page 32).

The threat to adequate Federal funding for physics research in the late 1980s led the society to appoint the Physics Planning Committee, made up of recognized leaders of research. Its original assignment was the preparation of a balanced plan for and the funding of physics research, a task that proved to have been unrealistic and unrewarding. PPC has been instrumental in helping to organize and carry out what the society now, without guilt feelings, supports as lobbying for physics. In recognition

of this reality, the committee was renamed the Physics Policy Committee in 1997. The answer (with tongue only slightly in cheek) to those members who have questioned the difference between POPA and PPC has been that POPA concerns itself with what physics can do for the country, while PPC worries about what the country can do for physics.

The new committee structure, the raised political and social awareness of physicists and the succession of activist presidents have led APS to issue statements on public policy matters over the past two decades that would not have been made in earlier times. On 18 November 1979, for instance, the council came out in support of the Equal Rights Amendment (for women) and, more significantly (and controversially), by a vote of 13 to 10 with two abstentions, resolved not to hold APS meetings in states that had not ratified the amendment. On 23 January 1983, APS, then led by Robert Marshak, issued an unprecedented statement on nuclear arms control, which evoked an extraordinary negative response from George Keyworth III, President Reagan's science adviser. While these statements and initiatives were, in the old tradition of APS, disinterested and even altruistic, others were designed, in part, to help maintain the economic health of the physics community.

One issue with scientific, economic and political components centered on the Superconducting Super Collider (SSC). It opened deep fissures in the physics community, which the APS could not ignore.

In the early 1980s, high-energy physicists concluded that an accelerator with energies two orders of magnitude higher than those of existing machines was required to elucidate certain features of the Standard Model of elementary particles and to provide vital data for a new final theory. When the SSC was first proposed, at a construction cost of around $4 billion, it was greeted with strong political support, undoubtedly based on the prestige of physicists, national pride, the prospect of jobs for workers and profits for industry and possibly even a commitment to scientific discovery. Among the distinguished physicists making the case for the SSC were Leon Lederman and Steven Weinberg, both Nobel laureates. But as the SSC's cost estimates continued to rise, opposition to it mounted from many quarters. Even some prominent physicists, in the most extreme formulation, argued that their particle physics colleagues were "spoiled brats" for demanding a multibillion-dollar machine while the country was running up $200 billion annual deficits.

Thus, the SSC became the most divisive issue ever to confront the US physics community. Philip Anderson, a Nobel Prize winner, told Congress that discoveries in condensed matter physics were no less fundamental than those in particle physics and that his field served society at far lower costs and with far greater payoffs. The APS council avoided taking a stand as long as possible, and when it did, in January 1991, it tried to reconcile the sharply conflicting views with a somewhat ambiguous statement: Though "the SSC should be built in a timely fashion," the necessary funds "must not be [obtained] at the expense of the broadly based scientific research program of the US." At a Senate hearing on the project, APS

Public Policy Studies by The American Physical Society

The traditional function of the American Physical Society has been to organize technical meetings and publish physics journals. Beginning in 1973, however, the society undertook to expand its role by studying emerging scientific and technical issues. In this context, APS has issued the following reports:

Technical Aspects of the More Efficient Utilization of Energy, W. Carnahan, K. W. Ford, A. Prosperetti, G. I. Rochlin, A. Rosenfeld, M. Ross, J. Rothberg, G. Seidel, and R. H. Socolow, eds. AIP Conf. Series vol. 25, American Institute of Physics, New York (1975).

This report was APS's first study, undertaken at the outset of the nation's energy crisis of the early 1970s. It was an introduction for scientists and engineers to problems of energy efficiency, focusing on areas where they might contribute inventions or improvements. Support came from the National Science Foundation (NSF), the Federal Energy Administration (FEA), and the Electric Power Research Institute (EPRI).

"Radiation Effects on Materials," F. L. Vook, chairman, *Reviews of Modern Physics*, vol. 47, suppl. 3 (1975), p. S-1.

This study examined the status of R&D in radiation effects on materials for the purpose of identifying basic scientific problems that limit progress in energy applications. Emphasis was on the technology of fission and fusion reactors. Support came from the Energy Research and Development Agency.

"Light-Water Reactor Safety," H. W. Lewis, chairman, *Reviews of Modern Physics*, vol. 47, suppl. 1 (1975), p. S-1.

A technical assessment of the safety of large, light-water nuclear power reactors in use in the US, this study was funded by NSF, FEA, and EPRI.

"Nuclear Fuel Cycles and Waste Management," L. C. Hebel, chairman, *Reviews of Modern Physics*, vol. 50, no. 1, pt. 2 (1978), p. S-1.

This study was an evaluation of technical issues arising from the use of fissionable material in nuclear reactor fuel and the principal economic, environmental, health and safety implications. The study was supported by NSF.

Solar Photovoltaic Energy Conversion, H. Ehrenreich, chairman, American Physical Society, New York (1979).

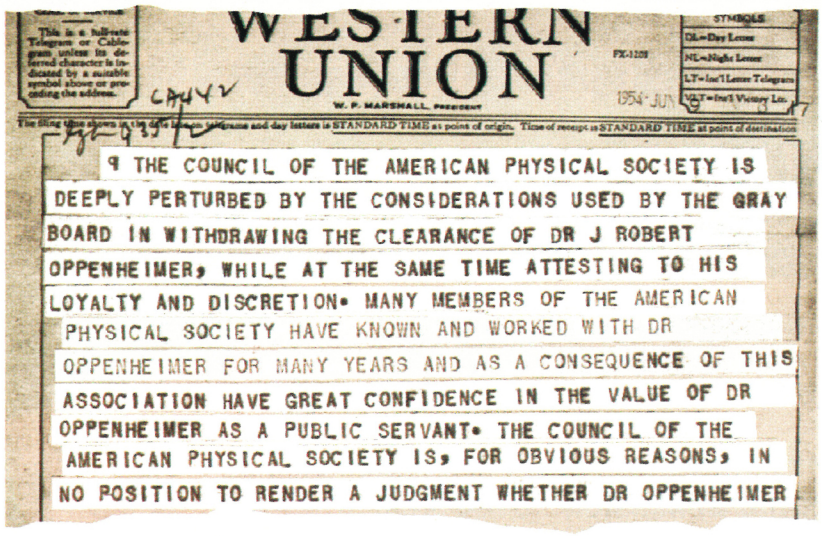
This detailed examination of silicon-based and thin-film solar cell technology provided systems considerations and perspectives on long-term research programs. It was prepared for the Office of Science and Technology Policy and the Department of Energy.

"Research Planning for Coal Utilization and Synthetic Fuel Production," B. R. Cooper, chairman, *Reviews of Modern Physics*, vol. 53, no. 4, pt. 2 (1981), p. S-1.

In the wake of the Three Mile Island nuclear power plant accident, the Nuclear Regulatory Commission asked APS to conduct a reassessment of radionuclide release from serious mishaps at nuclear reactors. The study panel used recent technical data and computational techniques to understand and forecast the consequences of a hypothetical reactor accident.

"Science and Technology of Directed Energy Weapons," N. Bloembergen and C. K. N. Patel, cochairmen, *Reviews of Modern Physics*, vol. 59, no. 3 pt. 2 (1987), p. S-2.

This study was the first major independent examination of the feasibility of using lasers or particle beams as a defense against ballistic missiles. The panel concluded that at least ten years of extensive research would be required to provide the technical information for making a knowledgeable decision about the effectiveness of such weapons. The report had considerable impact on the political and economic decisions about the system, which had come to be called Star Wars by the news media. The study had the full cooperation of the Strategic Defense Initiative and the Office of Science and Technology Policy. Financial support for the study came from the Carnegie Corporation of New York and the MacArthur Foundation.



WESTERN UNION

W. F. MARSHALL, PRESIDENT

SYMBOLS

DL=Day Letter
NL=Night Letter
LT=Int'l Letter Telegram
VLT=Int'l Victory Ltr.

CA44 V

1954 JUN

THE COUNCIL OF THE AMERICAN PHYSICAL SOCIETY IS DEEPLY PERTURBED BY THE CONSIDERATIONS USED BY THE GRAY BOARD IN WITHDRAWING THE CLEARANCE OF DR J ROBERT OPPENHEIMER, WHILE AT THE SAME TIME ATTESTING TO HIS LOYALTY AND DISCRETION. MANY MEMBERS OF THE AMERICAN PHYSICAL SOCIETY HAVE KNOWN AND WORKED WITH DR OPPENHEIMER FOR MANY YEARS AND AS A CONSEQUENCE OF THIS ASSOCIATION HAVE GREAT CONFIDENCE IN THE VALUE OF DR OPPENHEIMER AS A PUBLIC SERVANT. THE COUNCIL OF THE AMERICAN PHYSICAL SOCIETY IS, FOR OBVIOUS REASONS, IN NO POSITION TO RENDER A JUDGMENT WHETHER DR OPPENHEIMER

SPEEDING THE STATEMENT: Bethe sent a telegram bearing the APS council's resolution in the Oppenheimer case.

president Nicolaas Bloembergen, another Nobel laureate, carefully explained the council's resolution and then went on in defense of small science and observed that "major new initiatives, whose annual costs are projected to escalate for several years, threaten the already precarious house of government-funded research."

On 17 June 1992, the House of Representatives voted to terminate the SSC, whose cost was then reckoned to reach $8.6 billion, stunning its advocates and sending them into frantic efforts to reverse the decision in the Senate. Abashed by its lack of prior strong support for the SSC and for an important segment of the APS constituency, the society's executive board, a week after the House action, issued a statement deploring the impending cancellation of the project. The next day, 40 physicists, including 21 Nobel Prize winners, sent a letter to President Bush and members of Congress in defense of the SSC. Within three weeks, the letter was endorsed by more than 1700 other American scientists, plus 300 from foreign countries. But it was too late. Despite the Senate's support, reversing the House vote, and the backing of President Bush, whose science adviser was D. Allan Bromley, a respected nuclear physicist (who became the APS president in 1997), the newly elected Clinton Administration gave the SSC only tepid approval and allowed Congress to close down the project in October 1993.

Particle physicists found new hope for progress in their field in CERN's plans for a Large Hadron Collider. They lobbied aggressively for US scientific and financial participation in the LHC. Even some of the machine's former critics remarked that while not to build the SSC was conceivable, not to pursue particle physics is totally unacceptable to those who are concerned with and depend on the health of science. APS presidents from both sides of the SSC divide—including two Nobel laureates, Burton Richter, a proponent (who held office in 1994), and J. Robert Schrieffer, an opponent (who served later, in 1996)—agreed on participating in the LHC.

Realizing that in times of danger physicists should not circle their wagons and then shoot inward, APS in recent years has been effective in supporting all areas of basic and applied physics. In fact, APS ecumenism and activism, under Bromley's leadership, led the society to join with 110 professional societies in most fields of science and engineering to issue, in 1997, a Unified Statement on Research that calls for doubling Federal civilian research appropriations within ten years.

Upon its founding in 1899, APS had 59 members. On 1 January 1999, the count was 41 786. Except for occasional minor fluctuations, membership growth has been monotonic. The greatest growth, with the number of members doubling every ten years, occurred from 1945 until 1970, when the total stood at 28 207. In the years since, however, the total has increased by 48%. (See the graph on page 31.)

APS's 50th anniversary was observed in a ceremonial session in Sanders Theatre of Harvard University on 16 June 1949. After opening remarks by Harvard's president, James Bryant Conant, messages from world-famous individuals, including Bohr, were read. George Pegram, who had been the APS treasurer since 1918 (and would serve until 1957) spoke about the society's early years, and Karl Darrow, who had been the society's secretary since 1941 (and would serve until 1966) talked about APS's recent history. At the general session the next day, a series of talks dealt with the progress of physics. One of the speakers was Edward U. Condon, a former or future president of APS, AAPT, and AAAS, who reviewed the whole panoply of American physics.

As the society prepares for its 100th anniversary, its finances are sound, with assets of $80,852,060, as of 30 June 1998, of which $62,779,641 constitute its reserve fund. APS can take pride in its widely respected journals, its useful and well-attended meetings, and its increasingly effective public affairs programs. Some of the same problems and concerns that beset the society in its early days—notably, the tension between scientific elitism and democratic accountability to a scientifically challenged public—are still with us. Undoubtedly, they will be dealt with, constructively and resolutely, during the next 100 years.

Acknowledgments and disclaimer. This article is excerpted from my paper, "To Advance and Diffuse the Knowledge of Physics—The 100 Year History of The American Physical Society," to be published in the American Journal of Physics. *Although written on the occasion of the society's centennial, this article does not have the imprimatur of APS and the unattributed interpretations and opinions in it are solely mine. Many present and former APS officers and colleagues have helped with suggestions or contributed information and data. Any errors, however, are my sole responsibility.*

References

1. G. H. Daniels, *Science in American Society*, Knopf, New York (1971).
2. D. J. Kevles, *The Physicists: The History of a Scientific Community in Modern America*, Harvard U. P., Cambridge, Mass. (1995).
3. A. G. Webster, Phys. Rev. **18**, 306 (1904).
4. M. Pupin, *From Immigrant to Inventor*, Scribner, New York (1925).
5. F. Bedell, Phys. Rev. **75**, 1601 (1949).
6. M. Phillips, Am. J. Phys. **58** (3), 219 (1990).
7. A. Halsted, "From Manhattan to Maryland—The American Physical Society and Its Relocation," unpublished master's thesis, Baruch College of the City University of New York (1993).
8. Bull. Am. Phys. Soc. 1 (1899).
9. Various unpublished Minutes of the Council of the American Physical Society.
10. New York Times, 30 April 1939, p.35. ■